



Designation: A 463/A 463M – 05

Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process¹

This standard is issued under the fixed designation A 463/A 463M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers aluminum-coated steel sheet in coils and cut lengths available with two types of aluminum coating applied by the hot-dip process, with several coating weights [masses].

1.2 Product furnished under this specification shall conform to the applicable requirements of the latest issue of Specification **A 924/A 924M**, unless otherwise provided herein.

1.3 This specification is applicable to orders in either inch-pound units (as A 463) or SI units [as A 463M]. Values in inch-pound and SI units are not necessarily equivalent. Within the text, SI units are shown in brackets. Each system shall be used independently of the other.

1.4 Unless the order specifies the “M” designation (SI units), the product shall be furnished to inch-pound units.

1.5 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.6 *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:²

A 428/A 428M Test Method for Weight Mass of Coating on Aluminum-Coated Iron or Steel Articles

A 480/A 480M Specification for General Requirements for

Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

A 902 Terminology Relating to Metallic Coated Steel Products

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

E 517 Test Method for Plastic Strain Ratio r for Sheet Metal

E 646 Test Method for Tensile Strain-Hardening Exponents (n values) of Metallic Sheet Materials

3. Terminology

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

4. Classification

4.1 The steel sheet is available in several designations, as follows:

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

4.1.2 Forming Steel (FS),

4.1.3 Deep Drawing Steel (DDS),

4.1.4 Extra Deep Drawing Steel (EDDS),

4.1.5 Structural Steel (SS),

4.1.6 High Strength-Low Alloy Steel (HSLAS),

4.1.7 High Strength-Low Alloy Steel with improved formability (HSLAS-F),

4.1.8 Ferritic Stainless Steel (FSS Type 409), and

4.1.9 Ferritic Stainless Steel (FSS Type 439).

4.2 Structural Steel (SS), High Strength Low-Alloy Steel (HSLAS), and High Strength Low-Alloy with improved formability (HSLAS-F) are available in several grades and classes.

4.3 The aluminum coating is available in two types with several coating weights [masses] with coating designations as shown in **Table 1**.

4.3.1 *Coating Type 1* is manufactured using a coating bath of aluminum-silicon alloy containing 5 to 11 % silicon to promote better adherence. It is intended principally for heat-resisting applications and also for uses where corrosion resistance and heat are involved. It is available as a coating on each of the designations of steel sheet listed in **4.1**.

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 For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

**TABLE 1 Weight [Mass] of Coating Requirements^{A, B}**

NOTE 1—Tables X2.1 and X2.2 provide an estimate of coating thickness based on coating weight [mass].

Coating Designation	Minimum Requirement	
	Triple-Spot Test, Total Both Sides	Single-Spot Test, Total Both Sides
	Inch-Pound Units	
	oz/ft ²	oz/ft ²
T1–13	0.13	0.10
T1–25	0.25	0.20
T1–40	0.40	0.30
T1–100	1.00	0.90
T2–LC	no minimum	no minimum
T2–65	0.65	0.60
T2–100	1.00	0.90
	SI Units	
	g/m ²	g/m ²
T1M 40	40	30
T1M 75	75	60
T1M 120	120	90
T1M 300	300	270
T2M LC	no minimum	no minimum
T2M 200	200	180
T2M 300	300	270

^A The coating designation number is the term by which this product is specified. Because of the many variables and changing conditions that are characteristic of continuous hot-dip coating lines, the weight [mass] of coating is not always evenly divided between the two surfaces of a sheet, nor is the coating evenly distributed from edge to edge. However, normally not less than 40 % of the single-spot test limit will be found on either surface.

^B No minimum means that there are no established minimum requirements for triple- and single-spot tests, but aluminum coating shall be present.

4.3.2 *Coating Type 2* is a commercially pure aluminum. It is intended principally for use in applications requiring corrosion resistance and is available only as a coating on Commercial Steel, Forming Steel, Structural Steel, and High Strength-Low Alloy Steel.

