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MILITARY SPECIFICATION

PLATING, TIN-LEAD (ELECTRODEPOSITED)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for electrodeposited tin-lead plating.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-N-290	Nickel Plating (Electrodeposited)
QQ-S-571	Solder, Tin-Alloy; Lead-Tin Alloy; and Lead Alloy
QQ-S-624	Steel Bar, Alloy, Hot Rolled and Cold Finish

Military

MIL-S-5002	Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems
MIL-F-14256	Flux, Soldering, Liquid (Rosin-Base)
MIL-C-14550	Copper Plating (Electrodeposited)
MIL-F-35081	Fat, Hydrogenated, Vegetable or Animal

FSC MFFP

STANDARDS

Federal

Fed. Test Method Std. No. 151	Metals; Test Methods

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-202	Test Methods for Electronic and Electric Component Parts
MIL-STD-1312	Fasteners, Test Methods

(Copies of specifications, standards, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

* 2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Standards

B487	Measuring Metal and Oxide Coating Thickness by Microscopic Examination of a Cross Section
B499	Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metal
B504	Measuring the Thickness of Metallic Coatings by the Coulometric Method
B567	Measuring Coating Thickness by the Beta-Backscatter Principle
B568	Measuring Coating Thickness by X-Ray Spectrometry
E 8	Tension Testing of Metallic Materials

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

3.1 Materials. The materials used shall be such as to produce electrodeposited tin-lead coatings which meet the requirements of this specification.

3.1.1 Composition. Unless otherwise specified, the coating composition shall be as specified in Table I (see 6.2 and 6.3).

* TABLE I

COATING COMPOSITION

Element	Percent by weight
Tin (Sn)	50 to 70
Other metals and non-metallics	1.0 Maximum
Lead (Pb)	Remainder

3.2 General requirements.

* 3.2.1 High tensile strength steel parts. Unless otherwise specified, steel parts having an ultimate tensile strength greater than 240,000 pounds per square inch (psi) shall not be plated without specific approval of the procuring activity (see 6.2).

* 3.2.2 Stress relief treatment. All steel parts having an ultimate tensile strength of 150,000 pounds per square inch (psi) and above, which are machined, ground, cold formed or cold straightened, shall be given a heat treatment at a minimum of 375 ± 25°F (191 ± 14°C) for three hours or more prior to cleaning and plating for the relief of damaging residual tensile stresses.

* 3.2.3 Cleaning. All steel parts shall be cleaned in accordance with MIL-S-5002. Other basis metals shall be cleaned by methods which shall not damage the substrate and shall not interfere with adhesion of the deposit (see 6.6).

* 3.2.4 Plating application. Unless otherwise specified, the plating shall be applied after all basis metal heat treatments and mechanical operations such as machining, brazing, welding, forming and perforating of the article have been completed (see 6.2).

* 3.2.5 Underplating. Unless otherwise specified (see 6.2), tin-lead shall be deposited directly on the basis metal without a preliminary plating of other metal. When the basis metal is a copper alloy containing more than 15 percent by weight of zinc (such as Copper Alloy Numbers 268, 270, 752, etc.) or a beryllium

copper alloy (such as Copper Alloy Numbers 170, 172, etc.) either a copper underplating, in accordance with MIL-C-14550, or a nickel underplating, in accordance with QQ-N-290, shall be applied to the basis metal in a thickness of 0.0001 inch (0.1 mil) prior to the tin-lead plating. Nickel underplating shall not be deposited on a copper alloy part that will be flexed or bent during manufacture or use.

* 3.2.6 Coverage. Unless otherwise specified, the plating shall cover all surfaces including roots of threads, corners and recesses (see 6.2).

* 3.2.7 Embrittlement relief. All steel parts having a hardness of Rockwell C40 and higher shall be baked at 340 ±10°F (171 ±6°C) for three hours or more, within four hours after plating, to provide hydrogen embrittlement relief (see 6.8). The baked parts, when tested in accordance with 4.5.6, shall not crack or fail by fracture (see 4.4.3.6). Plated springs and other parts subject to flexure shall not be flexed prior to the hydrogen embrittlement relief treatment.

