SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS2700 | REV. E

Issued 2000-03
Revised 2011-11

Superseding AMS2700D
AMS-QQ-P-35
QQ-P-35

Passivation of Corrosion Resistant Steels

RATIONALE

AMS2700E is issued to incorporate all changes approved by AMS Committee B by 28 day Limited Scope Ballot closed on 6/14/2011 and which were intended to be reflected in AMS2700D but some of which were inadvertently omitted. A complete list of each of these changes is listed in 8.17.

1. SCOPE

1.1 Purpose

This specification covers the requirements for a process to assure removal of free iron or other less noble contaminants from the surfaces of corrosion resistant steel parts.

1.2 Application

The processes defined in this specification have been used typically to dissolve tramp metallic elements from the surfaces of corrosion resistant steels to improve their corrosion resistance, but usage is not limited to such applications.

1.3 Classification

1.3.1 Methods

Passivation methods covered by this specification are as follows:

Method 1 - Passivation in Nitric Acid
Method 2 - Passivation in Citric Acid

Method 1 shall be used unless Method 2 is authorized by the cognizant engineering organization.

1.3.2 Types

The following types may be specified for Method 1:

Type 1 Low Temperature Nitric Acid with Sodium Dichromate
Type 2 Medium Temperature Nitric Acid with Sodium Dichromate
Type 3 High Temperature Nitric Acid with Sodium Dichromate
Type 4 40% Nitric Acid for Free Machining Steels

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS2700E

Type 5 Anodic, for High Carbon Martensitic Steels
Type 6 Low Temperature Nitric Acid
Type 7 Medium Temperature Nitric Acid
Type 8 Medium Temperature, High Nitric Acid Concentration

Where no type is specified, the processor may use any of the listed types that meet the requirements given herein.

1.3.3 Classes

Passivation verification classes are as follows:

1.3.3.1 Class 1

The following types of parts shall be selected for testing in accordance with 4.3.1.

1.3.3.1.1 Fasteners, including nuts, bolts, washers, rivets and related hardware where a test frequency is not defined in the procurement documents.

1.3.3.1.2 Standard parts defined by drawings labeled AN, MS, NAS or similar where frequency of test is not otherwise defined.

1.3.3.1.3 When specified by purchaser.

1.3.3.2 Class 2

Frequency of corrosion testing shall be one part per lot.

1.3.3.3 Class 3

Frequency of testing shall be on a periodic basis.

1.3.3.4 Class 4

Parts for which AMS-QQ-P-35 or QQ-P-35 is specified shall be acceptance tested in accordance with 4.3.4.

1.3.3.5 When no class is specified and neither 1.3.3.1 nor 1.3.3.4 apply, class 2 shall apply.

1.4 Safety - Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AS2390 Chemical Process Test Specimen Material

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 117 Operating Salt Spray (Fog) Testing Apparatus

ASTM D 1193 Reagent Water

3. REQUIREMENTS

3.1 Procedure

3.1.1 Passivation shall be performed only on surfaces free from water breaks and visible rust or scale. See 8.8.

3.1.2 Method 1 - Passivation in Nitric Acid

3.1.2.1 Passivation shall be accomplished by immersion in a bath in accordance with Table 1. When permitted by the cognizant engineering organization, other nitric acid solutions may be used. See 8.13.