5. Ordering Information

5.1 Product under this specification shall be ordered to decimal thickness only, and dimensional tolerances of Specification **A 924/A 924M** shall apply. Specification **A 480/A 480M** shall apply to FSS (Types 409 and 439) for thickness tolerances only. The following, as required, shall be used to adequately describe the product required.

5.1.1 Name of product (steel sheet, aluminum-coated Type 1 or 2),

5.1.2 Designation of sheet (CS (Types A, B, and C), FS, DDS, EDDS, SS, HSLAS, HSLAS-F, or FSS (Types 409 and 439)).

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

5.1.2.2 When a SS or HSLAS designation is specified, state the type, grade, or class, or combination thereof.

5.1.3 ASTM designation number and year of issue,

5.1.4 Coating designation,

5.1.5 Specify whether oiled or dry or chemically treated, oiled or dry,

5.1.6 Dimensions (show thickness, minimum or nominal; width; 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 $\frac{3}{8}$ -in. [10-mm] edge distance, or the table of thickness tolerances for 1-in. [25-mm] edge distance. **A 480/A 480M** shall apply to FSS (Types 409 and 439) for thickness tolerances only.

5.1.7 Coil size requirements (specify maximum outside diameter (OD), acceptable inside diameter (ID), and maximum coil weight),

5.1.8 Application (show part identification and description),

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

5.1.10 Special requirements (if required).

NOTE 1—Typical ordering descriptions are as follows: Steel sheet, aluminum-coated, Forming Steel (FS), ASTM A 463 – __, Coating Designation T1 40, chemically treated dry, minimum 0.040 in. by 34 in. by coil, 48-in. maximum outside diameter, 20-in. inside diameter, 20 000-lb maximum coil weight, for muffler ends.

Steel Sheet, aluminum-coated, Commercial Steel (CS Type A), ASTM A 463M – __, Coating Designation T1M 120, chemically treated dry, minimum 1.00 mm by 920 mm by coil, 1200-mm maximum outside diameter, 500-mm inside diameter, 10 000-kg maximum coil weight, for range heat shield.

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, DDS, EDDS, and FSS (Types 409 and 439), and in **Table 3** for SS, HSLAS, and HSLAS-F.

6.1.2 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 as either <0.008 % or the actual determined value.

6.1.3 See Specification **A 924/A 924M** for chemical analysis procedures and product analysis tolerances.

6.1.4 The heat analysis of the base metal for FSS (Types 409 and 439) shall conform to the requirements shown in **Table 2**.

6.1.5 See Specification **A 480/A 480M** for chemical analysis procedures and product analysis tolerances for FSS (Types 409 and 439).

6.2 Coating Bath Composition:

6.2.1 The bath metal used for Type 1 shall contain an aluminum-silicon alloy containing 5 to 11 % silicon, the balance aluminum.

6.2.2 The bath metal used for Type 2 shall contain commercially pure aluminum.

7. Mechanical Properties

7.1 Structural steel and high strength low alloy steel shall conform to the mechanical property requirements of **Table 4** for the type, grade, or class, or combination thereof, specified.

7.2 The typical mechanical properties for CS (Types A, B, and C), FS, DDS, EDDS and FSS (Types 409 and 439), steel sheet designations are listed in **Table 5**. These mechanical property values are nonmandatory. The purchaser may



TABLE 2 Chemical Requirements

Designation	Composition, %—Heat Analysis Element, max (unless otherwise shown)											
	C	Mn	P	S	Al ^A	Cu ^B	Ni ^B	Cr ^B	Mo ^B	V	Cb ^C	Ti
CS Type A ^{D,E,F}	0.10	0.60	0.030	0.035	...	0.20	0.20	0.15	0.06	0.008	0.008	0.30
CS Type B ^{D,F}	0.02 to 0.15	0.60	0.030	0.035	...	0.20	0.20	0.15	0.06	0.008	0.008	0.30
CS Type C ^{D,F}	0.08	0.60	0.10	0.035	...	0.20	0.20	0.15	0.06	0.008	0.008	0.30
FS ^F	0.02 to 0.10	0.50	0.020	0.030	...	0.20	0.20	0.15	0.06	0.008	0.008	0.30
DDS ^{G,H}	0.06	0.50	0.020	0.025	0.01, min	0.20	0.20	0.15	0.06	0.008	0.008	0.30
EDDS ^{I,H}	0.02	0.40	0.020	0.020	0.01, min	0.20	0.20	0.15	0.06	0.008	0.008	0.30
FSS Type 409 ^J	0.030	1.00	0.040	0.020	...	0.50	0.50	10.5 to 11.7	0.60	...	...	^J
FSS Type 439 ^K	0.07	1.00	0.040	0.030	0.15	0.50	0.50	17.0 to 19.0	0.06	...	...	^K

