

INCH-POUND

MIL-PRF-32660  
10 November 2020

## PERFORMANCE SPECIFICATION

PLATING, ZINC-NICKEL ALLOY, LOW HYDROGEN EMBRITTLEMENT,  
ALKALINE 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 electro-deposition of a Low Hydrogen Embrittlement (LHE) zinc-nickel alloy containing 12-15 percent nickel. LHE alkaline zinc-nickel alloy electroplating meeting this specification is an alternative for cadmium as a corrosion control coating.

1.2 Restriction. Hardness and tensile strength restrictions for high strength steel are in accordance with MIL-DTL-5002.

1.3 Classification. LHE zinc-nickel alloy plating are of the following types and classes:

1.3.1 Types. The types of plating are as follows:

- Type I - As-plated without supplementary treatment
- Type II - As-plated with supplementary non-hexavalent chromium post treatment
- Type III - As-plated with supplementary non-chromium post treatment

Unless otherwise specified, Type II Zinc-Nickel alloy plating will be applied.

1.3.2 Classes. The classes of plating are as follows:

- Class 1 - 0.0005 inch, minimum thickness
- Class 2 - 0.0003 inch, minimum thickness
- Class 3 - 0.0002 inch, minimum thickness

Comments, suggestions, or questions on this document should be addressed to Commanding Officer, Naval Air Warfare Center Aircraft Division Lakehurst, Systems Standardization and PHS&T Branch, Code BL32600, Mail Stop 120-3, Route 547, Joint Base MDL, NJ 08733-5100 or emailed to [frank.magnifico@navy.mil](mailto:frank.magnifico@navy.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST online database at <https://assist.dla.mil>.

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1.3.2.1 Unless otherwise specified, the maximum thickness will be the minimum plus 0.0003 inch, except in high cathode current density areas, such as corners and edges. For internal threaded parts, a maximum of 0.0005 inch above the minimum is allowed on the external surfaces. If no Class is specified, Class 1 will be applied (see 3.4.3).

1.3.3 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

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

### 2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

#### DEPARTMENT OF DEFENSE SPECIFICATION

MIL-DTL-5002    Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems

#### DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-865    Selective Brush Plating, Electro-Deposition

MIL-STD-1504    Abrasive Blasting

MIL-STD-1916    DoD Preferred Methods for Acceptance of Product

(Copies of these documents are available online at <https://quicksearch.dla.mil/>.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

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## ASTM INTERNATIONAL

ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B487	Standard Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section
ASTM B568	Standard Test Method for Measurement of Coating Thickness by X-Ray Spectrometry
ASTM B571	Standard Practice for Qualitative Adhesion Testing of Metallic Coatings
ASTM E376	Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods
ASTM F519	Standard Test Method for Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments

(Copies of these documents are available online at <http://www.astm.org/>.)

## SAE INTERNATIONAL

SAE AMS 2451/9	Plating, Brush, Zinc-Nickel Low Hydrogen Embrittlement
SAE AMS 2759/9	Hydrogen Embrittlement Relief (Baking) of Steel Parts
SAE AMS 2759/11	Stress Relief of Steel Parts
SAE AS2390	Chemical Process Test Specimen Material

(Copies of these documents are available online at <http://www.sae.org/>.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

3.1 Materials. The materials used shall produce deposits that meet the requirements of this specification.

3.2 General requirements.

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3.2.1 Basis metal. The basis metal (parts) submitted for the plating process shall be free from visible defects such as blemishes, prior pitting from corrosion, nicks, scratches, burrs or other geometrical or base metal defects that could be detrimental to the appearance or performance of the plating. As part of the plating process, the basis metal (parts) shall receive the necessary cleaning and surface activation to yield a deposit that is in accordance with the requirements of this specification.

3.2.2 Preplate operations. Prior to plating, parts to be plated shall have undergone all required heat treatments and mechanical operations (machining, welding, brazing, forming, punching, grinding, peening and similar operations) (see 6.2).

3.2.3 Preplate stress relief. All steel parts having an ultimate tensile strength of 180,000 pounds per square inch (psi) (40 HRC) or greater that have been machined, ground, cold formed or cold straightened, shall be cleaned as required to remove contamination and thermally stress relieved prior to plating (see 6.3). Stress relief shall conform to requirements in SAE AMS2759/11. Temperature uniformity of furnaces shall be  $\pm 25$  °F. When peening is required, thermal stress relief shall be performed prior to shot or rotary flap peening (see 6.3).