3.1.2.2 When a specific passivation type is not specified, Table 4 may be consulted for recommended types.

TABLE 1 - METHOD 1 PASSIVATION TYPES

Type	Feature	Value
1	Bath Composition	20 to 25% by volume of HNO_3 2 to 3% by weight $Na_2Cr_2O_7 \cdot 2H_2O$
	Bath temperature	70 to 90 °F (21 to 32 °C)
	Immersion time	30 minutes minimum
2	Bath Composition	20 to 25% by volume of HNO_3 2 to 3% by weight $Na_2Cr_2O_7 \cdot 2H_2O$
	Bath temperature	120 to 130 °F (49 to 54 °C)
	Immersion time	20 minutes minimum
3	Bath Composition	20 to 25% by volume of HNO_3 2 to 3% by weight $Na_2Cr_2O_7 \cdot 2H_2O$
	Bath temperature	145 to 155 °F (63 to 68 °C)
	Immersion time	10 minutes minimum
4	Bath Composition	38 to 42% by volume of HNO_3 2 to 3% by weight $Na_2Cr_2O_7 \cdot 2H_2O$
	Bath temperature	70 to 120 °F (21 to 49 °C)
	Immersion time	30 minutes minimum
5	Bath Composition	20 to 25% by volume of HNO_3 2 to 3% by weight $Na_2Cr_2O_7 \cdot 2H_2O$
	Bath temperature	70 to 90 °F (21 to 32 °C)
	Immersion time	2 minutes minimum
	Voltage	Part anodic at 3 to 5 volts
6	Bath Composition	25 to 45% by volume HNO_3
	Bath temperature	70 to 90 °F (21 to 32 °C)
	Immersion time	30 minutes minimum
7	Bath Composition	20 to 25% by volume HNO_3
	Bath temperature	120 to 140 °F (49 to 60 °C)
	Immersion time	20 minutes minimum
8	Bath Composition	45 to 55% by volume HNO_3
	Bath temperature	120 to 130 °F (49 to 54 °C)
	Immersion time	30 minutes minimum

NOTE: Nitric acid concentration shown is by volume of 42° Baume (sp. gr. 1.4) nitric acid. See 8.12.

3.1.3 Method 2 - Passivation in Citric Acid

3.1.3.1 Bath Composition

Parts shall be immersed in an aqueous solution of 4 to 10 weight percent citric acid, with additional wetting agents and inhibitors as applicable.

3.1.3.2 Operating Conditions

3.1.3.2.1 Temperature

Bath temperature shall be 70 to 160 °F (21 to 71 °C) with an immersion time of not less than 4 minutes for baths operating over 140 °F (60 °C), not less than 10 minutes for baths operating in the 120 to 140 °F (49 to 60 °C) range, not less than 20 minutes for baths operating in the range of 100 to 119 °F (38 to 48 °C) or not less than 30 minutes for baths operating below 100 °F (38 °C).

3.1.4 Final Rinse

Immediately after removal from the passivating solution the parts shall be thoroughly rinsed. Final rinse shall be carried out in clean water. See 8.14.

3.1.5 Post Treatment

When a post treatment is specified, after rinsing, parts made from ferritic, martensitic and precipitation hardening steels shall be immersed in a solution containing 4 to 6% by weight of sodium dichromate dihydrate ($Na_2Cr_2O_7 \cdot 2H_2O$) at 140 to 160 °F (60 to 71 °C) for 1 hour, rinsed, and dried. See 8.2.

3.2 Properties

3.2.1 Corrosion Resistance

Except for parts containing 0.85% carbon or more (such as AISI 440C), parts shall meet one of the following conditions, or, when specified, a test method in Appendix A.

3.2.1.1 Humidity

Parts shall be free from visible red rust after exposure to 95% minimum relative humidity at 100 to 115 °F (38 to 46 °C) for not less than 24 hours.

3.2.1.2 Water Immersion

Parts shall be free from visible red rust after alternately immersing in reagent water (ASTM D 1193 Type IV) for 1 hour and allowing to dry in room temperature air for 1 hour, until 24 hours (12 cycles) have elapsed. See 8.15.