^AWhere an ellipsis (. . .) appears in the table, there is no requirement, but the analysis result shall be reported.

^BThe sum of copper, nickel, chromium, and molybdenum shall not exceed 0.50 % on heat analysis. When one or more of these elements are specified, the sum does not apply; in which case, only the individual limits on the remaining elements shall apply. This requirement does not apply to Types 409 and 439.

^CFor steels having a carbon content of 0.02 % or less, the limit for columbium is 0.045 % maximum.

^DFor CS, specify Type B to avoid carbon levels below 0.02 %.

^ECS Type B describes the typical commercial quality product previously included in this specification.

^FWhen a deoxidized steel is required for the application, the purchaser has to option to order CS to a minimum of 0.01 % total aluminum.

^GFurnished either as stabilized or not-stabilized steel at the producer's option.

^HDDS and EDDS are available only as Coating Type 1 steel sheet.

^IShall be furnished as a stabilized steel.

^JShall contain silicon 1.00 % maximum, nitrogen 0.030 % maximum, and titanium [6 × (carbon + nitrogen)] minimum to 0.50 % maximum.

^KShall contain silicon 1.00 % maximum, nitrogen 0.04 % maximum, titanium + columbium [0.20 + 4 × (carbon + nitrogen)] minimum to 1.10 % maximum.

TABLE 3 Chemical Requirements^A

	Composition, %—Heat Analysis Element, max (unless otherwise shown)										
Designation	C	Mn	P	S	Cu ^B	Ni ^B	Cr ^B	Mo ^B	V ^C	Cb ^{C,D}	Ti
SS											
Grade 33 [230]	0.20	...	0.40	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 37 [255]	0.20	...	0.10	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 40 [275]	0.25	...	0.10	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 50 [340](Classes 1 and 2)	0.25	...	0.20	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 50 [340](Class 3)	0.25	...	0.04	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 80 [550]	0.20	...	0.04	0.04	0.20	0.20	0.15	0.06	0.008	0.008	0.30
HSLAS ^E											
Grade 50 [340]	0.20	1.20	...	0.035	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 60 [410]	0.20	1.35	...	0.035	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 70 [480]	0.20	1.65	...	0.035	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 80 [550]	0.20	1.65	...	0.035	0.20	0.20	0.15	0.06	0.008	0.008	0.30
HSLAS-F ^{E,F}											
Grade 50 [340]	0.15	1.20	...	0.035	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 60 [410]	0.15	1.20	...	0.035	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 70 [480]	0.15	1.65	...	0.035	0.20	0.20	0.15	0.06	0.008	0.008	0.30
Grade 80 [550]	0.15	1.65	...	0.035	0.20	0.20	0.15	0.06	0.008	0.008	0.30

^AWhere an ellipsis (. . .) appears in the table, there is no requirement, but the analysis result shall be reported.

^BThe sum of copper, nickel, chromium and molybdenum shall not exceed 0.50 % on heat analysis. When one or more of these elements are specified the sum does not apply; in which case, only the individual limits on the remaining elements shall apply.

^CThe limits do not apply when HSLAS is specified.

^DFor steels having a carbon content of 0.02 % or less, the limit for columbium is 0.045 % max.

^ESteel conforming to this designation commonly contains the strengthening elements columbium, nitrogen, phosphorus, or vanadium added singly or in combination.

^FHSLAS-F steel shall be treated to achieve inclusion control.

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 sheet is 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 base metal microstructure. Appendix X1 lists the suggested minimum inside radius for 90° cold bending for these steel sheets. 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.