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Standard Specification for Passivation of Stainless Steels Using Electropolishing[1]

This standard is issued under the fixed designation B 912; 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.

ε[1] NOTE—The units statement in subsection 1.2 was corrected editorially in April 2008.

1. Scope

1.1 This specification covers the passivation of stainless steel alloys in the 200 (UNS2XXXX), 300 (UNS3XXXX), and 400 (UNS4XXXX) series, and the precipitation-hardened alloys, using electropolishing procedures.

NOTE 1—Surface passivation occurs simultaneously with electropolishing under proper operating conditions. The quality of passivation will depend on the type of stainless steel, the formulation of the electropolishing solution, and the conditions of operation. Free iron on the surface of the stainless steel is removed resulting in improved corrosion resistance. Surface smoothing obtained by electropolishing will also improve corrosion resistance. Electropolishing will also remove heat tint and oxide scale.

~~1.2~~

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This specification may involve hazardous materials, operations, and equipment. This specification 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 380 Practice for Cleaning, Descaling, and ~~Descaling~~ Passivation of Stainless Steel Parts, Equipment, and Systems
A 967 Specification for Chemical Passivation Treatments for Stainless Steel Parts
B 117 Practice for Operating Salt Spray (Fog) Apparatus
B 322~~Practice~~ Guide for Cleaning Metals Prior to Electroplating
B 374 Terminology Relating to Electroplating
B 602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings
D 3951 Practice for Commercial Packaging

2.2 *ISO Standards:*[3]

ISO 2080 Electroplating and Related Processes—Vocabulary
ISO 4519 Electrodeposited Metallic Coatings and Related Finishes—Sampling Procedures for Inspection by Attributes
ISO 9227 Corrosion Tests in Artificial Atmospheres—Salt Spray Tests
~~ISO/DIS 15730Metallic~~ISO 15730 Metallic and Other Inorganic Coatings—Electropolishing as a Means of Smoothing and Passivating Stainless Steels~~,~~
~~ISO/DIS 16348Metallic and Other Inorganic Coatings—Definitions and Conventions Concerning Appearance~~[6]

3. Terminology

~~3.1Definition of terms in this specification can be found in Terminology B374 and ISO 2080.~~
~~3.2*Definitions:*~~
~~3.2.1~~
3.1 *Definitions:*

~~[1] This specification is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B.08.07 on Chromate Conversion Coatings.~~
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[1] This specification is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.07 on Conversion Coatings.
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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* ~~, Vol 01.03.~~volume information, refer to the standard's Document Summary page on the ASTM website.
~~[3] Annual Book of ASTM Standards, Vol 03.02.~~
[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

3.1.1 *electropolishing*, *n*—electrochemical process in which the article(s) to be passivated are treated anodically in a suitable acid medium.

3.1.2 *passivation*, *n*—~~The rendering~~ —rendering of a stainless steel surface into a lower state of chemical reactivity.

~~3.2.1.1~~3.1.2.1 *Discussion*—Passivated surfaces are characterized by the absence of free iron, as defined by Practice A 380.

~~3.2.2*electropolishing*, *n*—the electrochemical process in which the article(s) to be passivated are treated anodically in a suitable acid medium.~~

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 Definitions of terms in this specification can be found in Terminology B 374 and ISO 2080.

4. Ordering Information

4.1 When ordering articles to be electropolished in conformance with this standard, the purchaser shall state the following:

4.1.1 *Alloy Designation*—When ordering articles passivated in accordance with this specification, the purchaser shall state, in addition to the ASTM designation number, the date of issue, the alloy designation number, and the testing method(s) by which the article will be evaluated (see 5.3).

4.1.2 *Appearance*—The purchaser shall specify the appearance required, for example, bright or dull. Unless otherwise specified by the purchaser, a bright luster shall be acceptable. Alternatively, samples showing the required finish, or range of finish, shall be supplied or approved by the purchaser. When required, the basis material may be subjected, before electropolishing, to such mechanical polishing as may be required to yield the desired final surface characteristics.

4.1.3 *Contact Marks*—Visible contact marks may occur. The location of electrical contact marks shall be agreed upon between purchaser and supplier.

4.1.4 *Metal Removal*—Some metal is removed from the surface of the article during electropolishing, typically 5 to 10 µm. As much as 50 µm may be removed for additional smoothing. The ordering document shall include the maximum amount of metal to be removed.

4.1.5 Any requirement for certification—See Section 9.

4.1.6 Any requirement for packaging—See Section 10.

5. Product Requirements

5.1 *Visual Defects*—When specified, the significant surfaces of the article to be passivated by electropolishing shall be free of clearly visible defects such as pits, roughness, striations, or discoloration when examined with 20/20 eyesight at a distance of approximately 0.5 m.

NOTE 2—Defects in the surface of the basis material such as scratches, porosity, inclusions, and so forth, may adversely affect the appearance and performance of the article. Visible examination shall include wearing correctional glasses if the inspector normally wears them.

5.2 *Process*:

5.2.1 *Surface Preparation*—Preparatory procedures and cleaning of the basis material may be necessary; see Practices A 380 and ~~B322.~~B 322.

5.2.2 *Electropolishing*—Following the preparatory operations, the articles are introduced into the electropolishing solution for a period of time at the current density and temperature required to produce the passive surface and required surface finish, if any.

NOTE 3—A typical electropolishing solution and operating conditions suitable for many stainless steel alloys is shown in Appendix X1. Proprietary electropolishing solutions are available offering special features such as low sludging, better bright throwing power, longer life, or better performance with specific stainless steel alloys.

NOTE 4—Intricately shaped articles may not receive the same degree of passivation in recessed area as a result of low-current densities. Increasing time or overall current density, or both, or the use of auxiliary cathodes, may be used to improve electropolishing in these areas and to pass subsequent passivation tests.

5.2.3 *Post Dip*—Articles withdrawn from the electropolishing solution will have a residual film that may adversely affect the appearance or performance of the product. The preferred method of removing this film is by rinsing the articles in a room-temperature solution of 10 to 30 % v/v nitric acid (specific gravity 1.42, 70 % w/w).

5.2.3.1 Where local conditions prevent the use of nitric acid (nitrates) for film removal, other options may be used as long as the articles meet the requirements of 5.3.

NOTE 5—A 60-g/L solution of citric acid has been used for film removal; however, note that this procedure may pose waste treatment difficulties. The use of other mineral acids, such as sulfuric or hydrochloric acids, is not recommended as the passive film may be compromised. Neutralization procedures such as immersion in alkaline solutions should not be used as they can have a tendency to "set" the residual film and detract from appearance and performance.

5.2.4 *Final Rinsing*—Rinsing subsequent to passivation is necessary to remove all traces of acidified water that may affect the appearance and performance of the passive part. Deionized or distilled water may be used to avoid water spots.

5.3 *Passivation Testing*:

5.3.1 Passivation by electropolishing shall be evaluated by one or more of the following test methods (see Section 6 for test procedures):

5.3.1.1 Water immersion test,