Designation: A623M – 22

Standard Specification for Tin Mill Products, General Requirements [Metric][1]

This standard is issued under the fixed designation A623M; 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.

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

INTRODUCTION

This specification is the metric counterpart of Specification A623. It is not intended to replace A623. Users of the standard should note several very significant differences in how the product is produced and marketed.

(1) The metric product does not carry the overrun associated with tin mill products produced to customary units. Metric tin mill products are produced to ordered size.

(2) The metric product is designated in units of 100 m^2 called a SITA (System International Tinplate Area), rather than in base boxes.

(3) The metric product is designated by thickness in millimetres rather than by basis weight.

(4) Coating weights are given in grams per square metre, not pounds per base box.

(5) Thickness tolerances are given in absolute figures instead of a ± percentage.

(6) Each package of metric tin mill products contains 100 sheets, not the 112 of customary unit packages.

All of the above significant differences, as well as others of lesser consequence, should be considered when switching from Specification A623 to Specification A623M.

1. Scope

1.1 This specification covers a group of common requirements, which unless otherwise specified in the purchase order or in an individual specification, shall apply to tin mill products.

1.2 In case of conflict in requirements, the requirements of the purchase order, the individual material specification, and this general specification shall prevail in the sequence named.

NOTE 1—A complete inch-pound companion to Specification A623M has been developed—Specification A623; therefore, no inch-pound equivalents are presented.

1.3 The following safety hazards caveat covers Annex A1 through Annex A8 of this specification: *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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:*[2]

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A623 Specification for Tin Mill Products, General Requirements

A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment

A987 Practice for Measuring Shape Characteristics of Tin Mill Products

E18 Test Methods for Rockwell Hardness of Metallic Materials

E112 Test Methods for Determining Average Grain Size

2.2 *Military Standards:*[3]

MIL-STD-129 Marking for Shipment and Storage

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.20 on Tin Mill Products.

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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.

[3] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

MIL-STD-163 Steel Mill Products, Preparation for Marking and Storage

2.3 *Federal Standard:*[3]

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

3. Terminology

3.1 *Definitions:*

3.1.1 *black plate, n*—light-gage, low-carbon, cold-reduced steel intended for use in the untinned state or for the production of other tin mill products. It is supplied only in a dry or oiled condition.

3.1.2 *box annealing, n*—a process involving slow heating of coils to a subcritical temperature, holding, and cooling therefrom, to recrystallize the grain, and thus, relieve stresses produced during cold reduction. It is accomplished in a sealed container. By introducing and maintaining an inert or slightly reducing atmosphere during the cycle, a relatively bright surface is obtained.

3.1.3 *bright finish, n*—a surface that has a lustrous appearance.

3.1.4 *burr, n*—metal displaced beyond the plane of the surface by slitting or shearing (see 9.1.7 and 9.2.6).

3.1.5 *camber, n*—the greatest deviation of a coil edge from a straight line; the measurement is taken on the concave side and is the perpendicular distance from a straight line to the point of maximum deviation (see 9.1.9 and 9.2.7).

3.1.6 *chemical treatment, electrolytic tin plate, n*—a passivating chemical treatment applied to the surface of electrolytic tin plate to stabilize the plate surface characteristics compatible with a specified end use (see Annex A7).

3.1.7 *chemically treated steel, n*—light-gage, low-carbon, cold-reduced steel that has a passivating or chemical treatment applied to the surface to provide rust resistance or retard underfilm corrosion, or both.

3.1.8 *cold reduction, n*—the process of reducing the thickness of the strip cold, generally accomplished by one rolling through a series of four-high mills arranged in tandem.

3.1.9 *continuous annealing, n*—a process consisting of passing the cold-reduced strip continuously and in a single thickness through a series of vertical passes within a furnace consisting of heating, soaking, and cooling zones to recrystallize the grain and thus relieve stresses produced during cold reduction. An inert or slightly reducing atmosphere is maintained in the furnace to obtain a relatively bright strip.

3.1.10 *differentially coated tin plate, n*—electrolytic tin plate with a different weight of tin coating on each surface.

3.1.11 *double-reduced plate, n*—plate given a second major cold reduction following annealing. Some double-reduced products are produced to achieve a minimum level of ductility (% elongation) in the material. These products carry the designation of High Elongation Double-Reduced, or HEDR.

