

**Plating, Lead and Indium**

**1. SCOPE:**

**1.1 Purpose:**

This specification covers the engineering requirements for electrodeposition of lead and indium and diffusion of the indium into the lead, and the properties of the deposit.

**1.2 Application:**

This process has been used typically to improve the performance and prevent corrosion of bearings or of other parts, but usage is not limited to such applications.

**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 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.

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## 2.1 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or [www.astm.org](http://www.astm.org).

ASTM B 487	Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM B 499	Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
ASTM B 504	Measurement of Thickness of Metallic Coatings by the Coulometric Method
ASTM B 568	Measurement of Coating Thickness by X-Ray Spectrometry
ASTM B 571	Adhesion of Metallic Coatings
ASTM E 376	Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Test Methods

## 3. TECHNICAL REQUIREMENTS:

### 3.1 Preparation:

- 3.1.1 Steel parts, having a hardness of 40 HRC or higher and which have been ground after heat treatment, shall be cleaned to remove surface contamination and stress relieved before preparation for plating. Unless otherwise specified, the stress relief shall be not less than 275 °F ± 25 (135 °C ± 14) for not less than five hours for parts with hardness 55 HRC or higher and not less than 375 °F ± 25 (191 °C ± 14) for not less than four hours for parts with lower hardness.
- 3.1.2 When specified by purchaser, the surfaces to be plated shall be blasted lightly with fine grit to obtain a matte finish.
- 3.1.3 Parts shall have clean surfaces, free from water-break, prior to immersion in the plating solution.
- 3.1.4 Except for barrel plating, electrical contact points shall be as follows. For parts which are to be plated all over, locations shall be acceptable to purchaser; for parts which are not to be plated all over, locations shall be in areas on which plating is not required.

### 3.2 Procedure:

- 3.2.1 Lead Plating: Parts shall be plated by electrodeposition of lead from a suitable lead plating solution directly onto the cleaned basis metal.
  - 3.2.1.1 After completion of the lead plating operation, the plated parts shall be rinsed immediately in running water and, except as specified in 3.2.1.1.1, transferred directly to the indium plating solution.
    - 3.2.1.1.1 If indium cyanide is used in the make up of the indium plating bath, the lead plated parts, after rinsing, and prior to indium plating, shall be immersed in a suitable sodium cyanide solution to neutralize remaining traces of acid lead solution and again thoroughly rinsed in running water.

3.2.1.2 Parts shall not be permitted to dry between the time they are removed from the rinse after lead plating and the time they are immersed in the indium plating solution.

3.2.2 Indium Plating: The plating process shall consist of electrodeposition of indium from a suitable indium plating solution onto the rinsed, wet, lead plated surfaces of the part.

3.2.2.1 Spotting-in is not permitted.

3.2.2.2 After plating, parts shall be thoroughly rinsed and dried.

3.3 Post Treatment:

Parts, after plating, rinsing, and drying, shall be heated in an oil bath to 340 to 350 °F (171 to 177 °C) and held at heat for not less than two hours to diffuse the indium into the lead. Heat treated parts, including carburized parts, which will decrease in hardness or be otherwise deleteriously affected if heated to 350 °F (177 °C) shall be post treated by a method acceptable to purchaser.

3.4 Properties:

The deposited lead and indium shall conform to the following requirements:

3.4.1 Composition: The weight of indium deposited shall be within the range 5.5 to 8.0% of the weight of deposited lead, determined by a method acceptable to purchaser.

3.4.2 Thickness: The combined thickness of lead and indium shall be as specified on the drawing, determined in accordance with ASTM B 487, ASTM B 499, ASTM B 504, ASTM B 568, ASTM E 376, or other method acceptable to purchaser. A tolerance of  $\pm 0.0001$  inch ( $\pm 2.5$   $\mu\text{m}$ ) on the combined thickness of lead and indium shall be allowed when the nominal thickness is 0.001 inch (25  $\mu\text{m}$ ) or under. A tolerance of  $\pm 0.00025$  inch ( $\pm 6.4$   $\mu\text{m}$ ) in combined thickness of lead and indium shall be allowed when the nominal thickness is over 0.001 inch (25  $\mu\text{m}$ ). These tolerances apply unless other values are specified.