3.2.1.3 When specified or when permitted by the cognizant engineering organization, (1) for austenitic steels of the AISI 200 or AISI 300 series and (2) for precipitation hardened steels and ferritic steels containing more than 16% chromium, one of the following requirements shall be met in lieu of humidity or immersion testing:

3.2.1.3.1 Copper Sulfate Test

Parts shall be swabbed with or immersed in a test solution containing 8 grams of copper sulfate ($CuSO_4 \cdot 5H_2O$) and 2 to 3 milliliters of sulfuric acid (H_2SO_4, sp. gr. 1.84) in 500 milliliters of reagent water in accordance with ASTM D 1193 Type IV, keeping the surface wet for not less than 6 minutes. Rinse and dry the surface without disturbing any deposits. A copper colored deposit indicates the presence of unacceptable free iron. The effectiveness of copper sulfate solutions shall be validated by one of the following methods:

a. Periodic chemical analysis in accordance with 4.2.2.1

b. Verification before use. Test specimens of any convenient size, made from materials in accordance with AS2390 representing transformation hardening steels and properly cleaned, shall exhibit a copper-colored deposit when subjected to the test above.

3.2.1.3.2 Salt Spray

Parts shall withstand exposure to 2 hours minimum in a salt spray environment operated in accordance with ASTM B 117. Parts shall not show evidence of red rust following completion of the test.

3.2.2 Surface Appearance

After completion of processing, there shall be no evidence of etching, pitting, smutting, frosting, dimensional changes, or other chemical attack on the parts. However, loss of temper color when Method 2 is used is acceptable.

3.3 Written Procedure

All processing and testing shall be done in accordance with a written procedure acceptable to the cognizant engineering organization. See 4.4.3.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The processor shall supply all test specimens for processor's tests and shall be responsible for the performance of all required tests. When parts are to be tested, such parts shall be supplied by purchaser, and, if acceptable after testing, may be included with the lot of processed parts. The cognizant engineering organization reserves the right to perform any confirmatory testing deemed necessary to ensure that processing conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

4.2.1.1 Classes 1, 2 and 4

Corrosion resistance (3.2.1) and surface appearance (3.2.2) are acceptance tests and shall be performed on each lot.

4.2.1.2 Class 3

Surface appearance (3.2.2) is an acceptance test and shall be performed on each lot.

4.2.2 Periodic Tests

4.2.2.1 Compositions of passivating and post treatment solutions are periodic tests, and shall be performed at a frequency selected by the processor unless frequency of testing is specified by the cognizant engineering organization. See 8.9

4.2.2.2 Class 3 Parts

Corrosion resistance is a periodic test and shall be performed at a frequency selected by the processor unless frequency of testing is specified by the cognizant engineering organization.

4.2.3 Preproduction Tests

All technical requirements (3.2 and 3.3) of this specification are preproduction tests, and shall be performed prior to production and when the cognizant engineering organization deems confirmatory testing is required.

4.3 Sampling for testing shall not be less than the following: A lot shall be all parts of the same part number, processed in the same set of solutions within a 24 hour period, and presented for processor's inspection at the same time. Tested parts shall be selected randomly from all parts in each lot.

4.3.1 Class 1 Parts

Unless the cognizant engineering organization specifies a different sampling plan, the minimum number of samples selected for test shall be as shown in Table 2.

TABLE 2 - NUMBER OF PARTS TO BE TESTED

Number of Parts in Lot			Surface Appearance	Corrosion Test
1	to	6	All	2
7	to	15	7	2
16	to	40	10	3
41	to	50	15	3
51	to	110	15	5
111	to	150	25	8
151	to	500	35	8
501	to	700	50	13
701	to	1200	75	13
Over		1200	125	13

4.3.2 Class 2 parts or samples shall be corrosion tested at a frequency of one part per lot, and visually examined at the frequency given in Table 2.

4.3.3 Where parts are not available for test, as in the case of large parts or parts that might be damaged by such testing, identically processed specimens fabricated from the same alloy as the parts represented may be used. See 8.10.

