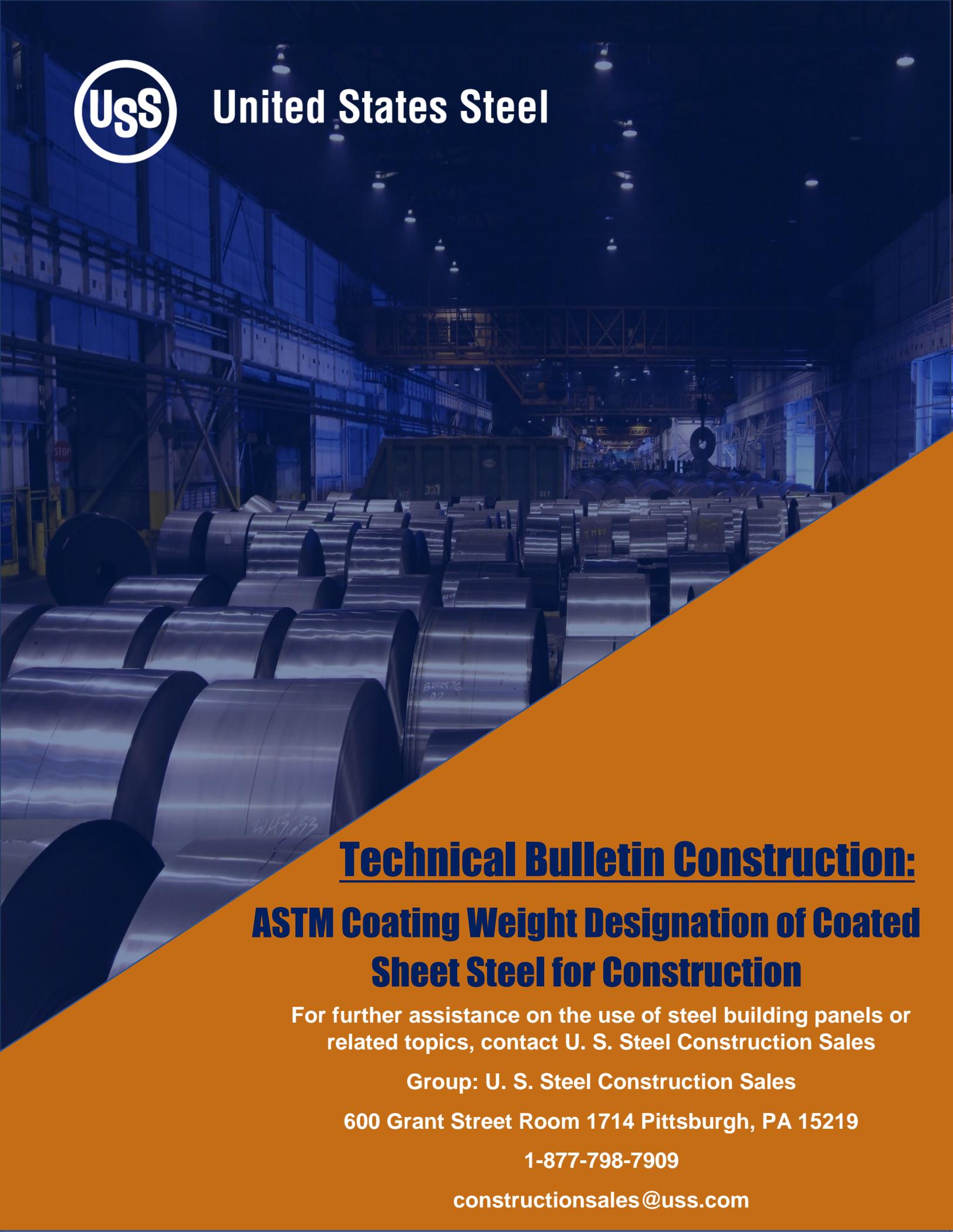




United States Steel



Technical Bulletin Construction:

ASTM Coating Weight Designation of Coated Sheet Steel for Construction

For further assistance on the use of steel building panels or related topics, contact U. S. Steel Construction Sales

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Background

ASTM designates coating weights, steel strength grades and coating compositions for coated sheet steels. United States Steel Corporation recommends that coated steel users familiarize themselves with these ASTM specifications. U. S. Steel recognizes the need for the construction market to have this information compiled in one easy-to-use source. This Technical Bulletin brings together summary information from the various ASTM specifications for use by the construction industry. The coating weight designation of coated sheet steel products commonly used in the metal building industry may cause confusion if not well understood. This document provides the coating bath chemistry specifications and quick conversions between coating weight and thickness for these coatings.

