Designation: A 875/A 875M – 02a

Standard Specification for Steel Sheet, Zinc-5 % Aluminum Alloy-Coated by the Hot-Dip Process[1]

This standard is issued under the fixed designation A 875/A 875M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers steel sheet, in coils and cut lengths, metallic-coated by the hot-dip process, with zinc-5 % aluminum alloy coating. The Zn-5Al alloy coating also contains small amounts of elements other than zinc and aluminum that are intended to improve processing and the characteristics of the coated product.

1.2 The coating is produced as two types: zinc-5 % aluminum-mischmetal alloy (Type I) and zinc-5 % aluminum-0.1 % magnesium alloy (Type II), and in two coating structures (classes). The coated sheet is produced in several coating designations (coating weight [mass]).

1.3 The material is intended for applications requiring corrosion resistance, formability, and paintability.

1.4 The steel sheet is produced in a number of designations, types, grades, and classes designed to be compatible with differing application requirements.

1.5 Coated sheet material furnished under this specification shall conform to the applicable requirements of the latest issue of Specification A 924/A 924M, unless otherwise provided herein.

1.6 This specification is applicable to orders in either inch-pound units (as A 875) or metric (SI) units [as A 875M]. Values in inch-pound and SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents. Therefore, each system shall be used independently of the other.

1.7 Unless the order specifies the "M" specification designation (SI units), the material shall be furnished to inch-pound units.

1.8 The text of this specification references notes and footnotes that provide explanatory material. These notes and footnotes, excluding tables and figures, shall not be considered as requirements of this specification.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

A 90/A 90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings[2]

A 902 Terminology Relating to Metallic Coated Steel Products[2]

A 924/A 924M Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process[2]

B 750 Specification for Zinc-5 % Aluminum-Mischmetal Alloy (UNS Z38510) in Ingot Form for Hot-Dip Coatings[3]

E 47 Test Methods for Chemical Analysis of Zinc Die-Casting Alloys[4]

E 517 Test Method for Plastic Strain Ratio[5]

E 646 Test Method for Tensile Strain-Hardening Exponents (n-Values) of Metallic Sheet Materials[5]

E 1277 Test Method for Chemical Analysis of Zinc-5 Aluminum-Mischmetal Alloys by ICP Emission Spectrometry[6]

2.2 *ISO Standard:*

ISO 14788 Continuous Hot-Dip Zinc-5 % Aluminum Alloy Coated Steel Sheet and Coils[7]

2.3 *Other Document:*

GF-1 Standard Practice for Determination of Cerium and Lanthanum Compositions in Galfan Alloy (5 % Al-0.4 % La-0.4 % Ce-Bal SHG ZN)[8]

3. Terminology

3.1 *Definitions*—See Terminology A 902 for definitions of general terminology relating to metallic-coated steel products.

3.2 *Definitions of Terms Specific to This Standard:*

[1] This specification is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.11 on Sheet Specifications.

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[2] *Annual Book of ASTM Standards*, Vol 01.06.

[3] *Annual Book of ASTM Standards*, Vol 02.04.

[4] Discontinued 1997; see *Annual Book of ASTM Standards*, Vol 03.05.

[5] *Annual Book of ASTM Standards*, Vol 03.01.

[6] *Annual Book of ASTM Standards*, Vol 03.06.

[7] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

[8] Available from International Lead Zinc Research Organization, Inc., 2525 Meridian Parkway, P.O. Box 12036, Research Triangle Park, NC 27709-2036.

3.2.1 *minimized coating structure, n*—a coating characterized by a finer metallurgical coating structure obtained by a treatment designed to restrict the formation of the normal coarse grain structure formed during solidification of the Zn-5A1 alloy coating.

3.2.2 *regular coating structure, n*—the normal coating structure resulting from unrestricted grain growth during normal solidification of the Zn-5Al alloy coating.

3.3 *Abbreviations:*

3.3.1 *MM*—mischmetal.

3.3.2 *Zn-5A1*—zinc-5 % aluminum.

3.3.3 *Zn-5Al-MM*—zinc-5 % aluminum-mischmetal.

3.3.4 *Zn-5Al-Mg*—zinc-5 % aluminum-0.1 % magnesium.