4.3.4 Class 4 parts or samples shall be tested as shown in Table 3.

TABLE 3 - NUMBER OF PARTS TO BE TESTED FOR CLASS 4

Number of Parts in Lot (1)	Surface Appearance	Corrosion Test (2)
1 to 13	All	All
14 to 1200	13	13
1201 to 35 000	50	13
35 001 to 500 000	80	50

(1) For Class 4, a lot shall consist of one of the following:
a) Parts of similar alloy and manufacturing methods that are pretreated and passivated in one day's production or within a timeframe which will ensure consistent passivation results.
b) The same product of one size from one heat in one shipment.
c) When the quantity of passivated parts in one day's production does not warrant daily testing, the lot size shall be as agreed upon by the cognizant engineering organization and the processor.

(2) Identically processed specimens, made from the same alloys used to fabricate the parts, may be used for test purposes. The test specimens shall be randomly distributed throughout the lot during processing. When multiple tests are to be performed, separate samples are required for each test.

4.4 Approval

4.4.1 The process and control procedures, or a preproduction processed part, or both, whichever is specified, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 If the processor makes a significant change to any material, process or control factor which was used for process approval, all preproduction tests shall be performed and the results submitted to the cognizant engineering organization for process reapproval unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, could affect the properties or performance of the parts.

4.4.3 Control factors shall include, but are not limited to the following:

Composition and composition limits of the processing solutions
Temperature and temperature limits of the processing solutions
Immersion time limits of the process for each processing solution
Method(s) for precleaning in preparation for passivating. See 3.1.1.
Method(s) used to test for corrosion resistance
Periodic test plan. See 8.9.

4.5 Reports

The processor shall furnish with each shipment a report stating that parts have been processed and tested in accordance with the specified requirements and that they conform to acceptance tests requirements. Where post treatment is used, the report shall so indicate that it was completed. The report shall state the class, method, and, if applicable, type of passivation used. This report shall also include the purchase order number, lot number, AMS2700E, part number, and quantity of parts processed.

4.6 Resampling and Retesting

4.6.1 If any part subjected to the surface appearance testing fails to meet surface appearance requirements, that part shall be subject to rejection, and all parts in the lot shall be visually examined for conformance to surface appearance requirements or subject to rejection.

4.6.2 If any part subjected to corrosion testing fails to meet corrosion test requirements, that part shall be subject to rejection. The balance of the lot may be reprocessed and retested at the frequency defined by Table 2 for the original number of parts in the lot, or the remaining parts in the lot shall be tested.

5. PREPARATION FOR DELIVERY

Packages of passivated parts shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the processed parts.

6. ACKNOWLEDGMENT

A processor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS

Parts that are not processed in accordance with the requirements of this specification or to modifications authorized by the cognizant engineering organization will be subject to rejection.

8. NOTES

8.1 A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

8.2 When post treatment is not specified, parts should be neutralized, preferably in a solution of 2 to 5% sodium hydroxide, rinsed and dried.

8.3 Terms used in AMS are clarified in ARP1917.

8.4 Dimensions and properties in inch-pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as approximate equivalents of the primary units and are presented only for information.

8.5 Purchase documents should specify not less than the following:

AMS2700E
Material being processed
Quantity of parts to be processed
Method (1.3.1), type (1.3.2) if required, or class (1.3.3)
Test method in Appendix A, if required
Post treatment when required. See 3.1.6.

8.6 These processes have been used primarily to enhance the corrosion resistance of corrosion resistant steel alloys, but the nitric acid process has also been successfully and historically applied to nickel-chromium high temperature alloys for removal of free iron resulting from machining or other processing. Different types of smeared metal on the corrosion resistant surfaces, or the presence of other surface treatments such as plating or braze filler metals may dictate the use of either nitric acid or citric acid as applicable to the specific case.

8.7 It is recommended that this process be used prior to heating corrosion resistant steel parts to temperatures exceeding 1200 °F (649 °C) to prevent diffusion of free iron from the surface into the surfaces of parts.

8.8 This document does not address methods for removal of scale or foreign materials from the surfaces of parts prior to passivation. Methods for accomplishing this may be found in such other documents as ISO 8074, ISO 8075 or ASTM A 380.

8.9 ARP4992, Periodic Test Plan for Process Solutions, is recommended to satisfy the requirements for control of processing solutions.