3.2.4 Cleaning. The plating shall be applied over a surface free from water breaks. The cleaning procedure shall not produce pitting, intergranular attack, or hydrogen embrittlement of the basis metal and shall preserve dimensional requirements. Metal parts shall be cleaned in accordance with MIL-DTL-5002, MIL-STD-1504 or by methods that neither damage the substrate nor interfere with the adhesion of the deposit.

3.3 Processing requirements. Unless otherwise specified in the contract or order, parts shall be plated with LHE alkaline zinc-nickel alloy onto a properly prepared surface directly on the basis metal without a coating of another metal underneath, except that of a preliminary plating of nickel or other suitable metals as applicable to ensure adhesion of the basis metal being plated. In no case shall any underplate be substituted for any part of the specified LHE alkaline zinc-nickel alloy plating thickness.

3.3.2 Conformal anode. To meet thickness and coverage requirements specified in the contract or order, it will be at the discretion of the processor to utilize appropriate conformal or special anodes as needed to ensure the above requirements are met. The anodes utilized shall be manufactured of Nickel 200 or equivalent with a nickel content  $\geq 99.6\%$  for appropriate plating transfer without the potential of contamination.

3.3.3 Coverage. All surfaces of the part, except those that cannot be touched by a sphere 0.75 inch in diameter, shall be plated to the specified thickness. Unless otherwise specified in the contract or order, surfaces such as holes, recesses, threads and other areas where a controlled deposit cannot be obtained under normal plating conditions, may be under the specified thickness limit provided visual plating coverage is shown. The plate shall be uniform in thickness on significant surfaces with the exception of build-up on exterior corners or edges that shall be permitted provided finished drawing dimensions are met.

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3.3.4 Contact marks. The size and number of contact marks shall be at a minimum or in locations with minimum exposure to service environmental conditions important to the function of the part. When specified by the CEA, contact marks in critical areas may be repaired using approved selective brush plating processes. For parts that are not to be plated all over, and contact locations are not specified, the locations shall be in areas on which coating is not required.

3.3.5 Touch Up. Parts or areas requiring touch up shall be brush plated in accordance with the latest revision of SAE AMS2451/9 and MIL-STD-865 as directed by the CEA using non-embrittling zinc-nickel alloy products.

3.3.6 Re-processing. Parts rejected for defective plating, requiring stripping and re-plating, shall include all of the pre-plating steps of this standard.

3.4 Electrodeposited coating requirements.

3.4.1 Coating composition. When tested in accordance with 4.5.1, the deposit shall consist of a uniform zinc-nickel alloy composition containing 12-15 percent nickel.

3.4.2 Appearance. For all surfaces required to be plated, the deposit shall be smooth, continuous, adherent to the basis metal, and visually free from blisters, nodules, pits, and burning, and other imperfections detrimental to performance of the plating. Appearance after application of supplementary treatments shall be essentially uniform in color and appearance consistent with the type of treatment applied. Superficial staining, which has been demonstrated as resulting from rinsing, or slight discoloration resulting from any drying or baking operations shall not be cause for rejection.

3.4.3 Thickness. Thickness shall be determined by non-destructive methods on actual production parts or test specimens in accordance with ASTM B568, ASTM E376, or other method acceptable to the CEA which may include destructive testing. For destructive measuring of plating thickness, procedures in accordance with ASTM B487 or other acceptable method acceptable to the CEA may be used. The plating thickness shall meet the requirements as specified in the contract (see 1.3.2). Unless otherwise specified in the contract or order (see 6.2), the minimum plating thickness shall be 0.0005 inch on all visible surfaces except those that cannot be touched by a sphere 0.75 inch in diameter. For surfaces that cannot be touched by a 0.75 inch sphere, including internal threads, no plating thickness is required, but such areas shall show evidence of plating.

3.4.4 Adhesion. The adhesion of the plating shall be such that when examined at a magnification of 4X to 10X, the plating shall show no separation from the basis metal nor from any underplating at the interface, nor shall any underplating show separation from the basis metal, when tested in accordance with 4.5.3. The formation of cracks in the plating caused by rupture of the basis metal, the underplating or combination of both which do not result in flaking, peeling, or blistering of the plating shall not be cause for rejection.

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3.4.5 Corrosion resistance. Test specimens or test production parts shall be used for corrosion testing by continuous exposure to salt spray in accordance with ASTM B117 for determining resistance to white corrosion in accordance with 3.4.5.1 and base metal corrosion in accordance with 3.4.5.2. A minimum of 2 test specimens prepared in accordance with 4.5.4 shall be used for each test. The same specimen may be used for both resistance to white corrosion and base metal corrosion testing. To secure uniformity of results, Type II or Type III supplementary coatings shall be aged at room temperature for 24 hours minimum before subjected to the salt spray.

