

MIL-L-13762B

31 August 1983

SUPERSEDING

MIL-L-13762A(MR)

22 December 1969

MILITARY SPECIFICATION

LEAD ALLOY COATING, HOT DIP
(FOR IRON AND STEEL PARTS)

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

1. SCOPE

1.1 Scope. This specification covers lead alloy coating applied by the hot dip process to iron and steel surfaces for protection against corrosion.

1.2 Classification. Lead alloy coating shall be of the following types as specified (see 6.2):

- Type I - Low tin content
- Type II - Medium tin content
- Type III - High tin content

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, US Army Materials and Mechanics Research Center, ATTN: DRXMR-SMS, Watertown, MA 02172 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

NO DELIVERABLE DATA REQUIRED BY THIS DOCUMENT

/ AREA MFFP /

MIL-L-13762B

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

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

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

B117 - Method of Salt Spray (Fog) Testing

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

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Material. The lead alloys shall be of such quality as to produce coatings which meet the requirements hereinafter specified.

3.1.1 Basis metal. The basis metal shall be substantially free from defects which are considered detrimental to the appearance or protective effectiveness of the lead coating. Prior to coating, the surfaces shall be subjected to all the necessary cleaning, pickling, and finishing operations (see 3.2) to insure the deposition of lead coatings having the desired appearance and quality characteristics, as hereinafter specified.

3.1.2 Lead coating. The lead coating shall be smooth, fine-grained and adherent. The coating shall be free from blisters, rough surfaces, sharp projections, and other injurious defects. An iridescent appearance or presence of discoloration does not affect the quality of the lead coating and is, therefore, not considered a defect for the purpose of rejection.

3.2 General requirements.

MIL-L-13762B

3.2.1 Preparation of surfaces to be coated. Unless otherwise specified, the items to be coated shall be subjected to all the required mechanical operations, such as machining, brazing, welding, forming, and perforating, prior to the application of the specified type of lead coating. The cleaning and finishing operations shall be performed with minimum abrasion, erosion, or pitting of the surfaces.

3.2.2 Pre-coating heat treatment. All items made of metal having a hardness of Rockwell C40 or greater and at the direction of the procuring activity shall be given a suitable heat treatment to remove any objectionable residual stresses, prior to being subjected to the final cleaning and coating operations.

3.3 Detail requirements.

3.3.1 Composition. The lead coatings shall meet the following chemical requirements.

Type I

Lead, minimum	93.5 percent
Tin, minimum	5.0 percent
Other elements, maximum	1.0 percent

Type II

Lead, minimum	89.0 percent
Tin	6.5 to 8.5 percent
Bismuth, maximum	1.5 percent
Other elements, maximum	1.0 percent

Type III

Lead, minimum	67.0 percent
Tin, minimum	30.0 percent
Antimony, maximum	1.0 percent
Other elements, maximum	1.0 percent

3.3.2 Thickness of coating. The average minimum thickness of the lead coating on all significant surfaces of the coated items (see 6.3 and 6.4) shall be not less than 0.00028 inch. The minimum thickness of the coating at any point on the surface of the coated item shall be not less than 0.00021 inch. The thickness of the coating shall be determined as specified in 4.6.1.

3.3.3 Continuity of coating. The lead coating shall be continuous and reasonably uniform in thickness. It shall be free from bare or uncoated areas visible to the unaided eye. Pin holes (holidays) shall not be considered a defect to cause rejection of the material.

MIL-L-13762B

3.3.4 Salt-spray (fog) requirements. When subjected to the salt-spray test specified in 4.6.2 for the applicable continuous length of time shown in table I for the specified type of coating, the coating shall give satisfactory protection against corrosion. For purposes of evaluating the protective value of the coating, the following test results shall be considered satisfactory.

a. The formation of not more than 6 rust spots, none of which shall be larger than 1/16 inch in diameter, per square foot of coated surface; or

b. The formation of not more than 2 such rust spots when the coated surface area does not exceed 1/3 square foot.