8.10 "Identically processed" as used in 4.3.3 refers to such operations as machining, grinding, heat treating, welding, and similar processes.

8.11 Carburized and nitrided surfaces should not be passivated. Passivating should be accomplished after completion of all manufacturing operations, such as but not limited to forming, turning, milling, heat treatment or shot peening, that could affect the passivity of the surface of the material. Where other surface altering operations are performed, such as electroplating or nitriding, purchaser should specify when the passivation operation is accomplished within the manufacturing sequence.

8.12 Solutions may be made up and maintained with nitric acid at other than the specified 42° Baume if the concentration is adjusted to compensate.

8.13 Guidelines for alternative passivation solutions that may be useful to the cognizant engineering organization are as follows.

8.13.1 Bath Composition

Passivation may be accomplished by immersion in a bath of an aqueous solution of 20 to 55% by volume of 42° Baume (sp. gr. 1.4) nitric acid (HNO_3). See 8.12.

8.13.1.1 It is recommended that the concentration of the nitric acid be above 40% for free machining steels.

8.13.1.2 Where the acid concentration is less than 35% by volume, and for ferritic and martensitic steels, it is recommended that additional oxidizers be added to the bath in the form of 2 to 6% by weight of sodium dichromate dihydrate ($Na_2Cr_2O_7 \cdot 2H_2O$).

8.13.1.3 For the purpose of removing lead alloys from surfaces, molybdic acid ($HMoO_3$) may be added to the bath at a concentration of up to 0.35 weight percent.

8.13.2 Operating Conditions

Bath temperature should be in the range of 70 to 155 °F (21 to 68 °C) with an immersion time of not less than 30 minutes for baths operating at temperatures below 100 °F (37 °C), not less than 20 minutes for baths operating at temperatures below 125 °F (52 °C), or not less than 10 minutes for baths operating at temperatures above 125 °F (52 °C).

8.13.3 For certain high carbon corrosion resistant steels, such as AISI 440C, it may be desirable to passivate with the parts anodic for 2 to 3 minutes at 2 to 3 volts to prevent etching.

8.14 It has been found that water containing up to 200 ppm total dissolved solids may be considered to be clean but this limit is not a requirement. Rinsing may be accomplished with stagnant, countercurrent and/or spray rinses prior to final rinse.

8.15 Type IV grade of reagent water may be prepared by distillation, ion exchange, continuous electrodeionization, reverse osmosis, electrodialysis, or a combination thereof. Reagent water prepared by distillation may give more consistent results in the water immersion test compared to other preparation methods.

8.16 It has been found that iron concentration in the passivating solution exceeding 2 weight percent may reduce the ability to remove iron contamination from parts.

8.17 Cumulative changes made to Revisions C and D:

8.17.1 Paragraph 3.1.2.2 was "Iron concentration in passivating baths shall not exceed 0.5 percent." This was deleted and moved, with a change to a recommended 2 percent maximum, to 8.16. Reason: Performance tests demonstrate solution effectivenesss regardless of iron content. This was not considered to be a technical change.

8.17.2 "minimum" was added to Table 1 for Type 8 value to correct an omission.

8.17.3 Paragraphs 3.1.4 and 3.1.5 were paragraphs 3.1.3.2.2 and 3.1.3.2.3 respectively.

8.17.4 Paragraph 3.2.1.3.1, "or immersed in" a test solution was added so as not to restrict the test to use of a swab. Last sentence "Aqueous copper sulfate solutions more than two weeks old shall not be used for this test" was deleted and replaced with "The effectiveness of copper sulfate solutions shall be validated by one of the following methods:

a. Periodic chemical analysis in accordance with 4.2.2.1

b. Verification before use. Test specimens of any convenient size, made from materials in accordance with AS2390 representing transformation hardening steels and properly cleaned, shall exhibit a copper-colored deposit when subjected to the test above."