4. Classification

4.1 The material is classified in terms of the base metal and in terms of the coating.

4.2 *Base Metal Classifications*:

4.2.1 The material is available in the designations as follows:

4.2.1.1 Commercial Steel (CS Types A, B, and C),

4.2.1.2 Forming Steel (FS Types A and B),

4.2.1.3 Deep Drawing Steel (DDS),

4.2.1.4 Extra Deep Drawing Steel (EDDS),

4.2.1.5 Structural Steel (SS),

4.2.1.6 High Strength-Low Alloy Steel (HSLAS Type A), and

4.2.1.7 High Strength-Low Alloy Steel (HSLAS Type B).

4.2.2 Structural Steel and High Strength Low Alloy Steel are available in several grades based on mechanical properties. Structural Steel Grade 50 [340] is available in three classes based on tensile strength.

4.3 *Coating Classifications*:

4.3.1 The coating is available in two types, as follows:

4.3.1.1 *Type I*—Zinc-5 % aluminum-mischmetal (Zn-5Al-MM), and

4.3.1.2 *Type II*—Zinc-5 % aluminum-0.1 % magnesium (Zn-5Al-Mg).

4.3.2 The coating is available in two coating classes, or structures, as follows:

4.3.2.1 *Class A*—Minimized coating structure, and

4.3.2.2 *Class B*—Regular coating structure.

4.3.3 The coating is available in several coating designations, or weights [masses] of coating, as shown in Table 1.

4.3.3.1 The coated sheet is available with the same or different coating designations on each surface.

5. Ordering Information

5.1 Zinc-5 % aluminum alloy-coated sheet in coils and cut lengths is produced to thickness requirements expressed to 0.001 in. [0.01 mm]. The thickness of the sheet includes both the base metal and the coating.

5.2 Orders for coated sheet to this specification shall include the following information, as necessary, to adequately describe the desired product.

5.2.1 Name of material (steel sheet, Zn-5Al alloy coated),

5.2.2 Designations of sheet steel [CS (Type A, B, or C), FS (Type A or B), DDS, EDDS, SS, or HSLA (Type A or B)].

TABLE 1 Weight [Mass] of Coating Requirements [A, B, C]

NOTE 1—The coating thickness may be estimated from the coating weight [mass] by using Table .

	Minimum Requirements[D]		
	Triple-Spot Test		Single-Spot Test
Inch-Pound Units			
Coating Designation	Total Both Sides, oz/ft^2	One Side, oz/ft^2	Total Both Sides, oz/ft^2
GF235	2.35	0.80	2.00
GF210	2.10	0.72	1.80
GF185	1.85	0.64	1.60
GF165	1.65	0.56	1.40
GF140	1.40	0.48	1.20
GF115	1.15	0.40	1.00
GF90	0.90	0.32	0.80
GF75	0.75	0.26	0.65
GF60	0.60	0.20	0.50
GF45	0.45	0.14	0.35
GF30	0.30	0.10	0.25
GF01	no minimum	no minimum	no minimum
SI Units			
Coating Designation	Total Both Sides, g/m^2	One Side, g/m^2	Total Both Sides, g/m^2
ZGF700	700	238	595
ZGF600	600	204	510
ZGF450	450	154	385
ZGF350	350	120	300
ZGF275	275	94	235
ZGF225	225	78	195
ZGF180	180	60	150
ZGF135	135	45	113
ZGF90	90	30	75
ZGF001	no minimum	no minimum	no minimum

[A] The coating designation number is the term by which this material is specified. Because of the many variables and changing conditions that are characteristic of continuous hot-dip coating lines, the zinc-5 % aluminum alloy coating is not always evenly divided between the two surfaces of a coated sheet; nor is it always evenly distributed from edge to edge. However, the minimum triple- spot average coating [mass] on any one side shall not be less than 40 % of the single-spot requirement.

[B] As it is an established fact that the atmospheric corrosion resistance of zinc-5 % aluminum alloy-coated sheet products is a function of coating thickness (weight [mass]), the selection of thinner (lighter) coating designations will result in reduced corrosion performance of the Zn-5Al coating. For example, the heavier zinc-5 % aluminum alloy coatings perform adequately in bold atmospheric exposure whereas the lighter coatings are often further coated with paint or a similar barrier coating for increased corrosion resistance. Because of this relationship, material carrying the statement "meets ASTM A 875/A 875M requirements" should also specify the particular coating type and designation.