The formation of any rust spot larger than 1/16 inch in diameter on any test specimen, regardless of total area of coated surface, or the occurrence of rust spots in excess of the limits specified above, shall be cause for rejection of the coating under test.

TABLE I. Salt-spray (fog) exposure of the lead coating

Type of coating	Salt spray exposure time, hours
I (Low tin content)	48
II (Medium tin content)	96
III (High tin content)	72

3.4 Adhesion. The adhesion of the coating shall be such that when examined at the magnification of approximately 4 diameters, it does not show separation from the basis metal at the interface when subjected to the test specified in 4.6.3. The interface between the lead and the basis metal is the surface of the basis metal before plating. The formation of cracks in the basis metal or plate which do not result in flaking, peeling, or blistering of the plate shall not be considered as nonconformance to this requirement.

3.5 Workmanship. All details of workmanship shall be in accordance with good commercial practice for the production of high-quality, hot dip, lead coating.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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.

MIL-L-13762B

4.2 Place of inspection and test. Unless otherwise specified, sampling, inspection, and tests shall be made at the place of manufacture.

4.3 Separate specimens. When the coated articles are of such form as to be not readily adaptable to a test specified herein, the test may be made by the use of separate specimens coated 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 condition and finish of surface prior to coating. For example, a smooth cold-rolled surface should not be employed for representing a hot-rolled surface, but due to the impracticability of hot forging or casting separate test specimens, hot-rolled specimens may be used when coated parts are hot forged or cast. The separate specimens may be strips approximately 1 inch wide, 4 inches long and 0.04 inch thick, for adhesion tests but shall be at least 4 inches wide, 6 inches long and approximately 0.04 inch thick for all other tests. These specimens shall be introduced into a lot at regular intervals prior to the cleaning operations preliminary to coating and shall not be separated therefrom until after completion of the processing. Conditions affecting the coating of the specimens shall correspond as nearly as possible to those affecting the significant surfaces of the articles represented.

4.4 Sampling.

4.4.1 Lot. A lot shall consist of coated articles of the same type, size and shape submitted for inspection at one time.

4.4.2 Sampling for examination. A random sample of articles prepared for coating (see 3.2) and of coated articles shall be selected from each lot in accordance with Inspection Level I of MIL-STD-105. The acceptable quality level (AQL) shall be 1.5 percent defective.

4.4.3 Sampling for tests. Four coated articles or strip specimens (see 4.3) shall be selected from each lot and subjected to the tests indicated in 4.6.

4.5 Inspection.

4.5.1 Examination. The uncoated samples selected as in 4.4.2 shall be examined for compliance with the requirements of 3.1.1 and 3.2. The coated samples selected shall be examined for compliance with the requirements of 3.1.2, 3.3.3 and 3.5. Any articles not complying shall be rejected, and if the number of rejected samples exceeds the acceptance number of the appropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected.

4.5.2 Testing. The samples selected as in 4.4.3 shall be subjected to all tests of 4.6. Failure to pass any test and noncompliance with the requirements of section 3 shall cause rejection of the lot.

4.6 Test methods.

MIL-L-13762B

4.6.1. Thickness. The thickness of the lead coating shall be determined by either the method of 4.6.1.1 or 4.6.1.2 except that the microscopic method of 4.6.1.2 shall be used for referee testing. The coating thickness shall be measured in several places on each article or specimen. Measurement of coating thickness on threaded articles such as screws, nuts and bolts shall be made on the shank or other smooth surface as nearly adjacent to the threads as practicable. If the minimum coating thickness on any sample is less than 0.00021 inch, the lot shall be rejected. The minimum thickness measured on each article shall be recorded and the average minimum thickness computed. The average minimum thickness shall be not less than 0.00028 inch (see 3.3.2).

4.6.1.1 Magnetic gaging. Any suitable magnetic gage may be used, provided the accuracy of the instrument is within a tolerance of ± 15 percent. In the case of lead coatings, the surface shall be first treated with a very light film of mineral oil to prevent the lead from adhering to the magnet.