* 3.2.8 Luster. Unless otherwise specified, either a matte or bright luster shall be acceptable (see 6.2). For electronic components, only parts with a matte or a flow brightened (matte reflowed) finish shall be furnished. Such flow brightened parts shall have a maximum thickness of about 0.0003 inch (0.3 mil) as thicker platings on flat surfaces tend to reflow more uneven (see 6.4).

3.3 Detail requirements.

3.3.1 Thickness of plating. Unless otherwise specified, the thickness of the tin-lead plating, except when applied to electronic components (see 3.3.1.1), shall be not less than 0.0003 inch (0.3 mil) and shall not be greater than 0.0005 inch (0.5 mil) on all visible surfaces which can be touched by a ball 0.75 inch in diameter. All other visible surfaces shall be not less than 0.0002 inch (0.2 mil) minimum thickness. Unless otherwise specified, holes and other openings and internal threads from which the external environment is completely excluded and where a controlled deposit cannot be normally obtained, shall not be subject to a thickness requirement.

3.3.1.1 Electronic components. Unless otherwise specified, the thickness of tin-lead plating for electronic components (printed circuit boards, especially those plated-through-hole interconnections, terminals and eyelets) shall be a minimum average of 0.0003 inch (0.3 mil) thickness when measured at four points at least 0.10 inch apart. Walls of holes such as plated-through-holes in circuit boards shall have a plating with a minimum average of 0.0003 inch (0.3 mil) thickness. No single measurement shall be less than 0.0002 inch (0.2 mil) minimum thickness.

* 3.3.1.2 Underplating. The thickness of any underplate (see 3.2.5) shall not be used in the determination of the tin-lead plating thickness as specified herein.

3.3.2 Adhesion.

* 3.3.2.1 Shear or bend. The adhesion of the plating shall be such that when examined at a magnification of approximately 4 diameters, the plating shall not show separation from the basis metal or from any underplate at the interface, nor shall any underplate show separation from the basis metal at the interface, when subjected to the shear or bend test described in 4.5.3.1. The interface between the tin-lead and either the basis metal or the underplate is the surface before plating. The interface between the underplate and the basis metal is the surface before underplating. The formation of cracks in the plate caused by rupture of the basis metal, the underplate or combination of both which does not result in flaking, peeling or blistering of the plate shall not be considered as nonconformance to this requirement.

* 3.3.2.2 Quench. The adhesion of the plating shall be such that when examined at a magnification of approximately 4 diameters, the plating shall show no evidence of flaking, peeling or blistering and shall be free from bubbles, cracks and other defects when subjected to the quench test described in 4.5.3.2.

* 3.3.2.3 Reflow. The adhesion of the plating shall be such that when examined at a magnification of approximately 4 diameters, the plating shall show no evidence of bubbling, foaming, blistering, flaking, peeling, or uneven flow resulting in voids and roughness when subjected to the reflow test described in 4.5.3.3.

* 3.3.3 Porosity. Tin-lead plating on ferrous metals shall show no basis metal corrosion products when tested for porosity in accordance with 4.5.4. The appearance of corrosion products, visible to the unaided eye at normal reading distance shall be cause for rejection.

3.3.4 Solderability. Plated specimens or parts shall be easily and completely coated with solder when tested as specified in 4.5.5. The solder shall be deposited uniformly without lumps or peaks and shall be essentially free from evidence of bubbling, foaming, voids and other defects. The solder shall firmly adhere to the plating and the plating shall be firmly adherent to the basis metal or to any underplate. There shall be no separation at the solder-plating interface, the plating-basis metal interface, the plating-underplate interface, or at the undercoat-basis metal interface, so that they cannot be lifted when a sharp-edge instrument is applied.

3.4 Workmanship.

* 3.4.1 Basis metal. The basis metal shall be free from visible defects which will be detrimental to the appearance or protective value of the plating. The basis metal shall be subjected to such cleaning and plating procedures as necessary to yield deposits as herein specified.

