# AEROSPACE MATERIAL SPECIFICATION

| AMS2402™ | REV. L |
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| Issued 1942-12<br>Revised 2019-01<br><br>Superseding AMS2402K | |

Plating, Zinc

RATIONALE

AMS2402L results from a Five-Year Review and update of this specification with changes to ordering information, stress relief treatment (3.1.2), base metal strike (3.2.1.1), plate thickness (3.4.1), acceptance tests (4.2.1), periodic tests (4.2.2), sampling for acceptance tests (Table 2), periodic tests and preproduction tests (4.3.2), adhesion testing (4.3.3.3), and approval (4.4.2).

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:

- AMS2402L
- Plating thickness desired; see 3.4.1.
- Basis metal to be plated
- Tensile strength or hardness of the basis metal (applies to steel alloys only)
- Pre-plate stress relief to be performed by plating processor (time and temperature) if different from 3.1.2
- Special features, geometry or processing present on parts that require special attention by the plating processor
- Hydrogen embrittlement relief to be performed by plating processor (parameters or reference document) if different from 3.3
- Minimum thickness on internal surfaces, if required; see 3.4.1.4
- Periodic testing frequency and sample quantity, if different from 4.2.2 and 4.3.2
- Whether approval is based on approval of process/control factors or sample part or both; see 4.4.1
- Quantity of pieces to be plated
- Permissible electrical contact locations, if not specified; see 3.1.4



**TO PLACE A DOCUMENT ORDER:** **Tel: 877-606-7323 (inside USA and Canada)**
**Tel: +1 724 776 4970 (outside USA)**

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**http://www.sae.org/technical/standards/AMS2402L**

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2) Parts manufacturing operations such as heat treating, forming, joining and media finishing can affect the condition of the substrate for plating, or if performed after plating, 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. Unless otherwise specified by the cognizant engineering organization, high strength steel parts having a hardness of HRC 45 or greater shall not be electroplated.

## 1. SCOPE

### 1.1 Purpose

This specification covers the requirements for electrodeposited zinc plating.

### 1.2 Application

This process has been used typically to provide corrosion resistance to metal parts, but usage is not limited to such applications.

1.2.1 Unless otherwise stated on the engineering drawing, high strength steel parts having a hardness of HRC 45 or greater shall not be electroplated to this document (see 8.8).

### 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 +1 724-776-4970 (outside USA), www.sae.org.

AMS2750 Pyrometry

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

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

ARP4992 Periodic Test for Process Solutions

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 B117 Operating Salt Spray (Fog) Apparatus

ASTM B253 Preparation of Aluminum Alloys for Electroplating

ASTM B374 Terminology Relating to Electroplating

ASTM B487 Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of Cross Section

ASTM B499 Measurement of Coating Thicknesses by the Magnetic Method; Nonmagnetic Coatings on Magnetic Basis Metals

ASTM B504 Measurement of Thickness of Metallic Coatings by the Coulometric Method

ASTM B555 Measurement of Electrodeposited Metallic Coating Thicknesses by Dropping Test

ASTM B567 Measurement of Coating Thickness by the Beta Backscatter Method

ASTM B568 Measurement of Coating Thickness by X-Ray Spectrometry

ASTM B571 Qualitative Adhesion Testing of Metallic Coatings

ASTM E376 Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods

ASTM F519 Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments

3. TECHNICAL REQUIREMENTS

3.1 Preparation

3.1.1 Parts shall be within drawing dimension limits before plating, except as specified in 3.1.1.1.

3.1.1.1 Parts having part numbers with the prefix MA, AN, MS, or AS or parts where the drawing specifies dimensions apply after plating shall be made to such dimensions that parts will be within drawing limits after plating. Undercutting before plating shall not be permitted unless specifically authorized by specifications referenced or the applicable drawing.