3.1.12 *electrolytic chromium-coated steel, n*—light-gage, low-carbon, cold-reduced steel on which chromium and chromium oxides have been electrodeposited.

3.1.13 *electrolytic tin plate, n*—light-gage, low-carbon, cold-reduced steel on which tin has been electrodeposited by an acid or alkaline process.

3.1.13.1 *J Plate, n*—electrolytic tin plate, 5.6/2.8 g/m^2 or heavier tin coating, with improved corrosion performance for some galvanic detinning food products as specified in 3.1.13.2 and as measured by the Special Property Tests for Pickle Lag (PL) (see Annex A2), Iron Solution Values (ISV) (see Annex A4), Tin Crystal Size (TCS) (see Annex A3). The alloy layer is normally light in color, characteristic of the acid tinning process.

3.1.13.2 *K Plate, n*—electrolytic tin plate, 5.6/2.8 g/m^2 or heavier tin coating, with improved corrosion performance for some galvanic detinning food products as specified in the following table and as measured by the Special Property Tests for Pickle Lag (PL) (see Annex A2), Iron Solution Value (ISV) (see Annex A4), Tin Crystal Size (TCS) (see Annex A3), Alloy Tin Couple (ATC) (see Annex A5) and Aerated Media Polarization Test (AMP) (see Annex A8).

	Special Properties Aims
Pickle Lag[A]	10 s max
Iron Solution Value	20 µg iron max
Tin Crystal Size	ASTM No. 9 or larger
Alloy Tin Couple[B]	0.12 µA/cm^2 max

[A] The Pickle Lag test is not necessary if the product is processed using an anneal atmosphere gas of HNX or H_2.

[B] Good mill practice has demonstrated the ability to average 0.05 µA/cm^2 or less over an extended period of production.

3.1.13.3 *Discussion*—The production of J Plate and K Plate require special processing and testing. In order to receive J Plate or K Plate, this requirement must be specified on the order.

3.1.14 *length dimension, n*—the longer dimension of a cut size (see 9.2.9).

3.1.15 *lot, n*—each 20 000 sheets or part thereof or the equivalent in coils, of an item in a specific shipment having the same order specifications.

3.1.16 *matte finish, n*—a surface that has an unmelted tin coating, generally on a shot-blast finish (SBF) base steel.

3.1.17 *mechanical designation, n*—an arbitrary number to designate Rockwell hardness and ultimate tensile strength characteristics for double-reduced plate (see 8.2).

3.1.18 *oiling, n*—a lubricant film applied to both surfaces of the plate.

3.1.19 *package, n*—a quantity of 100 sheets.

3.1.20 *passivating treatment, n*—a surface chemical treatment (see 3.1.6).

3.1.21 *Rockwell hardness test, n*—a test for determining hardness (see Annex A1).

3.1.22 *rolling width, n*—the dimension of the sheet perpendicular to the rolling direction.

3.1.23 *single-reduced plate, n*—plate produced with one major cold reduction.

3.1.24 *SITA, n*—100 square metres.

Formula for cut lengths:

TABLE 1 Chemical Requirements for Tin Mill Products

Element	Cast Composition, max %		
	Type D	Type L	Type MR
Carbon	0.12	0.13	0.13
Manganese	0.60	0.60	0.60
Phosphorous	0.020	0.015	0.020
Sulfur	0.03	0.03	0.03
Silicon[A,B]	0.020	0.020	0.020
Copper	0.20	0.06	0.20
Nickel	0.15	0.04	0.15
Chromium	0.10	0.06	0.10
Molybdenum	0.05	0.05	0.05
Aluminum[C]	0.20	0.10	0.20
Other elements, each	0.02	0.02	0.02

[A] When steel produced by the silicon killed method is ordered, the silicon maximum may be increased to 0.080 %.
[B] When strand cast steel produced by the aluminum killed method is ordered or furnished, the silicon maximum may be increased to 0.030 % when approved by the purchaser.
[C] Types L and MR may be supplied as non-killed or killed, which would respectively be produced without and with aluminum additions. Minimum aluminum level for Type D is usually 0.02 %.

$$\text{SITA} = \frac{\text{width (mm)}}{1000} \times \frac{\text{length (mm)}}{1000} \times \text{number of packages}$$

Formula for coils:

$$\text{SITA} = \frac{\frac{\text{width (mm)}}{1000} \times \text{length (m)}}{100\text{m}^2}$$

3.1.25 *steel Type D, n*—base-metal steel aluminum killed, sometimes required to minimize severe fluting and stretcher-strain hazards or for severe drawing applications (see Table 1).