Reason: The two week age limit was too restrictive and a functional verification more appropriate. Para 2.1 was added to include AS2390.

8.17.5 Table 2 column 1 "41 to 51" was changed to "41 to 50" to correct an error.

TABLE 4 - RECOMMENDED PASSIVATION SOLUTIONS

Alloy	Method 1 Nitric Acid Type								Method 2 Citric Acid Solution
	1	2	3	4	5	6	7	8	
Austenitic									
S20100 (201)	X	X	X			X	X		X
S20200 (202)	X	X	X			X	X		X
S21800 (Nitronic 60®)	X	X	X			X	X		
S21900(Nitronic 40®)	X	X	X			X	X		
S30100 (301)	X	X	X			X	X		X
S30200 (302)	X	X	X			X	X		X
S30400 (304)	X	X	X			X	X		X
S30403 (304L)	X	X	X			X	X		X
S30409 (304H)	X	X	X			X		X	X
S30430 (302HQ)	X	X	X			X	X		X
S30451 (304N)	X	X	X			X	X		X
S30500 (305)	X	X	X			X	X		X
S30800 (308)	X	X	X			X	X		X
S30900 (309)	X	X	X			X	X		X
S30908 (309S)	X	X	X			X	X		X
S30940 (309Cb)	X	X	X			X	X		X
S3100 (310)	X	X	X			X	X		X
S31008 (310S)	X	X	X			X	X		X
S31100 (311)	X	X	X			X	X		X
S31400 (314)	X	X	X			X	X		X
S31500 (315)	X	X	X			X	X		X
S31600 (316)	X	X	X			X	X		X
S31603 (316L)	X	X	X			X	X		X
S31609 (316H)	X	X	X			X		X	X
S32100 (321)	X	X	X			X	X		X
S32109 (321H)	X	X	X			X		X	X
S32900 (329)	X	X	X			X	X		X
S34700 (347)	X	X	X			X	X		X
S34709 (347H)	X	X	X			X		X	X
Ferritic									
S40500 (405)	X	X	X					X	X
S40900 (409)	X	X	X					X	X
S42900 (429)	X	X	X				X	X	X
S43000 (430)	X	X	X				X		X
S43400 (434)	X	X	X				X		X
S43600 (436)	X	X	X				X		X
S44200 (442)	X	X	X				X		X
S44600 (446)	X	X	X				X		X
S44625 (XM-27)	X	X	X				X		X
Free Machining									
S30300 (303)		X		X					X
S30310 (303X)		X		X					X
S30323 (303Se)		X		X					X
S30330 (303Cu)		X		X					X
S30345 (303MA)		X		X					X
S30360 (303Pb)		X		X					X
S34720 (347S)		X		X					X
S34723 (347Se)		X		X					X
S43020 (430F)		X		X					X
S43023 (430FSe)		X		X					X
S44020 (440F)		X		X					X
S44023 (440FSe)		X		X					X

TABLE 4 - RECOMMENDED PASSIVATION SOLUTIONS (CONTINUED)

Alloy	Method 1 Nitric Acid Type								Method 2 Citric Acid Solution
	1	2	3	4	5	6	7	8	
Martensitic									
S40300 (403)	X	X	X					X	X
S41000 (410)	X	X	X	X				X	X
S41400 (414)	X	X	X	X				X	X
S41600 (416)	X	X	X	X					X
S41623 (416Se)	X	X	X	X					X
S41800(Greek Ascoloy)		X						X	
S42000 (420)	X	X	X						X
S43100 (431)	X	X	X					X	X
S44002 (440A)		X			X			X	X
S44003 (440B)		X			X			X	X
S44004 (440C)		X			X			X	X
Precipitation Hardening									
K66286 (A286)	X	X	X					X	X
S13800 (13-8Mo)	X	X	X					X	X
S15500 (15-5)	X	X	X					X	X
A15700 (15-7Mo)	X	X	X					X	X
S17400 (17-4)	X	X	X					X	X
S17700 (17-7)	X	X	X					X	X
S35000 (AM350)	X	X	X					X	X
S35500 (AM355)	X	X	X					X	X
S36200 (Almar 362)	X	X	X					X	X

PREPARED BY AMS COMMITTEE "B"

APPENDIX A - TEST METHODS FOR DETERMINATION OF PASSIVITY

A.1 SCOPE

The test methods in this appendix are to be used only when specified by the purchaser.