[C] The corrosion performance of Type I Zn-5Al-MM coated sheet products is nonlinear as the corrosion rate decreases with time, due to the formation of a characteristic passivation layer.

[D] No minimum value means that there are no established minimum requirements for triple- and single-spot tests.

5.2.2.1 When a CS Type is not specified, Type B will be furnished.

5.2.2.2 When a F5 type is not specified, F5 Type B will be furnished.

5.2.3 Structural or High Strength-Low Alloy Steel designation and, as required, type, grade, or class, or combination thereof.

5.2.4 ASTM designation number and year of issue, as A 875–____for inch-pound units or A 875M–____for SI units,

5.2.5 Coating type (I or II) (see 4.3.1),

5.2.6 Coating designation (see 4.3.3),

5.2.7 Class of coating structure (for example, Class A—Minimized, etc.) (see 4.3.2),

5.2.8 Chemically treated or not chemically treated,

5.2.9 Oiled or not oiled,

5.2.10 Extra smooth (if required),

5.2.11 Phosphatized (if required),

5.2.12 Dimensions (show thickness, width, flatness requirements and length, if cut lengths). The purchaser shall specify the appropriate table of thickness tolerances in Specification A 924/A 924M that applies to the order, that is, the table of thickness tolerances for ⅜-in. [10-mm] edge distance, or the table of thickness tolerances for 1-in. [25-mm] edge distance.

5.2.13 Coil size requirements (specify maximum outside diameter (OD), acceptable inside diameter (ID), and maximum weight [mass]),

5.2.14 Packaging,

5.2.15 Certification, if required, and heat analysis and mechanical property report,

5.2.16 Application (part identification and description), and

5.2.17 Special requirements (if any).

NOTE 1—Typical ordering descriptions are as follows:

Steel sheet, Zn-5Al alloy coated to ASTM A 875-____, Commercial Steel—CS Type B, Type I coating, designation GF 115, Class A (minimized coating structure), chemically treated, oiled, 0.040 min by 34 by 117 in., for stock tanks.

Steel sheet, Zn-5Al alloy coated to ASTM A 875M-____, Structural Steel—SS Grade 230, Type II coating, designation ZGF 275, Class B (regular coating structure), chemically treated, not oiled, phosphatized, 1.00 nominal by 900 mm by coil, 1200 mm max OD, 600 mm ID, 9000 kg max, for roof deck.

NOTE 2—The purchaser should be aware that there are variations in manufacturing practices among the producers and therefore is advised to establish the producer's standard (or default) procedures for thickness tolerances.

6. Chemical Composition

6.1 *Base Metal*:

6.1.1 The heat analysis of the base metal shall conform to the requirements shown in Table 2 for CS (Types A, B, and C), FS (Types A and B), DDS, and EDDS and Table 3 for SS and HSLAS (Types A and B).

6.1.2 Each of the elements listed in Tables 2 and 3 shall be included in the report of heat analysis. When the amount of copper, nickel, chromium, or molybdenum is less than 0.02 %, report the analysis either as <0.02 % or the actual determined value. When the amount of vanadium, titanium, or columbium is less than 0.008 %, report the analysis either as <0.008 % or the actual determined value.

6.1.3 See Specification A 924/A 924M for cast and product analysis procedures.

6.2 *Coating Bath Analysis*:

6.2.1 The bath metal used in continuous hot-dip Zn-5A1-MM alloy coating of Type I shall meet the chemical composition limits specified in Specification B 750.

6.2.2 The bath metal used in the continuous hot-dip Zn-5Al-Mg alloy coating of Type II shall conform to the requirements of Table 4.

6.3 *Methods of Analysis*:

6.3.1 *Coating Bath Metal*—The determination of chemical composition shall be made in accordance with suitable chemical (Test Method E 47 for tin), ICP argon plasma spectrometric (Test Method E 1277), or other methods. In case of dispute, the results secured by Test Method E 1277 shall be the basis of acceptance.