3.1.2 Stress Relief Treatment

All steel parts having a hardness of HRC 36 and above (and less than HRC 45) and that are machined, ground, cold formed or cold straightened after heat treatment shall be cleaned to remove surface contamination and thermally stress relieved before plating for relief of residual tensile stresses. (Residual tensile stresses have been found to be damaging during electrofinishing.) Furnaces used for stress relief shall be controlled per AMS2750; the minimum requirements shall be Class 5 and Type D Instrumentation. Temperatures to which parts are heated shall be such that maximum stress relief is obtained while still maintaining hardness of parts within drawing limits. Unless otherwise specified, the following treatment temperatures and times shall be used:

3.1.2.1 For parts, excluding nitrided parts, having a hardness of HRC 55 and above, including carburized and induction hardened parts, stress relieve at 275 °F ± 25 °F (135 °C ± 14 °C) for 5 to 10 hours.

3.1.2.2 For parts having a hardness less than HRC 55, stress relieve at 375 °F ± 25 °F (191 °C ± 14 °C) for a minimum of 4 hours. Nitrided parts fall into this category. Higher temperatures shall be used only when specified or approved by the cognizant engineering organization.

3.1.2.3 For peened parts, if stress relief temperatures above 375 °F (191 °C) are elected, the stress relieve shall be performed prior to peening or the cognizant engineering organization shall be consulted and shall approve the stress relief temperature.

3.1.3 The plating shall be applied over a surface free from water breaks. The cleaning procedure shall not produce pitting or intergranular attack of the basis metal and shall preserve dimensional requirements.

3.1.4 Except for barrel plating, electrical contact points shall be as follows. For parts that are to be plated all over, location shall be acceptable to purchaser. For parts that are not to be plated all over, location shall be in areas on which plating is optional.

3.1.5 Aluminum alloys shall be zincate treated prior to plating in accordance with ASTM B253 or other method permitted by the cognizant engineering organization.

3.2 Procedure

3.2.1 Except as noted, the zinc shall be deposited directly on the metal surface from a suitable zinc plating solution.

3.2.1.1 Nickel or cobalt alloys, corrosion resistant steels and aluminum may be given a nickel or other suitable metal strike prior to zinc plating.

3.2.2 After rinsing in water and without allowing the parts to dry, unless otherwise specified, plated parts shall be chemically treated by a process that has been demonstrated to prevent the formation of white corrosion products. If trivalent chromium treatment is elected, it may be applied prior to hydrogen embrittlement thermal treatment (see 3.3) without subsequent reactivation retreatment, provided it has demonstrated acceptable corrosion resistance (see 3.4.3). When plated parts specifying a traditional type of supplementary treatment, such as hexavalent chromate, require post thermal treatment as in 3.3, surface reactivation and supplementary treatment shall follow hydrogen embrittlement relief.

3.2.3 Spotting-in and double plating are prohibited.

3.2.4 The use of metallic brighteners is prohibited. Organic brighteners may be used to the extent necessary to produce acceptable corrosion and appearance characteristics while at the same time minimizing embrittlement tendencies.

3.3 Post Treatment

3.3.1 Hydrogen Embrittlement Relief

Treatment of steel parts HRC 36 or higher shall be in accordance with AMS2759/9.

3.4 Properties

3.4.1 Plate thickness shall be as specified on the drawing, determined in accordance with any of the following methods as applicable: ASTM B487, ASTM B499, ASTM B504, ASTM B567, ASTM B568, direct dimensional inspection provided the resolution of the measuring instrument is ten times more precise than the attribute being measured or ASTM E376, the drop test of ASTM B555, or other method permitted by the cognizant engineering organization. When thickness is determined by the drop test method, plating shall not be perforated in less time than specified in Table 1D.

3.4.1.1 Plate thickness may be specified by AMS2402 and a suffix number normally designating the minimum thickness in ten-thousandths of an inch (µm); except as indicated in Table 1, the maximum plate thickness shall be 0.0002 inch (5 µm) greater than the minimum. Thus AMS2402-2 designates a thickness of 0.0002 to 0.0004 inch (5 to 10 µm) and AMS2402-6 designates a thickness of 0.0006 to 0.0008 inch (15 to 20 µm).