* 3.4.2 Plating. The tin-lead plating shall be smooth, fine grained, adherent, continuous, free from visible blisters, pits, nodules, indications of burning, excessive build-up, staining and other defects. The size and number of contact marks shall be at a minimum consistent with good practice. The location of contact marks

shall be in areas of minimum exposure to service environmental conditions where important to the function of the part. Superficial staining which has been demonstrated as resulting from rinsing, or slight discoloration resulting from baking operations to relieve embrittlement, as specified above (see 3.2.7), shall not be cause for rejection. Flow brightened or reflowed matte plating shall be free from any material used as the heating media for the treatment and such plating shall be free from untreated areas. All details of workmanship shall conform to the best practice for high quality plating.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

* 4.2 Classification of inspection. The inspection requirements specified herein are classified as follows:

1 - Production control inspection (see 4.3)
2 - Quality conformance inspection (see 4.4)

* 4.3 Production control inspection.

* 4.3.1 Control records. When specified in the contract or order (see 6.2), the supplier shall maintain a record of each processing bath, showing all additional chemicals or treatment solutions to the unit, the results of all analyses performed and the quantity of parts plated during operation. Upon request of the procuring activity, such records shall be made available. These records shall be maintained for not less than one year after completion of the contract or purchase order.

* 4.3.2 Production control. The equipment, procedures and operations employed by a supplier shall be capable of producing high quality electrodeposited platings as specified in this document. When specified by the procuring activity (see 6.2), the supplier, prior to production, shall demonstrate the capability of the process used to show freedom from hydrogen embrittlement damage as indicated by satisfactory behavior of specimens prepared (see 6.2.2) and tested in accordance with 4.3.2.1 to comply to the requirements of MIL-S-5002 for preproduction process qualification.

* 4.3.2.1 Preproduction control. For preproduction control, four round notched steel specimens shall be prepared in accordance with 4.4.4.2 from four individual heats for a total of 16 specimens, using the specified steel alloy for which preproduction examination of the process is to be demonstrated. Specimens shall be heat treated to the maximum tensile strength representing production usage. The specimens shall be given the same pre-treatments, proposed for production. The

specimens shall be subject to test detailed in 4.5.6. The process shall be considered satisfactory if all specimens show no indication of cracks or failure. The test results and production control information shall be submitted to the procuring activity for approval. Until approval has been received, parts shall not be plated.

* 4.3.3 Frequency of tests. To assure continuous control of the process as required by MIL-S-5002 and to prevent detrimental hydrogen embrittlement during production, the satisfactory behavior of specimens, prepared and tested in accordance with Table II, shall be made once each month or more frequently if required by the procuring activity. The results of tests made to determine conformance of electrodeposited platings to all requirements of this specification for definite contracts or purchase order are acceptable as evidence of the properties being obtained with the equipment and procedures employed.

* TABLE II

PRODUCTION CONTROL TESTS AND SPECIMENS

Test	Requirement Paragraphs	Specimen Preparation Paragraphs 1/	Test Reference Paragraphs
Composition	3.1.1	4.4.4 and 4.4.4.1	4.5.1
Thickness	3.3.1, 3.3.1.1 and 3.3.1.2	4.4.4 and 4.4.4.1	4.5.2
Adhesion		4.4.4 and 4.4.4.1	
Shear or bend	3.3.2.1		4.5.3.1
Quench	3.3.2.2		4.5.3.2
Reflow	3.3.2.3		4.5.3.3
Porosity	3.3.3	4.4.4 and 4.4.4.1	4.5.4
Solderability	3.3.4	4.4.4 and 4.4.4.1	4.5.5
Hydrogen Embrittlement	3.2.7	4.3.4, 4.4.4 and 4.4.4.2	4.5.6

1/ Standard alloy steels shall be used for production control specimens. The selection shall be at the option of the supplier; however, alloy steels such as AISI or SAE numbers 4130, 4135, 4140, 4145, 4340, 8645 and 8740 conforming to QQ-S-624 shall be used.

* 4.3.4 Production control specimens. Test specimens for production control shall be prepared in accordance with 4.4.4 and 4.4.4.1 as applicable for composition, thickness, adhesion, porosity and solderability tests detailed in Table II. Specimens for the production control embrittlement relief test shall be four round notched steel specimens of alloy steel 4340 conforming to QQ-S-624, heat treated to the maximum tensile strength, from one or more heats, and prepared in accordance with 4.4.4.2.