A.1.1 Safety - Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this appendix may involve the use of hazardous materials, this appendix does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

A.2 APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

A.2.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 117 Operating Salt Spray Testing Apparatus

A.2.2 ASQ Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203 or www.asq.org.

ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes

A.3 TEST REQUIREMENTS

A.3.1 Method 100 - Water Immersion Test

This method is used to detect anodic surface contamination, including free iron, on corrosion resistant steel.

A.3.1.1 Apparatus and Materials

A tank that will not rust and reagent grade water.

A.3.1.2 Procedure

A.3.1.2.1 Parts shall be alternately immersed in reagent grade water for one hour, removed from the tank, and allowed to dry for one hour for a minimum of 24 hours.

A.3.1.2.2 After completion of the test, parts shall show no evidence of rust or corrosion.

A.3.2 Method 101 - High Humidity Test

This method is used to detect anodic surface contamination on corrosion resistant steel, including free iron.

A.3.2.1.1 Apparatus and Materials

A humidity cabinet capable of maintaining the conditions specified herein.

A.3.2.2 Procedure

A.3.2.2.1 Parts shall be placed in a humidity cabinet and exposed to 97% ± 3 relative humidity at 100 °F ± 5 (38 °C ± 3) for 24 hours minimum.

A.3.2.2.2 After completion of the test, parts shall show no evidence of rust or corrosion.

A.3.3 Method 102 - Copper Sulfate Test

This method is recommended to detect the presence of free iron on the surface of austenitic chromium-nickel steels of the AISI 200 and 300 series alloys, precipitation hardened types, and ferritic AISI 400 series alloys having a minimum of 16% chromium. It is not recommended for use on martensitic AISI 400 series alloys or ferritic AISI 400 series alloys with less than 16% chromium because the test will be positive for presence of iron. The test is sensitive and should be used and interpreted only by personnel familiar with its limitations. The test should not be used on parts to be used for food processing.

A.3.3.1 Apparatus

10 milliliters graduated cylinder
500 milliliters graduated cylinder
1000 milliliters beaker
Cotton swab
Balance or scale

A.3.3.2 Materials

Copper sulfate ($CuSO_4 \cdot 5H_2O$)
Reagent grade water
Sulfuric acid (specific gravity 1.84)

A.3.3.3 Procedure

A.3.3.3.1 Prepare the test solution as follows:

Dissolve approximately 8 grams of copper sulfate in approximately 500 milliliters of reagent water to which 2 to 3 milliliters of sulfuric acid have been added.

A.3.3.3.2 Aqueous copper sulfate solution prepared more than 2 weeks before use shall not be used for this test.

A.3.3.3.3 Swab the surface to be tested with the test solution and keep the surface wetted for approximately 6 minutes. Apply additional solution as needed during the test period to keep the surface wet.

A.3.3.3.4 Carefully rinse the surface and dry being careful not remove any copper that may have deposited.

A.3.3.3.5 The presence of a copper deposit indicates that metallic iron was present.

A.3.4 Method 103 - Potassium Ferricyanide Test

This method is recommended to detect the presence of very small amounts of free iron on the surface of austenitic chromium-nickel steels of the AISI 200 and 300 series alloys but it is not recommended for use on martensitic AISI 400 series alloys or ferritic AISI 400 series alloys because the test will provide a false positive for presence of iron. The test is extremely sensitive and should be used and interpreted only by personnel familiar with its limitations. The test should not be used on parts to be used for food processing.