3.1.26 *steel Type L, n*—base-metal steel, low in metalloids and residual elements, sometimes used for improved internal corrosion resistance for certain food-product containers (see Table 1).

3.1.27 *steel Type MR, n*—base-metal steel, similar in metalloid content to Type L but less restrictive in residual elements, commonly used for most tin mill products (see Table 1).

3.1.28 *surface appearance, n*—visual characteristics determined primarily by the steel surface finish; for electrolytic tin plate, the appearance is also influenced by the weight of coating and by melting or not melting the tin coating.

3.1.29 *surface finishes, n*—steel surface finishes for tin mill products imparted by the finishing-mill work rolls; these may be either ground, blasted, or etched roll finishes.

3.1.30 *temper designation, n*—an arbitrary number to designate a Rockwell hardness range for single-reduced products, which indicates the forming properties of the plate (see Section 8 and Table 2 and Table 3).

3.1.31 *temper mill, n*—a mill for rolling base metal steel after annealing to obtain proper temper, flatness, and surface finish; it may consist of one stand or two stands arranged in tandem.

3.1.32 *tin coating weight, n*—the weight of tin applied to the steel surface, usually stated as grams per square metre distributed evenly over both surfaces. The coating is usually referred to by designation numbers, referring separately to the nominal tin weight on each surface, but omitting the units. Thus, 2.8/2.8 designates tin plate with a coating of 2.8 g/m^2 on each of the two surfaces. For differential coatings, the same system is applied. Thus, 1.1/2.2 has a coating of 1.1 g/m^2 on one surface and 2.2 g/m^2 on the other surface.

3.1.33 *width dimension, n*—the shorter dimension of a cut size (see 9.2.9).

TABLE 2 Temper Designations and Hardness Values Single Reduces Tin Mill Products—Box Annealed

NOTE 1—Thinner plate (0.21 mm ordered thickness and thinner) is normally tested using the Rockwell 15TS scale and the results converted to the Rockwell 30TS scale (see Annex A1 and Table A1.1).

Temper Designation	Rockwell Hardness Values All Thickness HR30TS[A]		Characteristics and Typical End Uses
	Nominal	Rang[B] e	
T-1 (T49)	49	45-53	soft for drawing parts such as nozzles, spouts, and oil filter shells
T-2 (T53)	53	49-57	moderately soft for drawing shallow parts such as rings, plugs, and pie pans
T-3 (T57)	57	53-61	Fairly stiff for parts such as can ends and bodies, closures, and crown caps
T-4 (T61)	61	57-65	Increased stiffness for can ends and bodies, crown caps, and large closures

[A] These ranges are based on the use of the diamond spot anvil and a 1.588 mm hardened steel ball indenter.
[B] The hardness ranges are requirements unless otherwise agreed upon between producer and user.
Test conditions:
1. For referee purposes, samples of blackplate, unreflowed ETP, and ECCS shall be aged prior to testing by holding at 400 °F for 10 min.
2. For referee purposes, the hardness test area on material produced with SBF or equivalent rolls shall be sanded smooth on both surfaces.
3. To avoid incorrect results due to the cantilever effect, samples shall have an area no larger than 4 in.^{2} and the point of testing shall be no more than ½ in. off the center of the samples.

4. Base Metal

4.1 The steel shall be made by the open-hearth, electric furnace, or basic-oxygen process.

5. Chemical Composition

5.1 The steel shall conform to the chemical composition requirements as prescribed in Table 1 except as otherwise agreed upon between the manufacturer and the purchaser.

6. Cast or Heat Analysis

6.1 For Type D, MR, and L an analysis of each heat of steel shall be made by the supplier to determine the percentage of carbon, manganese, phosphorus, sulfur, silicon, and residual elements shown in Table 1. Other elements, unless agreed upon between the manufacturer and the purchaser, individually shall not exceed 0.02 %, maximum and while not necessarily analyzed are dependent on the suppliers' practices and controls.