6.3.1.1 A practice for X-ray fluorescence spectrometry for the determination of cerium and lanthanum in a zinc-5 % aluminum-mischmetal has been established by the International Lead Zinc Research Organization, as Practice GF-1.

6.3.2 In case of dispute, the results secured by Test Method E 1277 shall be the basis of acceptance.

7. Mechanical Properties

7.1 Structural steel and high-strength low-alloy steel shall conform to the mechanical property requirements of Table 5 for the type, grade or class, or combination thereof, specified.

7.2 The typical mechanical properties for CS (Types A, B, and C), FS (Types A and B), DDS, and EDDS steel sheet designations are listed in Table 6. These mechanical property

TABLE 2 Chemical Requirements[A]

Composition, %—Heat Analysis Element, Maximum, Unless Otherwise Shown													
Designation	C	Mn	P	S	Al	Cu	Ni	Cr	Mo	V	Cb	Ti[B]	N
CS Type A[C,D,E]	0.10	0.60	0.030	0.035	. . .	0.20	0.20	0.15	0.06	0.008	0.008	0.025	. . .
CS Type B[F,C]	0.02 to 0.15	0.60	0.030	0.035	. . .	0.20	0.20	0.15	0.06	0.008	0.008	0.025	. . .
CS Type C[C,D,E]	0.08	0.60	0.10	0.035	. . .	0.20	0.20	0.15	0.06	0.008	0.008	0.025	. . .
FS Type A[C,G]	0.10	0.50	0.020	0.035	. . .	0.20	0.20	0.15	0.06	0.008	0.008	0.025	. . .
FS Type B[F,C]	0.02 to 0.10	0.50	0.020	0.030	. . .	0.20	0.20	0.15	0.06	0.008	0.008	0.025	. . .
DDS[D,E]	0.06	0.50	0.020	0.025	0.01 min.	0.20	0.20	0.15	0.06	0.008	0.008	0.025	. . .
EDDS[H]	0.02	0.40	0.020	0.020	0.01 min	0.20	0.20	0.15	0.06	0.10	0.10	0.15	. . .

[A] Where an ellipsis (. . .) appears in this table, there is no requirement, but the analysis shall be reported.

[B] For steels containing more than 0.2% carbon, titanium is permitted to 0.025% provided the ratio of % titanium to % nitrogen does not exceed 3.4.

[C] When a deoxidized steel is required for the application, the purchaser has the option to order CS and FS to a minimum of 0.01 % total aluminum.

[D] Steel is permitted to be furnished as a vacuum degassed or chemically stabilized steel, or both, at the producer's option.

[E] For carbon levels less than or equal to 0.02%, vanadium, columbium, or titanium, or combinations thereof are permitted to be used as stabilizing elements at the producer's option. In such cases, the applicable limit for vanadium and columbium shall be 0.10% and for titanium 0.15%.

[F] For CS and FS, specify Type B to avoid carbon levels below 0.02 %.

[G] Shall not be furnished as a stabilized steel.

[H] Shall be furnished as a stabilized steel.

TABLE 3 Chemical Requirements[A]

Designation	Composition, %—Heat Analysis Element, maximum, Unless Otherwise Shown											
	C	Mn	P	S	Cu	Ni	Cr	Mo	V	Cb	Ti[B]	N
SS:												
Grade 33 [230]	0.20	. . .	0.04	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.025	...
Grade 37 [255]	0.20	. . .	0.10	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.025	...
Grade 50 [340] (Class 1 and 2)	0.25	. . .	0.20	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.025	...
Grade 50 [340] (Class 3)	0.25	. . .	0.04	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.025	...
Grade 80 [550]	0.20	. . .	0.04	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.025	...
HSLAS Type A[C]												
Grade 50 [340]	0.20	1.20	. . .	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	...
Grade 60 [410]	0.20	1.35	. . .	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	...
Grade 70 [480]	0.20	1.65	. . .	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	...
Grade 80 [550]	0.20	1.65	. . .	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	...
HSLAS Type B[C,D]												
Grade 50 [340]	0.15	1.20	. . .	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	...
Grade 60 [410]	0.15	1.20	. . .	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	...
Grade 70 [480]	0.15	1.65	. . .	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	...
Grade 80 [550]	0.15	1.65	. . .	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	...

