

Introduction

In GalvInfoNote #2 the hot-dip coating process for sheet steel was described, and it was explained how it is used to make seven different types of coatings. The products produced using these coatings are explained in more detail below. The ASTM standards describing these products (and how to obtain the standards) are further covered in GalvInfoNote #16.

Types of Hot-Dip Coatings

1. Galvanized	Zinc	ASTM A 653/A 653M (Wide variety of end uses)
2. Galvanneal	Zinc/10% Iron	ASTM A 653/A 653M (Intended to be painted)
3. Galvalume	55% Al/Zinc/1.5% Si	ASTM A 792/A 792M (Metal roofing & siding)
4. Galfan	Zinc/5% Al	ASTM A 875/A 875M (Prepainted siding)
5. Aluminized	Al or Al/5-11% Si	ASTM A 463/A 463 M (Heat/oxidation resistance)
6. Terne	Lead/8% Tin	ASTM A 308/A 308M (Fuel tanks)

General requirements for all hot-dip coatings – ASTM A 924/A 924M

ASTM Hot-Dip Steel Sheet Specifications

A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) for Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

- Covers galvanized and galvanneal steel sheet in coils and cut lengths.
- The most commonly used type of coated-steel sheet within the metal-construction industry.

A 792/A 792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

- Covers 55% aluminum-zinc alloy-coated steel sheet in coils and cut lengths.
- Intended for applications requiring high corrosion resistance and/or heat resistance.

A 463/A 463M - Standard Specification for Steel Sheet, Aluminum-Coated by the Hot-Dip Process

- Covers aluminum coated steel sheet in coils and cut lengths with **two types** of aluminum coating.
- Type 1 coating is an aluminum-silicon alloy intended for heat resisting applications and for uses where corrosion and heat are involved.
- Type 2 coating is commercially pure aluminum intended for applications requiring corrosion resistance.

A 875/A 875M - Standard Specification for Steel Sheet, Zinc-5% Aluminum Alloy Metallic-Coated by the Hot-Dip Process

- Covers steel sheet, in coils and cut lengths, metallic-coated by the hot-dip process, with a zinc-5 % aluminum alloy coating.
- Coating is produced as **two types**: zinc-5% aluminum-mischmetal alloy or zinc-5% aluminum-magnesium alloy.
- Intended for applications requiring corrosion resistance, formability, and paintability.

A 308/A 308M - Standard Specification for Steel Sheet, Terne (Lead–Tin Alloy) Coated by the Hot-Dip Process

- Covers steel sheet, in coils and cut lengths, metallic-coated by the hot-dip process, with a lead-3-15% tin alloy coating.
- Primary end use is automotive fuel tanks.

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

- Covers the general requirements that apply to all hot-dip coated steel sheet in coils and cut lengths.
- Requirements that are common for all types of hot-dip metallic-coated steel sheet, such as product dimensional tolerances for thickness, width, flatness, etc. are contained in this standard.

Hot-Dip Galvanized Steel Sheet (A 653/A 653M)

- A galvanized coating is essentially a zinc coating on steel sheet. The term “galvanized” comes from the galvanic protection that zinc provides to steel when exposed to a corroding atmosphere.
- This is, by far, the most common hot-dip coated product. Wide range of applications.
- Zinc provides both galvanic and barrier protection. Galvanic protection is greater than for any other type of hot-dip coating on steel.
- The coating contains aluminum – typically between 0.20 and 0.30% - to control the growth rate of the alloy layer (bond zone between the steel and zinc coating). Added to dramatically improve adhesion during forming.
- Coating may contain a small amount of lead and/or antimony for spangle development. Today, a significant amount of galvanized product contains “no lead” to “less than 0.03%”.
- Coating weight (mass) range available: 0.30 – 4.00 oz/ft² (90 – 1200 g/m²) total both sides.
- Coating designations: “**G**” (Inch-Pound), “**Z**” (SI)

Hot-Dip Galvannealed Steel Sheet (A 653/A 653M)

- A hot-dip galvanized coating that is diffusion-alloyed with the steel by additional heating in the tower above the coating bath.
- Typical coating contains 8 to 11% iron.
- Intended to be painted for most applications.
- Characterized by its high hardness and brittle behavior during forming.