3.4.5.1 Resistance to white corrosion. Type II and Type III plated test production parts or test specimens shall not show evidence of white corrosion products of zinc-nickel alloy, pitting, or basis metal corrosion products at the end of 120 hours of continuous salt spray testing. The appearance of corrosion products visible to the unaided eye shall be cause for rejection, except that white corrosion products 0.25 inch (6.35 mm) or less from the edges shall not constitute failure. This test does not apply to Type I coatings.

3.4.5.2 Base metal corrosion resistance. When tested in accordance with 4.5.4, production parts or test specimens shall show no evidence of corrosion (red rust) of the basis metal after testing as specified in Table I. The appearance of white corrosion products on the zinc-nickel alloy coating during the test period shall not be cause for rejection. Areas within 0.25 inch (6.35 mm) from the edges of the panel, the identification markings, and the panel holding points during processing or salt spray exposure shall not be evaluated.

TABLE I. Time to red rust with salt spray test.

Class	Test period (hours)	
	Type I	Type II or III
1	504	672
2	336	504
3	168	336

3.4.6 Hydrogen embrittlement relief. The electrodeposition process shall not cause hydrogen embrittlement in the metal substrate when tested in accordance with 4.5.5. Unless otherwise specified in the contract or order (see 6.2), steel parts that are surface or through hardened to 180,000 psi (40 HRC) and higher and steel fasteners with a tensile strength 150,000 psi (34 HRC) and higher, shall be given a hydrogen embrittlement relief baking in accordance with SAE AMS2759/9 within 4 hours after completion of plating. Type IIA coatings shall be baked prior to supplemental treatment. Plated springs and other parts subject to flexure shall not be flexed prior to the embrittlement relief treatment.

#### 4. VERIFICATION

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

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- a. Periodic process control inspection (see 4.2). This inspection shall consist of periodic tests specified in Table II to ensure that the system or established process for producing deposits meeting this specification is in control.
- b. Conformance inspection (see 4.3). Unless otherwise specified by the CEA, this inspection shall consist of tests specified in Table III for conformance inspection testing of a sampled lot of parts processed in accordance with this specification.

#### 4.2 Periodic process control inspection.

4.2.1 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 chemical analyses performed, and the quantity of parts plated during operation (see 6.2 and 6.4). The supplier shall also maintain a record of all the production control test results including composition, appearance, thickness, adhesion, corrosion resistance and hydrogen embrittlement (if required)- see Table II.

4.2.2 Process control. The equipment, procedures and operations employed shall be capable of producing electrodeposited platings that meet the requirements specified throughout this document and in Table II.

4.2.3 Frequency of tests. Separate specimens shall be prepared (see 4.4.2) and tested in accordance with Table II at least once each month or as specified by the cognizant engineering authority. Intervals between each month shall not exceed 35 days. If production in accordance with this specification is not performed for a period of one month or longer, process control tests shall be conducted at the start of production or as specified by the cognizant engineering authority.

TABLE II. Process control tests.

Test	Requirement	Test Method
Coating Composition <u>1/</u>	3.4.1	4.5.1
Appearance	3.4.2	Visual Inspection
Thickness	3.4.3	4.5.2
Adhesion	3.4.4	4.5.3
Corrosion Resistance	3.4.5	4.5.4
Hydrogen Embrittlement Stress Relief (200 hr) <u>1/</u>	3.4.6	4.5.5

1/ If 3 consecutive monthly process control tests pass, process control testing frequency can be extended to once per quarter as a minimum or after each change of equipment or procedures, whichever occurs first.

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4.3 Conformance inspection.

4.3.1 Lot. A lot shall be defined as a group of parts of the same material and part number or similar part configuration, plated to the same range of deposit thickness, using the same chemical solutions in the same tanks under the same conditions, plated in a single continuous plating cycle not to exceed 16 hours, and presented for processor's inspection at one time. If the number of parts in an inspection lot is four or less, the number of parts in the sample may be determined by the CEA (see 6.2). Unless otherwise specified by the CEA, conformance testing of each inspection lot shall be performed in accordance with Table III.

TABLE III. Conformance tests.

Test	Requirement	Test method paragraph
Appearance	3.4.2	Visual inspection
Thickness	3.4.3	4.5.2
Adhesion	3.4.4	4.5.3

4.4 Sampling.

4.4.1 Sampling for inspection. The number of samples selected for plating tests from each inspection lot shall be determined by MIL-STD-1916, Verification Level (VL) = II or by the cognizant engineering authority (see 6.2).