[A]Where an ellipsis (. . .) appears in this table, there is no requirement, but the analysis shall be reported.
[B]Titanium is permitted to 0.025 % provided the ratio of % titanium to % nitrogen does not exceed 3.4.
[C]HSLAS and HSLAS-F steels commonly contain the strengthening elements columbium, vanadium, and titanium added singly or in combination. The minimum requirements only apply to the microalloy elements selected for strengthening of the steel.
[D]The producer has the option to treat HSLAS Type B steels by means of small alloy additions to effect sulfide inclusion control.

TABLE 4 Chemical Requirements, Coating Bath, Type II[A]

Element	Composition, weight %
Aluminum	4.5–6.2
Magnesium	0.06–0.15
Others, total, max[B]	0.01
Zinc[C]	remainder[C]

[A] By agreement between the purchaser and the supplier, analysis may be required and limits established for elements not specified in Table 4.
[B] Except iron.
[C] For information only. Quantitative determination of the element is not required.

values are nonmandatory. They are solely to provide the purchaser with as much information as possible to make an informed decision on the steel to be specified. Values outside these ranges are to be expected.

7.3 When base metal mechanical properties are required, all tests shall be conducted in accordance with the methods specified in Specification A 924/A 924M.

7.4 *Bending Properties*:

7.4.1 *Minimum Cold-Bending Radii*—Structural steel and high-strength, low-alloy steel, low-alloy sheet steels are commonly fabricated by cold bending. There are many interrelated factors that affect the ability of a steel to cold form over a given radius under shop conditions. These factors include: thickness, strength level, degree of restraint, relationship to rolling direction, chemistry, and microstructure. Appendix X1 lists the suggested minimum inside radius for 90° cold bending for structural steel and high-strength, low-alloy steel. They presuppose "hard way" bending (bend axis parallel to rolling direction) and reasonably good shop forming practices. Where possible, the use of larger radii or "easy way" bends are recommended for improved performance.

7.4.2 Fabricators should be aware that cracks may initiate upon bending a sheared edge. This is not considered to be a fault of the steel but is rather a function of the induced cold-work.

8. Coating Properties

8.1 *Coating Weight [Mass]*

8.1.1 Coating weight [mass] shall conform to the requirements as shown in Table 1 for the specific coating designation.

8.1.2 Use the following relationships to estimate the coating thickness from the coating weight [mass].

8.1.2.1 1 oz/ft^2 coating weight = 1.82 mils coating thickness, and

8.1.2.2 6.60 g/m^2 coating weight = 1 µm coating thickness.

8.2 *Coating Weight [Mass] Tests*:

8.2.1 Coating weight [mass] tests shall be performed in accordance with the requirements stated in Specification A 924/A 924M.

8.2.2 The referee method to be used shall be Test Method A 90/A 90M.

8.3 *Coating Bend Test*—The bend test specimens of coated sheet designated by the prefix GF [ZGF] shall be capable of being bent through 180° in any direction without flaking of the coating on the outside of the bend only. The coating bend test inside diameter shall have a relation to the thickness of the specimen as shown in Table 7. Flaking of the coating within 0.25 in. [6 mm] of the edge of the bend specimen shall not be cause for rejection.

9. Dimensions and Permissible Variations

9.1 All dimensions and permissible variations shall comply with the requirements of Specification A 924/A 924M.

10. Keywords

10.1 coatings, metallic; steel sheet, zinc alloy coated; steel sheet, zinc coated; zinc alloys; zinc-coated steel; zinc-5 % aluminum alloy-coated steel; zinc-5 % aluminum-mischmetal alloy-coated steel; zinc-5 % aluminum-0.1 % magnesium alloy-coated steel

TABLE 5 Mechanical Requirements, Base Metal (Longitudinal)

Inch-Pound Units

Designation	Type	Grade	Yield Strength, min, ksi	Tensile Strength, min, psi[A]	Elongation in 2 in., min, %[A]
SS	[B]	33	33	45	20
		37	37	52	18
		40	40	55	16
		50 (Class 1)	50	65	12
		50 (Class 2)	50	. . .	12
		50 (Class 3)	50	70	12
		80[A]	80[C]	82	. . .
HSLAS	[D]	50	50	60[E]	20
		60	60	70[E]	16
		70	70	80[E]	12
		80	80	90[E]	10
HSLAS	[C]	50	50	60[E]	22
		60	60	70[E]	18
		70	70	80[E]	14
		80	80	90[E]	12