4.4 Quality conformance inspection.

4.4.1 Lot. A lot shall consist of plated articles of the same material, plated and treated under the same conditions and approximately the same size and shape, submitted for inspection at one time.

* 4.4.2 Sampling for visual examination and nondestructive tests. Sampling for visual examination and nondestructive tests shall be conducted as directed by the procuring activity (see 6.2) in accordance with MIL-STD-105 or using Table III. A sample of coated parts or articles shall be drawn by taking at random from each lot the number of articles in accordance with MIL-STD-105, Level II, Acceptable Quality Level (AQL) 1.5 percent defective, or as indicated in Table III. The lot shall be accepted or rejected according to the procedures in 4.4.2.1 for visual examination and 4.4.2.2 for plating thickness (nondestructive tests).

TABLE III

SAMPLING FOR VISUAL EXAMINATION
AND NONDESTRUCTIVE TESTS

Numbers of items in lot inspections	Number of items in samples (randomly selected)	Acceptance number (maximum number of sample items nonconforming to any test)
15 or less	7 1/	0
16 to 40	10	0
41 to 110	15	0
111 to 300	25	1
301 to 500	35	1
501 and over	50	2

1/ If the number of items in the inspection lot is less than 7, the number of items in the sample shall equal the number of items in the inspection lot.

* 4.4.2.1 Visual examination. Samples selected in accordance with 4.4.2 shall be examined for compliance with the requirements of 3.4.2 after plating. If the number of nonconforming articles exceeds the acceptance number for the sample, the lot represented by the sample shall be rejected.

* 4.4.2.2 Thickness of plating (nondestructive tests). Samples selected in accordance with 4.4.2 shall be inspected and the plating thickness measured by the applicable tests detailed in 4.5.2, at several locations on each article as defined in 3.3.1, 3.3.1.1 or 3.3.1.2, as applicable, for compliance with the requirements. Measurements on fastener hardware shall be made at locations defined in MIL-STD-1312, Test 12. The part or article shall be considered nonconforming if one or more measurements fail to meet the specified minimum thickness. If the number of defective items in any sample exceeds the acceptance number for the specified sample, the lot represented by the sample shall be rejected. Separate specimens (see 4.4.4.1) shall not be used for thickness measurements unless a need has been demonstrated.

4.4.3 Sampling for destructive tests. A random sample of four plated parts or articles shall be taken from each lot for each destructive test or separately plated specimens shall be prepared in accordance with 4.4.4, 4.4.4.1 and 4.4.4.2 to represent each lot. If the number of articles in the lot is four or less, the number of articles in the sample shall be specified by the procuring activity (see 6.2).

* 4.4.3.1 Composition. When specified in the contract or order, compliance with the requirements for composition shall be determined (see 6.2). Samples selected in accordance with 4.4.3 shall be tested in accordance with 4.5.1 to determine compliance with 3.1.1.

* 4.4.3.2 Thickness of plating (destructive tests). If sampling and testing for thickness of plating by nondestructive testing is not the option of the supplier, samples selected in accordance with 4.4.3 shall be measured for plating thickness by the applicable tests detailed in 4.5.2 at several locations as defined in 3.3.1, 3.3.1.1 or 3.3.1.2, for compliance with the requirements. Measurements on fastener hardware shall be made at locations defined in MIL-STD-1312, Test 12. If the plating thickness on any place on any article or specimen is less than the specified minimum thickness, the lot shall be rejected. Separate specimens (see 4.4.4.1) shall not be used for thickness measurements unless a need has been demonstrated.

* 4.4.3.3 Adhesion (destructive tests). The articles or specimens used for the destructive thickness test (see 4.4.3.2), if of suitable size and form, may be used as the test pieces for the adhesion tests to determine compliance with the requirements of 3.3.2.1, 3.3.2.2 or 3.3.2.3. Failure of one or more of the test pieces shall constitute failure of the lot.

* 4.4.3.4 Porosity (destructive tests). When specified in the contract or order, compliance with the requirements for porosity shall be determined (see 6.2).

The articles or specimens used for the destructive thickness test (see 4.4.3.2), if of suitable size and form, may be used as test pieces for the porosity test (see 4.5.4) to determine compliance with the requirements of 3.3.3. Failure of one or more of the test pieces shall constitute failure of the lot.