- Easier to spot weld and paint than galvanized product.
- Performance under paint is usually beneficially affected. Compared with galvanized product, galvanized generally exhibits less undercutting corrosion beneath paint at exposed edges, scratches, or other defects in the paint.
- Used by a number of auto companies for body panels. (Galvanized used for automotive end uses is ordered to auto company specifications).
- Coating weight (mass) range available: 0.30 – 0.60 oz/ft² (90 – 180 g/m²) total both sides.
- Coating designations: “**A**” (Inch-Pound), “**ZF**” (SI)

Hot-Dip Galvalume[®] Coated Steel Sheet (A 792/A 792M)

[®]Galvalume is a registered trademark of BIEC International, Inc.

- An aluminum/zinc alloy coating that contains approximately –
 - 55% aluminum,
 - 43.5% zinc
 - 1.5% silicon.
- Offers excellent barrier-coating protection combined with some galvanic protection.
 - Retention of galvanic protection is an important feature.
- This particular combination of aluminum and zinc effect the formation of a coating microstructure that is very important for good performance. Provides a very good balance between galvanic and barrier protection.
- Silicon is added to control the alloy-layer growth rate. Improves adhesion during forming.
- Much higher resistance to corrosion than galvanized coatings in most environments. Long term durability has been demonstrated.
- Coating weight (mass) range available: 0.50 – 0.60 oz/ft² (150 – 180 g/m²) total both sides.
- Coating designations: “**AZ**” (Inch-Pound), “**AZ**” (SI)

Hot-Dip Galfan[®] Coated Steel Sheet (A 875/A 875M)

[®]Galfan is a registered trademark of the Galfan Technology Centre, Inc.

- A galvanic coating that contains approximately 95% zinc and 5% aluminum.
- Provides approximately the same galvanic protection as galvanized and improved corrosion resistance in most environments.
- Primary attribute is the improved ductility vs. a galvanized coating
- Used mostly for applications that require good coating ductility – deep drawn parts and prepainted sheets.
- Coating weight (mass) range available: 0.30 – 2.35 oz/ft² (90 – 715 g/m²) total both sides.
- Coating designations: “**GF**” (Inch-Pound), “**ZGF**” (SI)

Hot-Dip Aluminized Steel Sheet (A 463/A 463M)

- Two types of aluminized coatings -
 - Type 1 - Aluminum + 5 to 11% silicon
 - Type 2 – Pure aluminum coating

- Most common form is Type 1 coating; used for applications that require heat-oxidation resistance such as furnace parts, small appliances, exhaust systems, etc.
 - Best coating on steel sheet for heat-oxidation resistance
 - Can be applied over stainless steel to offer even better high temperature performance.
- Pure Al Type 2 coating is used for exterior applications.
 - Corrosion performance is based on barrier protection; no galvanic protection in most environments.
 - Barrier corrosion protection is very good.
 - Forms a stable aluminum oxide film on the surface of the coating.
- Coating weight (mass) range available: Type 1 0.25 – 1.00 oz/ft² (75 – 300 g/m²) total both sides.
Type 2 0.65 – 1.00 oz/ft² (200 – 300 g/m²) total both sides.
- Coating designations: Type 1 “**T1**” (Inch-Pound), “**T1**” (SI)
Type 2 “**T2**” (Inch-Pound), “**T2**” (SI)

Terne-Coated Steel Sheet (A 308/A 308M)

- A lead-alloy coating that contains 3 to 15% tin.
- Tin is added to develop a bond between the coating and steel.
- The coating is very formable. Improves the deep drawing behavior. Also, the product is easily welded.
- Very good resistance to gasoline, although use for fuel tanks is decreasing.
 - This is related to the environmental issue associated with lead; not product performance.
- Coating weight (mass) range available: 0.25 – 1.10 oz/ft² (75 – 335 g/m²) total both sides.
- Coating designations: “**LT**” (Inch-Pound), “**LTZ**” (SI)

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