4.6.1.2 Microscopic test for thickness. The specimen shall consist of a cross section of a significant surface suitably mounted and ground and polished. The thickness of coating at any desired point on the exposed section shall be measured by either of the methods described below. Specimens may be mounted in a plastic material such as a phenolic or acrylate resin. Flat specimens may be either mounted in pairs, coating-to-coating, or in clamps. Specimens that are not flat may be mounted against a piece of brass or steel conforming to the shape of the specimen. In mounting, care should be taken that voids do not form between the specimen and the mounting material. The minimum pressure must be applied in clamping lead coated specimens in order to prevent extrusion of the lead. The specimen shall be held rigidly and in such a position that the surface tested is perpendicular to the flat face that is to be ground and polished (a deviation of 10° from normal introduces an error of about 2 percent in thickness) or at a known angle, in which case the thickness measured must be corrected accordingly. The section to be examined shall be ground and polished by regular metallographic methods, using successively finer abrasives, the last of which shall not be coarser than 500 mesh. Polishing shall be done with minimum pressure from steel to lead, and alternately at 45° and 135° to the coated surface. The last polishing should be run at low speed (not exceeding 250 rpm).

4.6.1.2.1 The thickness shall be measured with a filar micrometer ocular that has been calibrated against a standard scale. The accuracy of the calibration shall be within ± 2 percent; or the method of measuring shall be as specified in 4.6.1.2.2.

4.6.1.2.2 The image of the specimen shall be projected at a known magnification on the ground-glass focusing plane of the camera of a metallographic microscope. The width of the projected line of deposit, when measured within a graduated linear scale, and divided by the magnification (for example, 500), gives the thickness of the coating.

MIL-L-13762B

4.6.2 Salt-spray (fog) test. The salt-spray (fog) test shall be made in accordance with ASTM B117 and for the lengths of time indicated in 3.3.4 for the applicable type of coating.

4.6.3 Adhesion (bend test). Separate strip specimens, prepared as described in 4.3, may be used to determine the adhesion of the coating. The test specimens shall be bent through an angle of 180° on a diameter equal to the thickness of the specimen and then carefully examined at four diameters magnification for evidence of non-adhesion. If the above specimens are not practically available, adhesion may be determined by scraping the surface of the coated article to expose the basis metal and examining the four diameters magnification to determine whether removal has been caused by the cutting away of an adherent plate or by the lifting of a non-adherent plate. Referee testing shall be performed by the bend test.

4.7 Retests. At the discretion of the procuring activity, articles rejected in the examination of 4.5.1 may be resubmitted for inspection after stripping and recoating or screening of the entire lot.

5. PACKAGING

5.1 Packaging requirements. There are no general packaging, packing, and marking requirements applicable to this specification. Preparation for delivery shall be as specified by the procuring activity.

6. NOTES

6.1 Intended use. Lead-tin alloy coatings are intended for corrosion protection and soldering. The addition of tin to lead improves the bond of the lead coating to steel and the wear and abrasion resistance without materially reducing the corrosion resistance.

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) Type required (see 1.2).
- (c) If pre-coating heat treatment is required (see 3.2.2).
- (d) Preparation for delivery (see 5.1).

6.3 In connection with the thickness requirements (see 3.2.2), it is intended that the thickness specified will apply to all visible surfaces which can be touched by a ball of 0.75 inch in diameter.

MIL-L-13762B

6.4 Significant surfaces (see 3.3.2) are those surfaces that are visible and subjected to wear and corrosion.

6.5 In connection with polishing specimens for the microscopic test (see 4.6.1.2), etching of lead on steel is not ordinarily considered necessary but a solution of 10 grams $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$, 2 ml. of concentrated hydrochloric acid, and 95 ml. of distilled water may be used.

Custodian:

Army - MK

Navy - SH

Air Force - ll

Preparing activity:

Army - MR

Review Activities:

Army - AR, AL, MI, ME, EA

Project No. MFFP-0153

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