* 4.4.3.5 Solderability (destructive tests). When specified in the contract or order, compliance with the requirements for solderability shall be determined (see 6.2). The articles or specimens used for the destructive thickness test (see 4.4.3.2), if of suitable size and form, may be used as the specimens for the solderability test (see 4.5.5) to determine compliance with the requirements of 3.3.4. Failure of one or more of the test specimens shall constitute failure of the lot.

* 4.4.3.6 Hydrogen embrittlement relief (destructive tests). When specified in the contract or order, conformance to the requirements of 3.2.7 for hydrogen embrittlement relief of treated steel parts shall be determined for those parts having a tensile strength of or heat treated to a tensile strength level of 240,000 psi or above and which will be subject to a sustained tensile load in use (see 6.2). A random sample of four plated articles shall be taken from each lot or four specimens, prepared in accordance with 4.4.4 and 4.4.4.2, shall be used to represent the lot. When tested as specified in 4.5.6, cracks or failure by fracture shall be cause for rejection. Failure of one or more of the test pieces shall reject the lot.

4.4.4 Quality conformance specimen preparation. When the plated articles are of such form, shape, size or value as to prohibit use thereof, or are not readily adaptable to a test specified herein, or when destructive tests of small lot sizes are required the test shall be made by the use of separate specimens plated concurrently with the articles represented. The separate specimens shall be of a basis metal equivalent to that of the articles represented. Equivalent basis metal includes chemical composition, grade, condition and finish of surface prior to plating. For example, a cold-rolled steel surface should not be used to represent a hot-rolled steel surface. Due to the impracticality of forging or casting separate test specimens, hot-rolled steel specimens may be used to represent forged and cast-steel articles. The separate specimens may be also cut from scrap castings when ferrous alloy castings are being plated. These separate specimens shall be introduced into a lot at regular intervals prior to the cleaning operations, preliminary to plating, and shall not be separated therefrom until after completion of plating. Conditions affecting the plating of specimens including the spacing, plating media, residual air pressure, temperature, etc. in respect to other objects being plated shall correspond as nearly as possible to those affecting the significant surfaces of the articles represented. Separate specimens shall not be used for thickness measurements, however, unless the necessity for their use has been demonstrated.

* 4.4.4.1 Specimens for composition, thickness, adhesion, porosity and solderability tests. If separate specimens for composition, thickness, adhesion, porosity and solderability tests are required, they shall be strips approximately 1 inch wide, 4 inches long and 0.04 inch thick.

4.4.4.2 Specimens for embrittlement relief. Separate specimens for embrittlement relief test shall be round notched specimens with the axis of the specimen (load direction) perpendicular to the short transverse grain flow direction. The configuration shall be in accordance with Figure 8 of ASTM E8 for rounded specimens. Specimens shall have a 60 degree V-notch located approximately at the center of the gage length. The cross section area at the root of the vee shall be approximately equal to half the area of the full cross section area of the specimen's reduced section. The vee shall have a 0.010 ± 0.0005 inch radius of curvature at the base of the notch (see 6.2.2).

4.5 Tests.

* 4.5.1 Composition. Either Method 513 or Method 514 of Fed. Test Method Std. No. 151 may be used for determination of composition and weight of the tin-lead plating, employing any recognized stripping method. Either Method 111 or Method 112 of Fed. Test Method Std. No. 151 may be used for determining composition of the tin-lead plating. The plating composition may also be determined by X-ray fluorescene techniques and by atomic absorption spectrophotometry.

* 4.5.2 Thickness. For nondestructive measuring of plating thickness, procedures in accordance with ASTM B499 (magnetic test), ASTM B567 (Betaradiation backscatter) or ASTM B568 (X-ray spectrometry) may be used. For destructive measuring of plating thickness, procedures in accordance with ASTM B487 (microcopic) or ASTM B504 (coulometric) may be used. In addition to the above, the other procedures embodied in MIL-STD-1312, Test 12, may be used for thickness of plated fastener hardware.