ASTM has specifications for each metal coating type and a general specification (A 924/A 924M) for metal coated sheet steel, including all the types discussed below. ASTM A 924 discusses steel composition, tests for mechanical properties, tests for coating weight, dimensions and permissible variations and certification.

The most commonly used coated sheet steel products in the metal building industry today are hot-dip galvanized (HDG), 55% aluminum-zinc alloy-coated (GALVALUME^{®1} Coated Steel), hot-dip galvanized (HDGA), zinc-5% aluminum alloy-coated (GALFAN^{®2} Coated Steel), and Type 2 aluminum-coated steel. These are all hot-dipped coatings applied in a continuous coil line operation in which the cold or hot-rolled steel strip passes through a molten metal bath.

Coating Chemistry and Types

Table 1 provides the ASTM product specification numbers for coatings used in the construction industry, the coating weight designations and the specified coating compositions. The term “triple spot” refers to the three sample test coupons obtained from the sheet centerline and from no less than two inches from each sheet edge.

Each type of coating has a one or two letter designation. In addition, the designation includes a number that is the minimum triple-spot average coating weight for both sheet surfaces, in units of ounces per square foot (oz/ft²).

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¹ GALVALUME[®] is an internationally registered trademark of BIEC International, Inc. and some of its licensed producers

² GALFAN[®] is a registered trademark of the Galfan Technology Center

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For example, G60 is galvanized with a two-side, triple-spot coating weight of at least 0.60 oz/ft². Hot-dip coating baths react with the steel, adding low levels of iron to the coating and the bath. Producers buy a license to produce GALVALUME® and GALFAN® as specified in the corresponding patents. The licenses define the product chemistry that the licensee can use with those trademarks to be within the patent limits. Thus, the ASTM specifications, necessarily, reflect these patents' ranges.

Table 1. Construction Hot-Dipped Coatings

Type of Coating	ASTM Number	Coating Designation	ASTM-Specified Coating Pot (Bath) Chemistry ^A
HDG ^B	A 653	G30 G40 G60 G90 G115 G165 G185	Not less than 99% Zn; contains Al, usually 0.05% to 0.25%
HDGA	A 653	A25 A40 A60	Not less than 99% Zn; contains Al, usually 0.05% to 0.25%. Product is annealed after coating to form a coating of Fe-Zn intermetallic compounds
GALVALUME®	A 792	AZ50 AZ55 AZ60	Nominally 55% Al, 1.6% Si, balance Zn
Aluminum-coated, Type 2	A 463	T2 65 T2 100	Commercially pure Al
GALFAN® Types I, II	A 875 B 750	GF60 GF75 GF90	Type I: 4.2% – 6.2% Al, 0.03% – 0.10% Ce plus La (mischmetal), balance Zn Type II: 4.5% – 6.2% Al, 0.06 – 0.15% Mg, 0.01% max. others, balance Zn

^A Excludes the <1% Fe from the hot-dip process. The compositions of the HDG and HDGA coatings on the steel sheet will have a higher Al content than the coating pot. HDGA coatings will typically contain 7 to 14% Fe.

^B Many steel companies provide heavier HDG coatings.

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Coating Weight Tests

The ASTM product specifications reference ASTM A 90, which discusses coating weight test procedures for HDG, HDGA, GALFAN® and GALVALUME®. ASTM A 463 references A 428 for coating weight tests for aluminized steel. ASTM A 90 and A 428 specify weigh-strip-weigh as the only method. All the coating specifications reference ASTM A 924, which allows magnetic, isotope and x-ray methods in addition to the weigh-strip-weigh method.

In actual practice, in-line X-ray or isotope gauges continuously monitor production coating weights and are generally used to report the official coating weight for each coil. The weigh-strip-weigh method is the reference or back-up method used to check the coating weight regularly throughout the production. Off-line X-ray instruments may also be used to periodically verify the on-line gauges. Many people consider the magnetic methods unsuitable because the uncertainty in the measurements is too large.