3.4.2.1 The plate shall be substantially uniform in thickness on significant surfaces except that build-up at exterior corners or edges will be permitted provided finished drawing dimensions are met.

3.4.2.2 Thickness requirements apply to surfaces that can be touched by a sphere 0.75 inch (19 mm) in diameter. Other areas, such as surfaces of holes, recesses, internal threads, or contact areas of parts plated all over, where a controlled deposit cannot be obtained under normal plating conditions, shall show evidence of plating.

3.4.3 Adhesion: After reflow (See 3.3) or when testing in accordance with ASTM B 571, there shall be no separation of the plating from the base metal or internal delamination.

### 3.5 Quality:

Plating shall be smooth, continuous, free from delaminations within the plating, uniform in appearance and free from imperfections detrimental to usage of the plating. Plating shall be visually free from frosty areas, pin holes, porosity, blisters, nodules, and pits.

- 3.5.1 Staining or discoloration, which may appear on the deposits after the diffusion treatment or during storage, is not acceptable.

## 4. QUALITY ASSURANCE PROVISIONS:

### 4.1 Responsibility for Inspection:

The processor shall supply all samples for processor's tests and shall be responsible for the performance of all required tests. Parts, if required for tests, shall be supplied by purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the lead-indium deposit conforms to specified requirements.

### 4.2 Classification of Tests:

- 4.2.1 All technical requirements are acceptance tests and shall be performed on each lot.
- 4.2.2 Periodic Tests: Tests of cleaning and plating solutions to ensure that deposited metals will conform to specified requirements are periodic tests (See 8.7) and shall be performed at a frequency selected by the processor unless frequency of testing is specified by purchaser.
- 4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed when preproduction tests are specified on the initial shipment of a plated part to a purchaser, when a change in material and/or processing requires reapproval by the cognizant engineering organization (See 4.4.2), and when purchaser deems confirmatory testing to be required.

### 4.3 Sampling and Testing:

Shall be not less than the following; a lot shall be all parts of the same part number, plated to the same range of plate thickness in the same solutions in each eight hours of continuous operation, and presented for processor's inspection at one time:

- 4.3.1 Samples shall be selected at random from all parts in the lot. Unless purchaser specifies a sampling plan, the minimum number of samples shall be as shown in Table 1.

TABLE 1 - Sampling for Acceptance Tests

Number of Parts in Lot		Quality	Thickness	Composition	Test Panels
1 to	6	All	3	1	1
7 to	15	7	4	1	2
16 to	40	10	4	1	3
41 to	110	15	5	1	4
111 to	300	25	6	1	5
301 to	500	35	7	1	6
501 to	700	50	8	1	6
701 to	1200	75	10	1	7
1201 and Over		125	15	1	10

4.3.2 Periodic Testing: Sample quantity and frequency of testing shall be at the discretion of the processor, unless otherwise specified.

4.3.2.1 Nondestructive testing shall be performed whenever practical. Except as noted in 4.3.2.2, actual parts shall be selected as samples for test.

4.3.2.2 Separate test panels made of the same generic class of alloy as the parts, distributed throughout the lot, cleaned, plated, and post treated with the parts represented, shall be used when plated parts are of such configuration or size as to be not readily adaptable to specified tests, when nondestructive testing is not practical on actual parts, and when it is not economically acceptable to purchaser to perform destructive tests on actual parts.

4.4 Approval:

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

4.4.2 The processor of plated parts shall make no significant change in bath types, plating conditions, or control factors from those on which the approval was based, 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 plated parts.

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

- Surface preparation
- Bath types and composition limits
- Bath temperatures and times
- Diffusion temperature and time
- Current and voltage limits for each plating bath
- Method of determining composition
- Periodic test plan.