4.5.3 Adhesion.

* 4.5.3.1 Shear or bend. Shear or bend adhesion may be determined by scraping the surface or shearing with a sharp edge, knife or razor through the plating down to the basis metal and parallel to surface of the basis metal and examining at four diameters magnification for evidence of nonadhesion. Alternately the article or specimen may be clamped in a vise and the projecting portion bent back and forth until rupture occurs, or specimens shall be given a bend test by bending 180 degrees over a mandrel having a diameter of the thickness of the specimen. If the edge of the ruptured plate can be peeled back or if a separation between the plate and the basis metal can be seen at the point of rupture when examined at four diameters magnification, adhesion is not satisfactory.

* 4.5.3.2 Quench. Quench adhesion may be determined by heating the plated specimen or article in an oven for a sufficient period of time to reach 300 ± 10°F (148.9 ± 5.5°C). The specimen or article shall then be quenched in water maintained at room temperature. The deposit shall be examined at four diameters magnification for any evidence of blistering, flaking, or exfoliation to indicate unsatisfactory adhesion.

* 4.5.3.3 Reflow. Reflow adhesion may be determined by totally immersing the article or specimen for 30 to 60 seconds in a bath of hydrogenated oils or fats, conforming to MIL-F-35061, held at 435 to 460°F(224 to 238°C). The article or specimen shall then be removed and quenched by air cooling. The deposit shall be examined at four diameters magnification for any evidence of unsatisfactory adhesion as indicated by beading, voids, roughness, peeling and flaking.

* 4.5.4 Porosity. Porosity shall be determined when the substrate is a ferrous metal by either the hot water test (see 4.5.4.1) or by the ferroxyl test (see 4.5.4.2).

* 4.5.4.1 Hot water test. The article or specimen should be placed in distilled hot water, contained in a beaker or other suitable container, maintained at 205 to 212°F(96 to 100°C). The coated article or specimen shall be immersed for 6 hours, after which it should be removed, allowed to dry by evaporation and inspected for red rust spots, which will appear at pores or discontinuities.

* 4.5.4.2 Ferroxyl test. A piece of filter paper, saturated by dipping in an aqueous solution of potassium ferricyanide (10 grams per litre), shall be applied to the article or specimen. Dark blue spots will develop on the paper where corrosion of the coating occurs at pores or other defects. Contact may be assured by the use of a soft bristle brush moistened with the ferricyanide reagent. For a permanent record, the paper can then be dried.

* 4.5.5 Solderability. Solderability shall be determined by coating with a flux conforming to Type W of MIL-F-14256 and then partially immersing in a solder conforming to composition Sn 60 of QQ-S-571 for 3 seconds at a solder pot temperature of 450 ±25°F (232 ±14°C). The specimen or part shall be preheated prior to immersion. A mechanical dipping device, similar to that detailed in Method 208 of MIL-STD-202, may be used to immerse the part or specimen at the rate of 1 ±1/4 inch per second. Upon removal, the specimen or part shall be shaken lightly to remove excess solder and allowed to cool in air. After examination, the article or the specimen shall be subjected to the bend test detailed in 4.5.3.1.

* 4.5.6 Embrittlement relief. Compliance with 3.2.7 shall be determined with samples of ferrous plated parts taken as specified in 4.4.3.5. Parts such as spring pins, lock rings, etc., which are installed in holes or rods shall be similarly assembled using the applicable parts specifications or drawing tolerances which impose the maximum sustained tensile load on the coated part. The selected samples shall be subjected to a sustained tensile load equal to 115 percent of the maximum design load for which the part was designed. Parts which require special fixtures, extreme loads to comply with the above requirements, or where the maximum design load is not known, may be represented by separate specimens prepared in accordance with 4.4.4.2. The notched specimens shall be subjected to a sustained tensile load equal to 75 percent of the ultimate notch tensile strength of the material. The articles,

parts or specimens shall be held under load for at least 200 hours and then examined for cracks or fracture.

5. PREPARATION FOR DELIVERY

5.1 Packaging and packing. Unless otherwise specified, preservation, packaging and packing methods for electrodeposited tin-lead parts or articles employed by the supplier shall be such as to preclude any physical damage during shipment and handling and surface deterioration during shipment and storage which would interfere with solderability.

6. NOTES

* 6.1 Intended use. The tin-lead plating covered in this specification is intended for use as a coating for corrosion protection, and as a base for soldering. On printed circuitry parts and components, the coating should be of the flow brightened (matte reflowed) finish so as to preclude any undesirable coating characteristics such as bubbles, voids and roughness.