Coating Weights

The main coating weight designation is based on a minimum specification for the sum of the triple-spot coating weight averages from each side. For each designation, ASTM specifies a minimum triple-spot average for one side and a single-spot minimum coating weight for the total of both sides. This ensures standards of uniformity. This is significant because typical applications require most of the corrosion protection on just one side. The triple-spot coating weight average for one side sets a standard of uniformity between the two sides. The single-spot coating weight for the total of both sides sets a standard for uniformity from one edge to the center and to the other edge of the strip. An example of the meaning of the triple and single spot designations for G90 is shown in Figure 1 for clarity. There is no minimum coating weight requirement for a single-spot on a single side.

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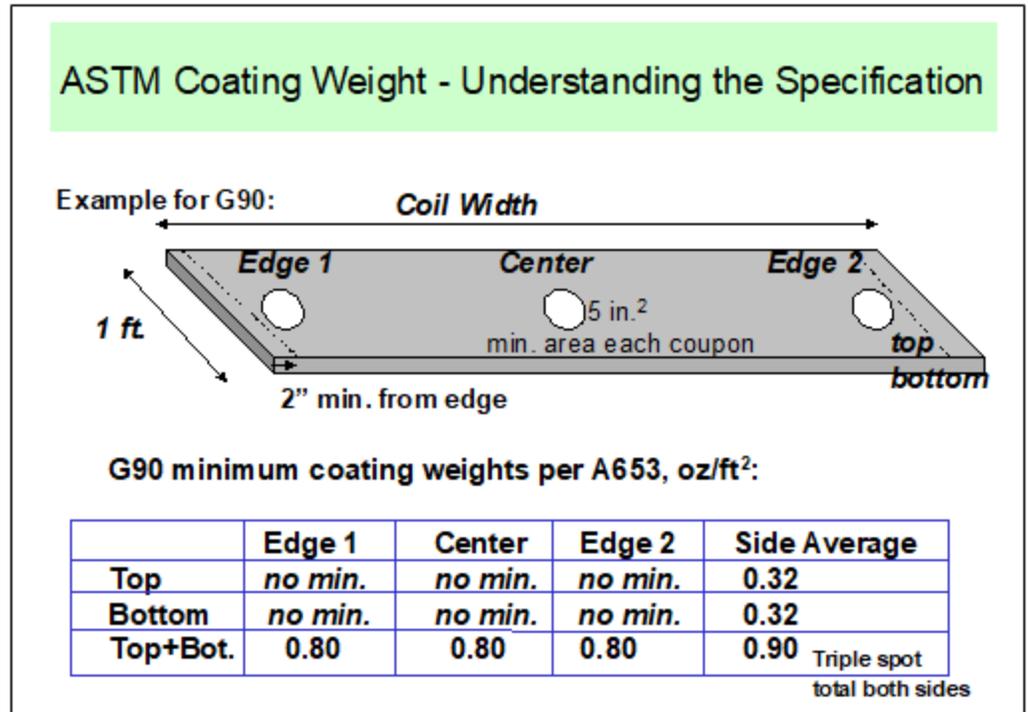


Figure 1. Understanding the ASTM triple-spot, single -spot specifications

ASTM specifications set a single-spot coating weight for two sides that is 0.05-0.10 oz/ft² below corresponding triple-spot coating weights. Table 2 lists the exact requirements for each coating listed in Table 1 along with the coating thickness. The coating weight converts to thickness using the values given in each individual product specification.

When comparing coating thickness for these products at a given coating weight, it should be noted that there are large differences due to various densities of the metallic coating types. The coating thickness given in Table 2 is a minimum value.

Coating thickness, measured as coating weight in ounces per square foot (oz/ft²) or grams per square meter (g/m²), is an important factor in the effective application of galvanized sheet. The coating weight should be chosen carefully, with full attention to the fabrication method and type of environment in which the sheet will be expected to serve. In general, the effectiveness of the zinc coating to protect the steel substrate from corrosion in any given environment is directly proportional to the coating thickness. For example, for any specific set of environmental conditions, a G90 coating will last about 50 percent longer than a G60 coating, maintenance, painting and all other factors being equal.

