Designation: A967/A967M – 25

Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts[1]

This standard is issued under the fixed designation A967/A967M; 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.

1. Scope*

1.1 This specification covers several different types of chemical passivation treatments for stainless steel parts. It includes recommendations and precautions for descaling, cleaning, and passivation of stainless steel parts. It includes several alternative tests, with acceptance criteria, for confirmation of effectiveness of such treatments for stainless steel parts.

1.2 Practices for the mechanical and chemical treatments of stainless steel surfaces are discussed more thoroughly in Practice A380/A380M.

1.3 Several alternative chemical treatments are defined for passivation of stainless steel parts. Appendix X1 and Appendix X2 give some nonmandatory information and provides some general guidelines regarding the selection of passivation treatments appropriate to particular grades of stainless steel. This specification makes no recommendations regarding the suitability of any grade, treatment, or acceptance criteria for any particular application or class of applications.

1.4 The tests in this specification are qualitative tests intended to confirm the effectiveness of passivation, particularly with regard to the removal of contaminant iron and other exogenous matter. These tests include the following practices:

1.4.1 *Practice A*—Water Immersion Test,
1.4.2 *Practice B*—High Humidity Test,
1.4.3 *Practice C*—Salt Spray Test,
1.4.4 *Practice D*—Copper Sulfate Test,
1.4.5 *Practice E*—Potassium Ferricyanide-Nitric Acid Test,
1.4.6 *Practice F*—Damp Cloth Test, and
1.4.7 *Practice G*—Boiling Water Immersion Test.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.6 *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.*

1.7 *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]

A380/A380M Practice for Cleaning, Descaling, Pickling, and Passivation of Stainless Steel Parts, Equipment, and Systems
A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
B117 Practice for Operating Salt Spray (Fog) Apparatus
B600 Guide for Descaling and Cleaning Titanium and Titanium Alloy Surfaces
B912 Specification for Passivation of Stainless Steels Using Electropolishing
D1193 Specification for Reagent Water
E2234 Practice for Sampling a Stream of Product by Attributes Indexed by AQL
E2910 Guide for Preferred Methods for Acceptance of Product
G48 Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution
G61 Test Method for Conducting Cyclic Potentiodynamic Polarization Measurements for Localized Corrosion Susceptibility of Iron-, Nickel-, or Cobalt-Based Alloys
G150 Test Method for Electrochemical Critical Pitting Temperature Testing of Stainless Steels and Related Alloys

[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 A01.14 on Methods of Corrosion Testing.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at 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**

2.2 *Federal Specification:*[3]

QQ-P-35C Passivation Treatments for Corrosion-Resistant Steels[4]

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of terms used in this standard, refer to Terminology A941.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *alloyed iron, n*—iron that is inherent to the composition of the alloy, especially at the metal surface where it is available to undergo oxidation.

3.2.1.1 *Discussion*—The removal of alloyed iron from the surface of stainless steel will typically enhance the corrosion resistance to some degree. "Oxidation" in the above context refers to both conversion to iron oxide on the surface (corrosion) and the removal of iron from the surface by conversion into ions released into the acid solution (passivation treatment).

3.2.2 *contaminant iron, n*—iron, especially nonstainless steel, deposited onto a metal surface from a separate and external source; also known as free iron.

3.2.2.1 *Discussion*—Contaminant iron is likely to corrode, irrespective of the properties of the substrate material. Contaminant iron that is deeply embedded in the surface is often more difficult to remove. Contaminant iron can be introduced through many routes, including, but not limited to the following: atmospheric deposition such as iron dust; use of blasting media, grinding media, fabrication equipment, or other tooling that has been used with or was in contact with nonstainless steels; contact by steel hooks, chains, forks or tools; nearby grinding or other work on nonstainless steels; residual iron salts from pickling solutions; iron deposits in welds; embedded iron; and iron oxide.

3.2.3 *passivation, n*—the chemical treatment of a stainless steel with a nitric acid or citric acid solution, or other chemical solutions or electrochemical treatments capable of producing similar results, for the purpose of the removal of any combination of contaminant iron, alloyed iron, and possibly other foreign matter from the surface, resulting in an increase of the corrosion resistance of the surface via enabling the formation of a better passive metal oxide film.

3.2.3.1 *Discussion*—In the broadest sense, passivation is any process through which a metal surface is rendered passive, which is to say, inactive and resistant to further chemical reactions, especially corrosion. The term passivation is commonly applied to several distinctly different operations or processes relating to stainless steels. In order to avoid ambiguity in the setting of requirements, it is necessary to define precisely the intended meaning of passivation in this standard. In this specification, passivation, unless otherwise specified, is defined as above. Some of the other various meanings associated with the term passivation that are in common usage include the following:

3.2.3.2 The formation of the protective passive metal oxide film on a stainless steel, also called passivation in a more general context, will occur spontaneously in air or other oxygen-containing environments when the stainless steel surface is free of oxide scale and exogenous matter. It was at one time considered that an oxidizing treatment was necessary to establish this passive metal oxide film, but it is now accepted that under this definition, stainless steels are autopassivating. The presence of exogenous surface contamination, including dirt, grease, contaminant iron from contact with steel tooling, and so forth, may interfere with the formation of the passive metal oxide film. The cleaning of these contaminants from the stainless steel surface will facilitate the spontaneous passivation by allowing the oxygen uniform access to the surface. The passive metal oxide film may be augmented by chemical treatments that provide an oxidizing environment for the stainless steel surface, for example the removal of alloyed iron from the surface, or providing a rich oxygen source to accelerate the formation of the passive metal oxide film after iron has been removed from the surface. However, such chemical treatment is generally not necessary for some formation of the passive metal oxide film.

3.2.3.3 In the case of stainless steels with additions of sulfur for the purpose of improved machinability, the removal of sulfide inclusions from the surface of the metal should also be included as part the overall passivation process, such as a pretreatment cleaning step. (See X2.5).

3.2.3.4 Chemical treatments providing a rich oxygen source, such as sodium dichromate or peroxide solutions, may facilitate the more rapid formation of the passive metal oxide film on a stainless steel surface already free of scale or foreign matter. Such treatments, also sometimes called passivation in common usage, are designated as post-cleaning treatments in this specification in order to distinguish them from chemical treatments capable of removing iron from the surface of stainless steels.

3.2.3.5 Passivation does not indicate the separate processes of descaling or pickling, although descaling or pickling may be necessary before passivation can be effective (see Practice A380/A380M). Chemical treatments capable of removing heat tint or oxide scale from stainless steel and capable of dissolving the stainless steel itself, typically called pickling, are substantially more aggressive than treatments used for passivation, as defined in 3.2.3. The surface of stainless steel that has been pickled is free of scale, contaminant iron, and exogenous foreign matter, and does not typically require a separate treatment for passivation as defined in 3.2.3. The passivation process defined in 3.2.3.2 will occur without further chemical treatment, but may be augmented and improved by the passivation treatment defined in 3.2.3 or the post-cleaning treatments defined in 3.2.3.4. A combination of pickling and passivation treatments, especially a nitric acid treatment per Section 6, can also produce brightening of the surface, but generally not with the brilliant luster obtained by polishing.

3.2.3.6 Electrochemical treatments, including electropickling and electropolishing capable of removing heat tint or oxide scale from stainless steel and capable of dissolving the stainless steel itself, are substantially more aggressive than treatments

[3] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

[4] In accordance with QQ-P-35C Notice 3, September 11, 1998, Specification QQ-P-35C is cancelled and Specification A967/A967M should be used in its place for DoD activities other than aerospace applications.