6.1.1 The tin-lead coatings, containing 20 to 97.5 percent tin should not be used on parts which in service reach a temperature of 250°F or higher or come in contact with other parts which reach those temperatures.

* 6.2 Ordering data. Purchasers should exercise any desired options offered herein and procurement documents should specify the following:

a. Title, number, and date of this specification.

b. Composition required, if other than specified (see 3.1.1 and 6.3).

c. When plating is to be applied if other than specified (see 3.2.1 and 3.2.4).

d. Underplating, if required (see 3.2.5 and 3.3.1.2).

e. Coverage, if other than specified (see 3.2.6).

f. Luster, if particular finish is required (see 3.2.8).

g. Thickness of plating, if other than specified (see 3.3.1, 3.3.1.1 and 3.3.1.2).

h. Control records requirement (see 4.3.1).

i. Preproduction control examination (see 4.3.2).

j. Sampling plan (see 4.4.2).

k. Number of samples for destructive testing (see 4.4.3).

l. Whether composition, porosity, solderability and hydrogen embrittlement relief tests are required for quality conformance inspection (see 4.4.3.1, 4.4.3.4, 4.4.3.5 and 4.4.3.6).

* 6.2.1 The manufacturer of the basis metal parts should provide the plating facility with the following data:

a. Hardness of steel parts (see 3.2.1).

b. Heat treatment for stress relief, whether has been performed or is required (see 3.2.2).

c. Tensile loads required for embrittlement relief test, if applicable (see 4.5.6).

* 6.2.2 The manufacturer of the basis metal parts should provide the plating facility with notched tensile specimens (see 4.4.4.2) to be plated for conformance with 3.2.7 required for preproduction control inspection (see 4.3.2.1) and lot acceptance (see 4.4.3 and 4.4.3.6).

6.3 Other compositions. If other compositions are specified than that stated in 3.1.1, the percentage of tin should not vary by more than ±10 percent from the specified nominal value.

* 6.4 Finish appearance. Tin-lead plating baths are generally composed of tin and lead fluoborates and other materials to promote stability. If the bath does not contain proprietary brightener materials, the finish will be a matte. With brighteners, the finish will be bright or semi-bright. A flow-brightened or reflowed matte finish is obtained by heating the matte finished plating above the melting point, that is 425 to 435°F (218 to 224°C) for a few seconds and then quenching (see 3.2.8).

6.5 Impurities. Impurities in the tin-lead plating composition, due to plating solution addition agents, improper rinsing and processing or substances volatile at soldering temperature can cause excessive bubbling or foaming during melting of the plating, embrittlement relief treatment (see 3.2.7), solderability testing or other types of heat treatments. Excessive bubbling or foaming will cause voids in or roughness of the tin-lead plating surfaces (see 3.4.2).

6.6 Cleaning. Copper and copper-based alloys may be cleaned as detailed in ASTM B281, Recommended Practice for the Preparation of Copper and Copper-Base Alloys for Electroplating (see 3.2.3).

6.7 Stress relief. There is a hazard that hardened and tempered cold-worked or cold-straightened steel parts may crack during cleaning and plating. Such parts should have a suitable heat treatment for stress relief prior to cleaning and plating (see 3.2.2).

6.8 Baking time. For higher strength materials it may be beneficial to extend the baking treatment to 23 hours to insure complete hydrogen embrittlement relief (see 3.2.7).

6.9 Threaded parts. As coatings of 0.0004 ±0.0001 inch (0.4 ±0.1 mil) are required for satisfactory service conditions rather than 0.0002 inch (0.2 mil), allowance should be made in the manufacture of most threaded articles, such as nuts, bolts and similar fasteners with complementary threads for dimensional tolerances necessary for coating build-up. Certain recessed areas, such as root diameters of threads, have a tendency with electroplated coatings to be thinner than the significant surfaces.

6.10 Marginal indicia. The margins of this specification have been marked to indicate where changes, deletions, or additions to the previous issue have been made. This has been done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these documents. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content as written, irrespective of the marginal notations and relationship to the last previous issue.

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