SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS2481 | REV. J

Issued 1946-11
Reaffirmed 2006-04
Revised 2010-02

Superseding AMS2481H

Phosphate Treatment Antichafing

RATIONALE

AMS2481J was issued to remove mandatory chromic acid post treatment which was not required in rev. G.

NOTICE

ORDERING INFORMATION: The following information shall be provided to the plating processor by the purchaser.

1) Purchase order shall specify not less than the following:

- AMS2481J
- Basis metal to be treated
- Tensile strength or hardness of the basis metal
- Pretreatment stress relief to be performed by processor (time and temperature) if different from 3.1.1
- Special features, geometry, or processing present on parts that requires special attention by the processor
- Hydrogen embrittlement relief to be performed by the processor if different from 3.3.2
- Quantity of pieces to be treated

2) Parts manufacturing operations such as heat treating, forming, joining and media finishing can affect the condition of the substrate for coating, or if performed after coating, could adversely affect the plated part. The sequencing of these types of operations should be specified by the cognizant engineering organization or purchaser and is not controlled by this specification.

1. SCOPE

1.1 Form

This specification covers the requirements for a manganese phosphate coating on ferrous alloys.

1.2 Application

This process has been used typically to produce a coating that will minimize chafing of contacting steel surfaces and retain an oil film, but usage is not limited to such applications.

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/AMS2481J

1.3 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 that 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.

AMS2759/9 Hydrogen Embrittlement Relief (Baking) of Steel Parts

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 F 519 Test Method for Mechanical Hydrogen Embrittlement Evaluation of Plating Processes and Service Environments

3. TECHNICAL REQUIREMENTS

3.1 Preparation

3.1.1 Steel parts having a hardness of 40 HRC or higher and that have been ground, cold formed, or cold straightened after heat treatment shall be cleaned to remove surface contamination and stress relieved before preparation for coating. Temperatures to which parts are heated shall be such that maximum stress relief is obtained without reducing hardness of parts below drawing limits, but, unless otherwise specified, the stress relief shall be not less than 275 °F (135 °C) for not less than 5 hours for parts having hardness of 55 HRC or higher or not less than 375 °F (191 °C) for not less than four hours for other parts. If a higher stress relief temperature is selected, it shall not exceed 50 Fahrenheit degrees (28 Celsius degrees) below the tempering temperature of the basis metal for a minimum of one hour per inch of thickness.

3.1.2 The phosphate coating shall be applied over a surface free from waterbreaks. The cleaning procedure shall not produce pitting or intergranular attack of the basis metal and shall preserve dimensional requirements.

3.2 Procedure

Parts shall be coated by immersing in a balanced manganese acid phosphating solution containing a suitable accelerating agent. The solution shall be maintained at the proper temperature and parts shall be held in contact with the solution for sufficient time to form a uniform, insoluble, crystalline manganese phosphate coating meeting the requirements of 3.4. Parts shall then be immediately rinsed in cold, running water.

3.3 Post Treatment

3.3.1 Post Treatment

After rinsing, parts shall be immersed in hot water. See 8.6. Parts shall be thoroughly dried unless a water-displacing oil is used for protection of parts in which case, drying may be omitted. Dried parts shall be oiled with a suitable corrosion-inhibiting oil.

3.3.1.1 The application of a water displacing oil or other corrosion inhibiting oil shall follow the hydrogen embrittlement relief bake (3.3.2), if baking is required.

3.3.2 Hydrogen Embrittlement

After phosphate coating and chromic acid dip, treatment of steel parts having a hardness of 40 HRC or higher shall be in accordance with AMS2759/9, except that parts shall be baked at 210 to 225 °F (99 to 107 °C) for 8 hours.

3.4 Properties

The coating shall conform to the following requirements:

3.4.1 Appearance

Coated parts shall have a uniform, usually grayish-black, finely-crystalline appearance prior to post-treatment.

3.4.2 The coating process after baking shall not cause hydrogen embrittlement in steel parts 40 HRC and over determined in accordance with 4.3.4 unless a different specimen type and/or method is specified by the cognizant engineering organization.

3.4.3 Phosphate Coating Weight

Unless otherwise specified, shall be 1500 mg/ft^2 minimum, determined using the differential weight method in accordance with the following relationship, using equation 1.

$$\text{Coating Weight} = \frac{\text{Coated Specimen Weight} - \text{Stripped Specimen Weight}}{\text{Total Coated Area}} \quad \text{(Eq. 1)}$$

Stripping of coating shall be accomplished using a nominal 5% chromic acid solution at 165 °F ± 10 (74 °C ± 6) or by a room temperature solution of 180 grams of sodium hydroxide and 90 grams of sodium cyanide per liter of water. Repeat the stripping operation until no further weight loss is found.

3.5 Quality

Surfaces of treated parts, as received by purchaser, shall be uniform in texture and appearance. Powdery areas, excessive buildup, and darkening of corners and edges are not acceptable.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The processor shall supply all specimens for processor's tests and shall be responsible for the performance of all required tests. Where parts are to be tested, such parts shall be supplied by purchaser. The cognizant engineering organization reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that processing conforms to the specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Appearance (3.4.1) and quality (3.5) are acceptance tests and shall be performed on parts, or specimens representing parts when permitted herein, each lot. See 4.3.3.

4.2.2 Periodic Tests

Coating weight (3.4.3) is a periodic test and shall be performed at least monthly unless frequency of testing is specified by the cognizant engineering organization. Hydrogen embrittlement (3.4.2) is a periodic test and shall be performed at least once in each month that steel parts 40 HRC and over are coated unless frequency of testing is specified by the cognizant engineering organization. Tests of cleaning and coating solutions are periodic tests and shall be performed at a frequency established by the processor unless frequency of testing is specified by the cognizant engineering organization. See 4.4.3 and 8.5.

4.2.3 Preproduction Tests

All property verification tests (Section 3.4) are preproduction tests and shall be performed prior to or on the initial shipment of coated parts to a purchaser and when the cognizant engineering organization deems confirmatory testing to be required.

4.3 Sampling for Testing

4.3.1 Acceptance Tests

Acceptance test samples shall be randomly selected from all parts in the lot. A lot shall be all parts of the same part number, processed in a continuous series of operations (3.1 through 3.3), in not longer than 8 consecutive hours, and presented for processor's inspection at one time. Unless the cognizant engineering organization provides a sampling plan, the minimum number of samples shall be as shown in Table 1.

TABLE 1 - Acceptance Test Sampling

Number of Parts in Lot	Appearance and Quality
Up to 6	All or 3*
7 to 15	7
16 to 40	10
41 to 110	15
111 to 300	25
301 to 500	35
501 to 700	50
701 to 1200	75
Over 1200	125

*Whichever is less

4.3.2 Periodic Tests

Sample quantity shall be one unless otherwise specified by the cognizant engineering organization. For hydrogen embrittlement, sample quantity shall be as specified in ASTM F 519 unless otherwise specified by the cognizant engineering organization.