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Table 2. ASTM Coating Weight Designations and Minimum Coating Weights

ASTM COATING DESIGNATION ^A		Minimum Coating Weight, oz/ft ²			
		Triple Spot Test			Single Spot Test
		Min. Average Total of Both Sides ^B oz/ft ²	Min. Average Per Side ^C thickness ^D mils	Min. Average Per Side ^C Oz/ft ²	Min. Total Both Sides oz/ft ²
Type	Weight				
HDG	G40	0.40	0.68	0.12	0.30
	G60	0.60	1.02	0.20	0.50
	G90	0.90	1.53	0.32	0.80
	G115	1.15	1.96	0.40	1.00
	G165	1.65	2.81	0.56	1.40
	G185	1.85	3.15	0.64	1.60
HDGA	A25	0.25	0.43	0.08	0.20
	A40	0.40	0.68	0.12	0.30
	A60	0.60	1.02	0.20	0.50
GALVALUME [®]	AZ50	0.50	1.60	not specified ^E	0.43
	AZ55	0.55	1.76	not specified ^E	0.50
	AZ60	0.60	1.92	not specified ^E	0.52
GALFAN [®]	GF60	0.60	1.09	0.20	0.50
	GF75	0.75	1.37	0.26	0.65
	GF90	0.90	1.64	0.32	0.80
Aluminum-coated Type 2	T2 65	0.65	2.43	not specified ^E	0.60
	T2 100	1.00	3.74	not specified ^E	0.90

- ^A The coating designation number is the term by which this product is ordered.
- ^B The weight of coating in oz/ft² refers to the total coating on both surfaces. The triple spot average encompasses an edge-center-edge sampling to determine adequate coverage across the sheet width. Typically, 40% or more of this coating is on the average of each side.
- ^C For coating weights ordered to the Underwriters Laboratories (UL[®])³ specifications (G60U, G90U, A40U, A60U) the minimum for average one side also applies to a single spot one side. For non-UL ASTM-specified coatings there is no required minimum coating weight for a single spot on one side.
- ^D The coating thickness values are indicated by ASTM specifications as guidelines, but the coating minimums are specified by weight. The indicated thickness is the average total of both sides.
- ^E For GALVALUME[®], A 792-02 and for Aluminized A 463-02a, the ASTM specifications state that "it can be normally expected that not less than 40% of the single-spot test limit will be found on either surface." However, the triple spot test average of one side does not have a specified minimum.

Factors in addition to corrosion resistance must be considered when selecting coating thickness. For example, the adherence of the coating generally is inversely proportional to the thickness; therefore, a thin coating is more desirable for applications involving high amounts of forming. Also, spot welding becomes more difficult as the coating thickness increases.

Coating weight and thickness conversions for galvanized and galvanized coatings (from ASTM A 653):

$$1.0 \text{ oz/ft}^2 = 1.7 \text{ mils coating} = 305.15 \text{ g/m}^2$$

$$1.0 \text{ mil} = 0.59 \text{ oz/ft}^2$$

$$1.0 \text{ } \mu\text{m} = 7.14 \text{ g/m}^2$$

(Valid for zinc coatings only - not for GALVALUME[®])

³ UL is a registered trademark of Underwriters Laboratories, and the designations G60U, G90U, A40U, A60U are used under license by U. S. Steel and other metallic-coated sheet producers.

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GALVALUME® Coating Thickness

Coating thickness (measured as ounces of coating per square foot, total both sides) is an important factor in the effective application of GALVALUME® sheet. The most common coating weights being used today are AZ50 and AZ55, which require that the product have 0.50 oz/ft² and 0.55 oz/ft² of triple-spot average for total both sides, respectively. Details about the total requirements for these two designations are contained in ASTM Specification A 792. In applications where formability is an important consideration, AZ50 is recommended for maximum coating adhesion. Where corrosion resistance is the prime factor, AZ55 is recommended. Other coating weights can be produced but the specific applications should be discussed thoroughly with U. S. Steel Technical Service Representatives to balance formability concerns and corrosion resistance.

Coating weight and thickness conversions (from ASTM A 792-02, Table X1.1)

$$1.0 \text{ oz/ft}^2 = 3.2 \text{ mils coating thickness} = 305.15 \text{ g/m}^2 = 81.28 \text{ } \mu\text{m}$$

$$1.0 \text{ mil} = 0.3125 \text{ oz/ft}^2 = 95.360 \text{ g/m}^2 = 25.4 \text{ } \mu\text{m}$$

$$1.0 \text{ } \mu\text{m} = 0.0122303 \text{ oz/ft}^2 = 3.7543 \text{ g/m}^2 = 0.03937 \text{ mils}$$

$$1.0 \text{ g/m}^2 = 0.00328 \text{ oz/ft}^2 = 0.010487 \text{ mils} = 0.26636 \text{ } \mu\text{m}$$

(Valid for GALVALUME® coatings only)

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