



Designation: A424/A424M – 25

## Standard Specification for Steel, Sheet, for Porcelain Enameling<sup>1</sup>

This standard is issued under the fixed designation A424/A424M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

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

### 1. Scope\*

1.1 This specification covers sheet steel in coils and cut lengths for porcelain enameling. The compositions and processing of these steels are such that articles for porcelain enameling may be fabricated from them and, under proper conditions, enameled. The steels are furnished as Type I, Type II, Type III, and Type IV. Type I and Type II are supplied in two designations, Commercial Steel (CS) and Drawing Steel (DS). Type III steel is interstitial-free and does not require a designation. Type IV steel is ultra-low carbon and does not require a designation.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 Tolerances are found in General Requirements Specifications A568/A568M and A635/A635M. The appropriate General Requirements specification is applied based on the thickness and width of the product ordered.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A568/A568M Specification for Steel, Sheet, Carbon, Structural, and High-Strength Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for  
A635/A635M Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for  
A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys  
A1008 Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable  
E517 Test Method for Plastic Strain Ratio  $r$  for Sheet Metal  
E646 Test Method for Tensile Strain-Hardening Exponents ( $n$ -Values) of Metallic Sheet Materials

### 3. Terminology

3.1 *Definitions*—For definitions of other terms used in this specification, refer to Terminology A941.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *base coat, n*—also known as ground coat. This coating layer is applied directly to the steel and promotes adhesion of the coating system to the steel.

3.2.2 *cover coat, n*—this coating layer is usually applied over the base or ground coat to improve the appearance and provide the proper color.

3.2.3 *direct cover coat, n*—this refers to a single coating application that provides both adequate adhesion and appearance.

### 4. Classification

#### 4.1 Types:

4.1.1 *Type I* steel has an extremely low carbon level achieved through sheet decarburization. This material is suitable for ground and cover coat enameling practice. It has good sag resistance and good formability. Type I can also be used for direct cover coat enameling practice. However, since direct cover coat is no longer a common practice, this requirement must be indicated by the purchaser in accordance with 5.1.6.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.19 on Steel Sheet and Strip.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [www.astm.org/contact](http://www.astm.org/contact). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard

4.1.2 *Type II* steel is suitable for applications where ground and cover coat enameling operations are employed. The composition of the Type II steel is obtained in the melt of the steelmaking process.

4.1.3 *Type III* is an interstitial-free steel and is suitable for applications where ground and cover coat enameling operations are employed. The composition of the Type III steel is obtained in the melt of the steelmaking process. It has good sag resistance and excellent formability.

4.1.4 *Type IV* steel has an ultra-low carbon chemistry achieved in the melt of the steelmaking process. This material is suitable for ground and cover coat enameling practice. It has good sag resistance and good formability. It may be considered an alternative for some applications previously using Type I, provided there is an agreement between producer and user or seller and purchaser. Type IV shall not be substituted for Type I applications that require a sheet decarburized product. Type IV can also be used for direct cover coat enameling practice. However, since direct cover coat is no longer a common practice, this requirement must be indicated by the purchaser in accordance with 5.1.6.

## 4.2 Product Designations:

4.2.1 *Commercial Steel (CS)* is intended for parts where bending, moderate forming, or moderate drawing may be involved.

4.2.2 *Drawing Steel (DS)* is intended for fabricating identified parts where the draw is particularly severe or where the material shall be essentially free of changes in mechanical properties over a period of time. Drawing Steel should be specified where the formed material shall be essentially free of such surface disturbances as stretcher strains or fluting without the need of prior roller leveling.

4.2.3 *Type III* interstitial-free steel is intended for fabricating identified parts where the most severe drawing or forming is involved and where the material must be free of changes in mechanical properties over time and completely free of such surface disturbances as stretcher strains or fluting without the need of prior roller leveling.

4.2.4 *Type IV* ultra-low carbon steel is intended for fabricating identified parts where severe drawing or forming is involved.

## 4.3 Porcelain Enamels:

4.3.1 Ground coat enamels are glasses used primarily for their bonding characteristics. They may be applied after proper metal preparation (either pickle or pickle-free depending on enamel system). These glasses may be applied as either dry powders or wet slips. Ground coat enamels are suitable for all four types of steel (Type I, II, III, or IV).

4.3.2 Cover coat enamels are appearance glasses applied for specific color, corrosion, alkali resistance, and so forth. These enamels may be applied directly to Type I steels after suitable metal preparation. They may also be applied over fired ground coat enamels. They may be applied as either dry powder or wet slip.

4.3.3 Two coat-one fire enamels are special glass systems applied as dry powders. They usually are applied as pickle-free systems. Two coat-one fire enamels are suitable for all four types of steel (Type I, II, III, or IV). Both the base coat

(adherence promoting enamel) and the cover coat (color or other specific properties) are applied and fired at the same time.

## 5. Ordering Information

5.1 Orders for material under this specification shall include the following information, as required, to describe adequately the desired material:

5.1.1 Quantity,

5.1.2 ASTM specification number and date of issue,

5.1.3 Name of material (Porcelain Enameling Sheet, Type I, Drawing Steel),

5.1.3.1 When a product designation (CS or DS) is not specified for Types I and II, CS shall be furnished.

5.1.4 Condition (oiled unless otherwise specified),

5.1.5 Finish (matte (dull) finish will be supplied unless otherwise specified),

5.1.6 Enameling practice (for Type I and Type IV, indicate if direct cover coat practice will be used),

5.1.7 Dimensions (thickness, width, and length for cut lengths, or thickness and width of coils),

NOTE 1—Not all producers are capable of meeting all of the limitations of the thickness tolerance tables in Specification **A568/A568M**. The purchaser should contact the producer regarding possible limitations prior to placing an order.

5.1.8 Coil size and weight requirements (must include inside and outside diameters and maximum weight),

5.1.9 Application (show part identification and description),

5.1.10 Heat analysis (if required) (see 10.1), and

5.1.11 Special requirements (if any).

5.1.11.1 When the purchaser requires thickness tolerances for  $\frac{3}{8}$  in. [10 mm] minimum edge distance (see Supplementary Requirement in Specification **A568/A568M**), this requirement shall be specified in the purchase order or contract.

NOTE 2—A typical ordering description is as follows: 40 000 lb, ASTM A424/A425M – NN Porcelain Enameling Sheet, Type I, Drawing Steel, direct cover coat, 0.048 in. by 35 in. by 96 in., Part 2587, Range Top, or, 50 000 kg, ASTM A424M/A424M – NN Porcelain Enameling Sheet, Type I, Drawing Steel, direct cover coat, 1.22 mm by 890 mm by 2440 mm, Part 2587, Range Top.

## 6. General Requirements for Delivery

6.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification **A568/A568M**.

6.2 Products covered by this specification are produced only to either decimal thickness where decimal thickness tolerances apply or to metric thickness where metric thickness tolerances apply.

## 7. Chemical Composition

7.1 The heat analysis of Type I, Type II, Type III, and Type IV shall conform to the requirements prescribed in **Table 1** except for carbon in Type I as noted.

## 8. Mechanical Properties

8.1 Typical nonmandatory mechanical properties for Type I CS, Type I DS, Type II CS, Type II DS, Type III, and Type IV are shown in **Table 2**.