

MIL-C-14538C

3 August 1983

SUPERSEDING

MIL-C-14538B(MR)

13 January 1975

MILITARY SPECIFICATION

CHROMIUM PLATING, BLACK (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 an electrodeposited black chromium finish. It is generally applied to steels but may be used as a plating for other metals such as brass, copper, iron and chromium (see 6.1, 6.3 and 6.4).

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.

STANDARDS

FEDERAL

Fed. Test Method Std. No. 595 - Colors

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.)

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

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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 - Standard Method of Salt Spray (Fog) Testing.

(Application for copies should be addressed to the American Society For Testing and Materials, 1916 Race St., Philadelphia, PA 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 Materials. Materials shall be selected by the contractor and they shall be of a quality consistent with the end result and performance specified herein.

3.2 Basis metal. The basis metal shall be free from visible defects that will be detrimental to the utility, appearance, or protective value of the plating.

3.2.1 Preplating operations. The contractor shall ascertain, prior to plating, that the items to be plated have undergone all required heat treatments and mechanical operations (machining, welding, brazing, forming, punching, grinding and similar operations). Unless otherwise specified by the procuring agency, no operations of the foregoing nature shall be performed on the items after plating nor shall the plated items be further processed in any way, except in cases where threading operations are required after plating.

3.2.2 Stress relief. Steel parts to be plated, having a Rockwell hardness in excess of C40 shall be stress relieved prior to plating by heating in an oven or in oil for one hour or more at a temperature of 300°F to 500°F (149° to 260°C). When this operation is omitted, the contractor shall furnish or make available objective evidence that the operation has been performed previously. After stress relief the hardness shall not be less than the initial hardness within the limit of error in taking hardness readings.

3.3 Cleaning. All items to be plated shall be cleaned thoroughly. Cleaning materials and methods shall be at the option of the contractor. The cleaning operations shall be performed without measurable abrasion of the surface and without contributing in any way to a defective end item.

3.4 Processing The processing for the application of the black chromium finish shall be as determined by the contractor. A solution that can be used for general application is outlined in 6.5.

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3.4.1 Hydrogen embrittlement relief. All steel parts having a hardness of Rockwell C40 and higher shall be baked at $375 \pm 25^{\circ}\text{F}$ ($191 \pm 14^{\circ}\text{C}$) for three hours or more after plating to provide hydrogen embrittlement relief. The baking shall begin within four hours after plating. Plated springs and other parts subject to flexure shall not be flexed prior to the baking operation.

3.5 Finish.

3.5.1 Uniformity. The black chromium finish shall be applied to the basis metal in such a manner as to be smooth and fine grained. It shall completely and uniformly cover all surfaces to be plated.

3.5.2 Luster. The finish shall be uniformly "dull" and without luster. Examination under controlled light shall show no "bright" spots due to wax, oil, or other causes.

3.5.3 Color. Unless otherwise specified the color of the deposit shall be a dark gray approaching black. It shall approximate color plate 37038 of Federal Standard No. 595. When a color sample is provided by the procuring agency it shall be matched for color. Solutions shall be so regulated and controlled as to give a smooth and uniform color as specified on all plated surfaces on the same order or contract (see 6.6).

3.5.4 Corrosion Resistance. After exposure to the salt spray fog for four hours as specified in paragraph 4.4.1, the specimens shall show no basis metal corrosion products when examined at normal reading distance. The presence of black streaks or stains shall not be cause for rejection.

3.6 Workmanship. The workmanship shall be of a quality to accomplish a thoroughly clean and contaminant free metal surface prior to the application of the black chromium finish together with a uniform and clean finish of the applied coating. Any evidence on the surface of discoloration, mottled effect, rainbowing, inadequate coverage, powdery deposits, blisters, pits, nodules or indications of burning shall be considered as defective workmanship.

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.

4.2 Lot. Unless otherwise specified, a lot shall consist of plated articles of the same material and condition, and of approximately the same size and shape, plated under similar conditions and submitted for inspection at the same time.

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4.3 Sampling.

4.3.1 Sampling for Inspection. Sampling shall be in accordance with MIL-STD-105, at inspection level S - 3, with an AQL 1.5 percent defective. Defects shall consist of deviations from the requirements specified in paragraphs 3.5 and 3.6.

4.3.2 For destructive tests. A random sample of four items shall be selected from each inspection lot, or four separate specimens shall be prepared in accordance with 4.3.2.1 to represent each inspection lot. If the number of items in an inspection lot is four or less, the number of items in the sample shall be determined by the procuring agency.

4.3.2.1 Separate specimens. When the plated articles are not readily adaptable to the test specified in 4.4.1 the test may 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, and should be at least 6 square inches on a side and 1/16 inch thick. The 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 the processing.