SI Units

Designation	Type	Grade	Yield Strength, min, MPa	Tensile Strength, min, MPa[A]	Elongation in 50 mm, min, %[A]
SS	[E]	230	230	310	20
		255	255	360	18
		275	275	380	16
		340 (Class 1)	340	450	12
		340 (Class 2)	340	. . .	12
		340 (Class 3)	340	480	12
		550[D]	550[C]	570	. . .
HSLAS	[D]	340	340	410[E]	20
		410	410	480[E]	16
		480	480	550[E]	12
		550	550	620[E]	10
HSLAS	[C]	340	340	410[E]	22
		410	410	480[E]	18
		480	480	550[E]	14
		550	550	620[E]	12

[A] Where an ellipsis (. . .) appears in this table, there is no requirement.
[B] No type has been established for Structural Steel (SS).
[C] As there is no discontinuous yield curve, the yield point should be taken as the stress at 0.5 % elongation under load or 0.2 % offset.
[D] For sheet thicknesses of 0.028 in. and thinner, no tension test is required if the hardness result is Rockwell B 85 or higher.
[E] If a higher tensile strength is required, the user should consult the producer.

TABLE 6 Typical Ranges of Mechanical Properties (Nonmandatory) (Longitudinal Direction)[A, B]

Designation	Yield Strength		Elongation in 2 in. [50 mm], %	r_m Value[C]	n Value[D]
	ksi	[MPa]			
CS Type A	25/50	[170/345]	≥20	[E]	[E]
CS Type B	30/50	[205/345]	≥20	[E]	[E]
CS Type C	25/55	[170/380]	≥15	[E]	[E]
FS Type A and B[F]	25/45	[170/310]	≥26	1.0/1.4	0.17/0.21
DDS[G]	20/35	[140/240]	≥32	1.4/1.8	0.19/0.24
EDDS[H]	15/25	[105/170]	≥40	1.6/2.1	0.22/0.27

[A] The typical mechanical property values presented here are nonmandatory. They are intended solely to provide the purchaser with as much information as possible to make an informed decision on the steel to be specified. Values outside of these ranges are to be expected. The purchaser may negotiate with the supplier if a specific range or a more restrictive range is required for the application.
[B] These typical mechanical properties apply to the full range of steel sheet thicknesses. The yield strength tends to increase and some of the formability values tend to decrease as the sheet thickness decreases.
[C] r_m *Value*—Average plastic strain ratio as determined by method in Specification E 517.
[D] n *Value*—Strain-hardening exponent as determined by method in Specification E 646.
[E] No typical mechanical properties have been established.
[F] The FS designation encompasses the properties of the previous DQ grade.
[G] The DDS designation encompasses the properties of the previous DQSK grade.
[H] EDDS Sheet will be free from changes in mechanical properties over time, (that is, nonaging).

TABLE 7 Coating Bend Test Requirements for Zinc-5 % Aluminum Alloy Coatings

Ratio of the Inside Bend Diameter to Thickness of the Specimen (Any Direction)													
	CS, FS, DDS, EDDS		SS, Grade[B]					HSLAS, Type A, Grade[B]		HSLAS, Type B, Grade			
Coating Designation[A]	Sheet Thickness, in. [mm]						Coating Designation[A]						
	through 0.039 [1.0]	over 0.039 [1.0] through 0.079 [2.0]	over 0.078 [3.0]	33 [230]	37 [255]	40 [275]		50 [340]	60 [410]	50 [340]	60 [410]	70 [480]	80 [550]
GF235 [ZGF700]	2	3	3	3	3	3	GF115 [ZGF350]	1½	3	1	1	1½	1½
GF210 [ZGF600]	2	2	2	2	2	2½	GF90 [ZGF275]	1½	3	1	1	1½	1½
GF185	2	2	2	2	2	2½	GF75 [ZGF225]	1½	3	1	1	1½	1½
GF165	2	2	2	2	2	2½	GF60 [ZGF180]	1½	3	1	1	1½	1½
GF140 [ZGF450]	1	1	2	2	2	2½	GF45 [ZGF135]	1½	3	1	1	1½	1½
GF115 [ZGF350]	0	0	1	1½	2	2½	GF30 [ZGF90]	1½	3	1	1	1½	1½
GF90 [ZGF275]	0	0	1	1½	2	2½	GF01 [ZGF001]	1½	3	1	1	1½	1½
GF75 [ZGF225]	0	0	1	1½	2	2½							
GF60 [ZGF180]	0	0	0	1½	2	2½							
GF45 [ZGF135]	0	0	0	1½	2	2½							
GF30 [ZGF90]	0	0	0	1½	2	2½							
GF01 [ZGF001]	0	0	0	1½	2	2½							