4.4.2 Separate specimen preparation. When the plated articles are not readily adaptable to the tests specified in 4.5, or when destructive tests of small lot sizes are required, the test may be made by the use of separate specimens. Production control test specimens for adhesion and corrosion resistance shall be AISI 4130 steel or of the same generic class of alloy as the parts processed as defined in SAE AS2390. Specimens shall be a minimum of 3 x 6 x 0.040 inches for corrosion testing and 1 x 4 x 0.040 inches for composition, thickness, and adhesion testing. Hydrogen embrittlement testing shall utilize ASTM F519, Type 1a.1 specimens. The specimens shall be introduced into a lot at regular intervals prior to the cleaning operations preliminary to plating and shall not be separated until after completion of the processing.

4.5 Test methods.

4.5.1 Coating composition. Separate specimens shall be used for coating composition testing. Specimens shall be AISI 4130 steel strips approximately 1 x 4 x 0.040 inches (25 x 102 x 1.0 mm). A minimum of four (4) test specimens shall be used for each test. Test specimens shall be zinc-nickel alloy plated to a Class 1 thickness in the as-plated condition with no supplementary treatment. Specimens shall be measured for nickel content by XRF or other suitable test method that shall quantitatively measure nickel content without damage to the coated surface.

4.5.2 Thickness. Sampling selected in accordance with 4.4 shall be inspected and the plating thickness measured by non-destructive methods on actual production parts in accordance



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with ASTM B568, ASTM E376, or other method acceptable to the CEA, which may include destructive testing. For destructive measuring of plating thickness, procedures in accordance with ASTM B487 or other method acceptable to the CEA shall be used. Measurements shall be taken on a minimum of 3 different surfaces of each component to verify all surfaces have the minimum required zinc-nickel alloy thickness. Failure to meet requirements of 3.4.3 shall be cause for rejection.

4.5.3 Adhesion. Specimens for adhesion testing shall be strips approximately 1 x 4 x 0.040 inches (25 x 102 x 1.0 mm). A minimum of 2 test specimens shall be used for each test. Test specimens shall be plated to Class 1 thickness. They shall be tested in accordance with ASTM B571 bend test – no mandrel, clamped in a vise and the projecting portion bent back and forth until rupture of the basis metal and/or plating occurs. If the edge of the ruptured plating can be peeled back or if separation between the plating and basis metal can be seen at the point of rupture when examined at 4 to 10X magnification, adhesion is not satisfactory. Cracking of the deposit is acceptable but flaking off or lifting of the deposit shall constitute failure.

4.5.4 Corrosion resistance. Specimens used for corrosion testing shall be a minimum of 3 x 6 x 0.040 inches (76 x 153 x 1.0 mm). Production control test specimens shall be AISI 4130 steel or of the same generic class of alloy as the parts processed as defined in SAE AS2390. A minimum of 2 test specimens representative of parts processed shall be used. Unless otherwise specified, test specimens shall be plated to a Class 2 thickness with a Type II supplementary post treatment. Coating thickness shall be determined for each test specimen using the same test procedure as used on production parts. Coated specimens shall be subjected to continuous salt spray testing in accordance with the requirements of ASTM B117 for the time periods specified in 3.4.5.

4.5.5 Hydrogen embrittlement relief test.

a. Testing shall be in accordance with the requirements of ASTM F519 Type 1a.1 using four (4) round notched specimens (4340 steel at HRC 51-54), stressed in tension under sustained load to 75 percent Notch Fracture Strength (NFS) for 200 hours. If no fracture occurs, the process is considered non-embrittling.

b. If only one of a minimum of four specimens fractures within the 200 hour sustained load exposure time, the remaining three specimens may be step loaded in accordance with ASTM F519 after completion of the 200 hour sustain load. If the three remaining specimens all sustain 90 percent NFS for 2 hours, the plating/coating process shall be considered non-embrittling.

c. For hydrogen embrittlement relief test purposes the plating thickness shall be Class 1, 0.0005 inch minimum measured on the smooth section of the specimen, but with visual evidence of plating at the root of the notch. The notch and 0.5 inch on both sides of the notch sample shall be plated. The test samples shall be exposed to all steps of the documented plating process including surface preparation.

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4.6 Resampling and retesting. If any test fails to meet specified requirements, the parts in that lot may be stripped, pretreated, plated and post treated as specified herein and retested. Alternatively, all parts in the lot may be inspected for the non-conforming attribute, and the non-conforming parts may be stripped, pretreated, plated, and post treated as specified herein and then retested. When specified in the contract or order, for testing, if hydrogen embrittlement fails to meet test requirements, retesting in accordance with the procedures of ASTM F519 is permitted.