4.4 Acceptance tests.

4.4.1 Corrosion resistance. The test for corrosion resistance shall be performed on the specimens selected in accordance with paragraph 4.3.2. The specimens shall be subjected to a continuous test of four hours in 5% salt spray fog in accordance with ASTM Method B117 (see 3.5.4). Any failure from a lot shall reject the lot.

4.4.2 Samples used for test in 4.4.1 shall be discarded except as the procuring agency may permit replating and reinspection.

5. PACKAGING

5.1 Packaging requirements. Preparation for delivery is not applicable to this specification.

6. NOTES

6.1 Intended use. Black chromium plate is hard, adherent, heat resistant, and free of light-reflection, therefore, is suited to military applications where a non-reflecting black coating is desirable such as:

- (a) rocket launcher rails
- (b) interior surfaces of optical parts, and
- (c) small arms applications.

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This coating provides limited corrosion protection, but added protection can be obtained by specifying a corrosion resistant underplate such as nickel.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number and date of this specification.
- (b) Sample of color to be duplicated, if required.
- (c) Basis metal to be plated.
- (d) Specification for cleaning, if required (see 3.3).
- (e) Lot size, if different (see 4.2).
- (f) Evidence of stress relief if required (see 3.2.2).

6.3 Dimensional change. Black chromium deposits involve only a slight dimensional change of approximately 0.0002 inches. In the usual applications, however, the dimensional increase is of little or no importance. For that reason it has not been considered necessary to specify an exact thickness of coating which should be no more than necessary to meet the required performance.

6.4 Adaptability. Black chromium plate may be applied to metals the same as bright chromium plate. It may also be applied over bright chromium plate with an increase in plating time to obtain added corrosion protection.

6.5 Equipment and processing. Plating tanks of mild steel or polyvinyl chloride have been found entirely satisfactory. Lead or butyl rubber lined tanks are not suitable due to the high acetic acid content of the solution. Tanks need not be equipped with steam coils. An adequate exhaust system is required to remove the acetic acid fumes. Anodes of mild steel are preferred to carbon anodes due to the attrition of carbon anodes. Parts with deeply recessed areas may require auxiliary iron wire or platinum anodes as the throwing power of black chromium plating solution is not appreciably greater than that of ordinary chromium solutions. The processing operations require careful control and proper maintenance of the solution. Plating can be accomplished at normal room temperature or temperature as high as 110°F (44°C). The usual plating time is 30 to 45 minutes. Racks and hooks should be kept clean for good contact and have adequate current carrying capacity. A stable power supply of 6 to 12 volts at a current density of 40-90 amp. per sq. ft. is required. A solution that can be used for general application is as follows: (see 3.4)

Chromium Trioxide, Technical - CrO₃
Federal Specification 0-C-303

33-40 oz/gal.

Acetic Acid, Glacial, Technical-CH₃COOH
Federal Specification 0-A-76

28.2 oz/gal.(By wt)

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Water - H ₂ O	Remainder
Barium Carbonate, Powder - BaCO ₃ or	
Barium Acetate, Crystal - Ba(CH ₃ COO) ₂	1 oz/gal.

Whenever an addition of CrO₃ is made to the solution, barium carbonate or barium acetate should also be added.

6.5.1 Solution maintenance. The bath may become sluggish and exhibit poor throwing power in use. The addition of one gallon of water per one hundred gallons of solution will generally improve the throwing power.

6.5.2 Solution analysis. The chromic acid and acetic acid content is determined by using an electrometric titrator with standard 0.1 Normal sodium hydroxide as the titrant. A curve is also made from a standard solution made up according to the formula in 6.5. The chromic acid is determined by comparing the volumes of standard sodium hydroxide for the unknown with the standard at pH 3.7.

6.5.3.1 Acetic acid content is determined by a comparison of volumes at pH 5.7.

6.5.2.2 Trivalent chromium is determined by first oxidizing all the chromium to the hexavalent form and determining total chromium. Hexavalent chromium is determined by conventional methods. The difference is the trivalent chromium. A useful range is 8 to 12%.

6.5.3 Additional information. Further details on operation and solution analysis may be obtained by reference to Rock Island Arsenal Laboratory Report No. 55-2705 and Department of Commerce publication PB111830.

6.6 Color. The color is a dark gray approaching a dull black. It may be waxed or oiled to darken the surface.

Custodian:

Army - MR
Navy - SH
Air Force - 11

Preparing activity:

Army - MF

Review activities

Army - AF, AL

Project No. MFFP-0223

User activity:

Army - MI

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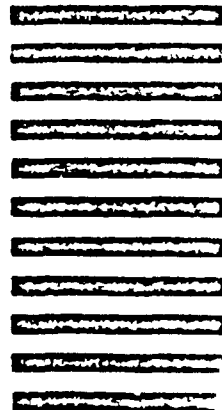


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