A.3.4.1 Apparatus

50 milliliters graduated cylinder
500 milliliters graduated cylinder
1000 milliliters beaker
Cotton swab
Stirring rod, flat ended
Balance or scale

A.3.4.2 Materials

Potassium ferricyanide, C.P.
Reagent grade water
Nitric acid, 70%, C.P.
Acetic acid, 10%
Oxalic acid, 8%

A.3.4.3 Procedure

A.3.4.3.1 Prepare the test solution as follows:

Dissolve approximately 10 grams of potassium ferricyanide in approximately 500 milliliters of reagent water in a 1000 milliliter beaker. Add approximately 30 milliliters of nitric acid and stir until the solid is dissolved. Dilute to 1000 milliliters with reagent water.

A.3.4.3.2 Test solution must be prepared the day of the test as it will change color on standing.

A.3.4.3.3 Swab the surface to be tested with the test solution. Formation of a dark blue color within 30 seconds indicates presence of metallic iron.

A.3.4.3.4 When the test is negative, rinse the surface thoroughly with warm water to remove the test solution. When the test is positive, the dark blue stain shall be removed by exposure to the acetic acid solution followed by the oxalic acid solution, and a thorough hot water rinse.

A.3.5 Method 104 - Salt Spray Test

This method is used to detect anodic surface contamination, including free iron, on corrosion resistant steel.

A.3.5.1 Apparatus and materials shall be as specified in ASTM B 117.

A.3.5.2 Procedure

A.3.5.2.1 Parts shall show no visual evidence of corrosion after being subjected to salt spray in accordance with ASTM B 117 for 2 hours minimum.

A.3.5.2.2 After completion of the test, parts shall show no evidence of rust or corrosion.

A.4 QUALITY ASSURANCE PROVISIONS

The processor shall supply all test specimens and shall be responsible for the performance of all required tests. When parts are to be tested, such parts shall be supplied by purchaser, and, if acceptable after testing, may be included with the lot of processed parts. Purchaser reserves the right to perform any confirmatory testing deemed necessary to ensure that processing conforms to specified requirements.

A.4.1 Sampling and Testing

A lot shall be all parts of the same part number, processed in the same set of solutions within a 24 hour period, and presented for processor's inspection at the same time. Tested parts shall be selected randomly from all parts in each lot. Unless otherwise specified, the number of parts tested shall be in accordance with ASQC Z1.4, Inspection Level S-4 with an acceptable quality level (AQL) of 1.0% defective.

A.4.2 Reports

The testing facility shall furnish with each shipment a report stating that the parts have been tested and conform to the specified requirements. This report shall include the purchase order number, part number, lot number, quantity of parts in the lot, quantity of parts tested, test method used, AMS2700E Appendix A, and name and address of testing facility.

A.4.3 Resampling and Retesting

If any part subjected to corrosion testing fails to meet test requirements, that part shall be subject to rejection. The balance of the lot may either be recleaned or repassivated as applicable, and tested in accordance with ASQC Z1.4 Inspection Level S-4, AQL 1.0% for that lot, or the remaining parts in the lot shall be corrosion tested.

A.5 PREPARATION FOR DELIVERY

Packages of passivated and tested parts shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the processed parts.

A.6 ACKNOWLEDGMENT

A processor shall mention this specification number and its revision letter and Appendix A in all quotations and when acknowledging purchase orders.

A.7 REJECTIONS

Parts not meeting the test requirements of this appendix, or to modifications authorized by purchaser, will be subject to rejection.

A.8 NOTES

A.8.1 A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

A.8.2 The test methods and test frequencies shown in this appendix are taken from, and are interchangeable with those in AMS-STD-753 and MIL-STD-753C.

A.8.3 Terms used in AMS are clarified in ARP1917.

A.8.4 Dimensions and properties in inch-pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as approximate equivalents of the primary units and are presented only for information.

A.8.5 Purchase documents should specify not less than the following:

AMS2700E Appendix A
Quantity of parts in the lot
Test method.