4.7 Stripping and re-plating. When stripping is performed, the method shall be approved by the CEA and shall not roughen, pit, or embrittle the basis metal or adversely affect part dimensions. When parts have been stripped and re-plated, the reprocessing shall be documented, and the CEA shall be informed.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful but is not mandatory.)

6.1 Intended use. The low hydrogen embrittlement alkaline Zn-Ni plating when post treated with a trivalent chromium conversion coating is intended as a cadmium and hexavalent chromium free plating process to provide corrosion resistance on steel aerospace components. The process can be used on lower strength steel alloys, corrosion resistant steel alloys, and copper based alloys. This process is non-embrittling to high strength steels and can meet the requirements for a non-embrittling process per ASTM F519. The deposit consists of a uniform zinc-nickel alloy containing 12-15 percent nickel. It has excellent heat and corrosion resistance, especially in high temperature applications.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Operations to be performed on the parts, if different than specified (see 3.2.2).
- c. Certification of stress relief, if required (see 3.2.3).
- d. Thickness of plating, as specified (see 3.4.3).

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- e. If a minimum plating thickness different than that specified in 3.4.3 is required.
- f. If different hydrogen embrittlement relief treatment is required (see 3.4.6).
- g. Control record requirement (see 4.2.1 and 6.4).
- h. Lot size, if different (see 4.3.1).
- i. Number of samples to be inspected from the lot for nondestructive tests, and for destructive tests, if the number of samples in a lot is four or less (see 4.4.1).
- j. Packaging requirements (see 5.1).

6.3 Part fabricator peening. Peening should be performed prior to plating by or on behalf of the part fabricator prior to plating or during overhaul of components.

6.4 Control records availability. Upon request of the CEA, such records as well as reports of the test results should be made available. These records should be maintained for not less than one year after completion of the contract or purchase order.

6.5 Equipment and processing. All instrumentation used to control, record or monitor process parameters should be calibrated. Processing tanks (except as noted in 6.5.2) made of polypropylene construction have been found to be satisfactory. Tank liners may be employed for compatibility with LHE alkaline zinc-nickel alloy infrastructure. An exhaust system is recommended to remove steam. Parts with deeply recessed areas may require auxiliary anodes. Plating solution is maintained between 68° - 78 °F (20° - 26 °C) with optimal coatings being accomplished between 75° - 77 °F (24° - 25 °C). The use of solution level controller technology is recommended to minimize volume changes associated with evaporative losses during electrodeposition.

6.5.1 Current. Either generated or rectified DC current may be used. Ripple value should not exceed 5 percent as measured by True RMS (AC voltage divided by the DC voltage multiplied by 100 when the rectifier is loaded).

6.5.2 Processing tanks. Tanks should be resistant to the operating temperature and the chemical environment that they are intended for. Tanks should be electrically insulated from purification units (pumps, filters, etc.), steam pipes, water pipes or agitation systems to prevent the possibility of stray currents or grounding.

6.5.2.1 Transferring solution. If transferring solution outside of plating tank is required for repair or maintenance, all associated equipment used including pumps, hoses, holding tanks, etc. should be chemically compatible with the solution.

6.5.3 Tank temperature. Processing tanks to be operated at temperatures other than room temperature should be equipped with automatic temperature indicating and regulating devices.

6.5.4 Measuring current. An ammeter should be placed in series with the LHE zinc-nickel alloy tank cathode. The ammeter should have sufficient shunts and switches to provide a

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full-scale reading equal to the maximum capacity of the power source, and an accuracy of  $\pm 10$  percent of the current being measured.

6.5.5 Blast cabinets. A blast cabinet should be located near the plating line. The size of the cabinet should be adequate to enclose the parts to be plated. Air lines should be suitably trapped and filtered to prevent in-process contamination of the parts to be cleaned.

6.6 Safety Data Sheet (SDS). 29 CFR 1910.1200 requires that the SDS for each hazardous chemical used in an operation must be readily available to personnel using the material. Contracting officers should identify the activities requiring copies of the SDS.

6.7 Subject term (key word) listing:  
Electroplating

## CONCLUDING MATERIAL

## Custodians:

Army - MR  
Navy - AS  
Air Force - 11

## Preparing activity:

Navy - AS

(Project MFFP-2020-007)

## Review activities:

Army - AR, AT, AV, MI  
Navy - OS, SH  
Air Force - 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.