[A] If other coatings are required, the user shall consult the producer for availability and suitable bend test requirements.
[B] SS Grades 50 [340] and 80 [550] and HSLAS Type A Grades 70 [480] and 80 [550] are not subject to bend test requirements.

APPENDIXES

(Nonmandatory Information)

X1. BENDING PROPERTIES

X1.1 Table X1.1 contains suggested minimum inside radii for cold bending.

TABLE X1.1 Suggested Minimum Inside Radii for Cold Bending

NOTE 1—*t* = radius equivalent to the steel thickness.
NOTE 2—The suggested radii should be used as minimums for 90° bends in actual shop practice.

Designation	Type	Grade	Minimum Inside Radius for Cold Bending[A]
SS[B]		33 [230]	1½ *t*
		37 [255]	2*t*
		40 [275]	2*t*
		50 [340] (Class 1)	not applicable
		50 [340] (Class 2)	not applicable
		50 [340] (Class 3)	not applicable
		80 [550]	not applicable
HSLAS	B	50 [340]	2½ *t*
		60 [410]	3*t*
		70 [480]	4*t*
		80 [550]	4½ *t*
HSLAS	A	50 [340]	2*t*
		60 [410]	2*t*
		70 [480]	3*t*
		80 [550]	3*t*

[A] Bending capability may be limited by the coating designation.
[B] No type has been established for Structural Steel (SS).

X2. RATIONALE FOR CHANGES IN PRODUCT DESIGNATIONS

X2.1 Subcommittee A05.11 has revised the designations used to classify the various products available in each hot-dip coated specification. The previous "quality" designations have been replaced with designations and descriptions more closely related with product characteristics. Many of the former "quality" specifications described the steel only in terms of limited chemical composition, which in some cases was identical for two or more qualities. The former designations also did not reflect the availability of new steels which are the result of the use of new technologies such as vacuum degassing

and steel ladle treatments.

X2.2 The former "quality" designators, defined in very broad qualitative terms, did not provide the user with all the information needed to select the appropriate steel for an application. The new designations are defined with technical information such as specific chemical composition limits and typical-nonmandatory mechanical properties. These steel characteristics are important to users concerned with the weldability and formability of the coated steel products. The typical mechanical properties included in the new designation system are those indicated by the tension test. These properties are more predictive of steel formability than other tests such as the hardness test which may not compensate adequately for product variables such as substrate thickness and coating weight.

X2.3 The new designations also provide the user with the flexibility to restrict the steels applied on any order. For example, a user can restrict the application of ultra low carbon steels on an application through the selection of an appropriate "type" designator.

X2.4 There is a limited relationship between the former and current systems of designation. Some of the reasons for this limited relationship are: addition of steels not previously described in ASTM specifications, restrictions placed on ranges of chemical composition, the addition of typical mechanical properties, and the enhanced capability of steel producers to combine chemical composition and processing methods to achieve properties tailored to specific applications.

X2.5 The changes in designation are significant, which may create transition issues that will have to be resolved. Continued dialogue between users and producers will have to be maintained to assist the transition to the new system of designations. A user with concerns about the appropriate coated steel to order for a specific application should consult with a steel supplier or producer.

X3. RELATIONSHIP BETWEEN SPECIFICATIONS THAT DESCRIBE REQUIREMENTS FOR A COMMON PRODUCT

X3.1 Standard ISO 14788 may be reviewed for comparison with this standard. The relationship between the standards may only be approximate; therefore, the respective documents should be consulted for actual requirements. Those who use these documents must determine which specifications address their needs.