MIL-R-46085B
24 April 1984
SUPERSEDING
MIL-R-46085A
23 March 1972

MILITARY SPECIFICATION

RHODIUM PLATING, ELECTRODEPOSITED

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

1. SCOPE

1.1 Scope. This specification covers the requirements for the electrodeposition of rhodium over metallic surfaces.

1.2 Classification. Rhodium plating shall be of the following classes, as specified (see 6.2 and 6.6):

Class 1 -	0.000002	inch thick, minimum
Class 2 -	0.00001	inch thick, minimum
Class 3 -	0.00002	inch thick, minimum
Class 4 -	0.00010	inch thick, minimum
Class 5 -	0.00025	inch thick, minimum

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.

/ AREA MFFP /

NO DELIVERABLE DATA REQUIRED BY THIS DOCUMENT

SPECIFICATIONS

FEDERAL

QQ-N-290 - Nickel Plating, Electrodeposited

STANDARDS

FEDERAL

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

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)

B 487 - Measuring Metal and Oxide Coating Thickness by Microscopical Examination of a Cross-Section.

B 529 - Measurement of Coating Thickness by Eddy Current Test Method; Nonconductive Coatings on Nonmagnetic Basis Metals

E 8 - Tension Testing of Metallic Materials

(Copies may be obtained from 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 Preproduction sample. When specified in the invitation for bids, contract or order (see 6.2), samples of electrodeposited rhodium, representative of the class to be furnished in accordance with this specification, shall be subject to preproduction inspection and approval prior to submission of lots for acceptance inspection.

3.2 Material. The material used shall produce deposits which meet the requirements of this specification.

3.3 General requirements.

3.3.1 Plating application. Unless otherwise specified in the contract or order, the plating shall be applied after all machining, brazing, welding, forming, and perforating of the article have been completed.

3.3.2 Stress relief treatment. All ferrous parts having a hardness of Rockwell C33 and above which are machined, ground, cold formed or cold straightened shall be given a heat treatment at a minimum of 190°C (375°F) for 3 hours or more prior to cleaning and plating for the relief of damaging residual tensile stresses.

3.3.3 Embrittlement relief. All ferrous parts having a hardness of Rockwell C40 and higher shall be baked at a minimum of 190°C (375°F) for 3 hours or more, within 4 hours after plating to provide hydrogen embrittlement relief. The baked parts, when tested as specified in 4.5.4, shall not crack or fail by fracture. Plated springs and other parts subject to flexure shall not be flexed prior to hydrogen embrittlement relief treatment.

3.4 Preparation of surfaces for plating. Surfaces shall be electrocleaned or otherwise subjected to any cleaning process necessary to insure rhodium plating meeting the requirements specified herein. Unless specified otherwise, ferrous metals having a hardness of Rockwell C40 or higher shall not be cleaned cathodically or acid cleaned.

3.5 Underplating. Surfaces other than nickel, silver gold or platinum shall be nickel plated (or nickel over copper plated as applicable) in accordance with QQ-N-290. An underplating of nickel shall be used when parts are of corrosion or heat resistant steels. The nickel plating shall be of such a thickness that after rhodium plating, the drawing dimensions shall be met. The thickness of the underplating shall not be used in the determination of the rhodium plating as stated herein.

3.6 Thickness. Thickness of the plating shall be in accordance with the requirements of the class specified by the procuring agency (see 1.2). Unless otherwise specified, the minimum plating thickness shall be as specified on all visible surfaces which can be touched by a ball 0.75 inch in diameter.

3.7 Coverage. The plating shall cover all surfaces as stated in 3.6 including corners, recesses and roots of threads.

3.8 Adhesion. The adhesion of the rhodium plating and any undercoat(s) shall be such that when testing in accordance with 4.5.2 and examined at a magnification of four diameters, neither the rhodium plating nor any electrodeposited undercoat shall show separation from the basis metal or from each other at their common interfaces.

3.9 Finish. When required for reflective purposes, the plating shall be sufficiently smooth to give a reflectance of at least 75 percent when tested in accordance with 4.5.3 (see 6.2). The reflectance standard shall be as specified by the procuring activity.

3.9.1 Relief [illegible] specified with plating when [illegible] specified

3.10 Workmanship. The plated articles shall be of smooth surface and free of cracks, streaks, burns, milkiness, poor coverage, built-up edges, or any other defect which might adversely affect the use or function of the part.

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 supplies and services conform to prescribed requirements.

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

1. Preproduction sample inspection (see 4.3).
2. Lot acceptance inspection (see 4.4).

4.3 Preproduction sample inspection. When specified in the contract or order, prior to the production plating of any article, the contractor shall prepare preproduction samples representing the minimum acceptable plating quality to be used in production. The preproduction sample shall be articles of the same basis metal and prepared for plating by similar procedures to those applying to the articles to be plated in production. The preproduction samples selected in accordance with 4.4.2 and 4.4.3 shall be subjected to all examination and tests specified herein. Equivalent substitute specimens may be used in lieu of the actual articles to be plated in production subject to the provisions of 4.4.3.1. Unless otherwise specified in the contract or order, the Government will perform the examinations and test for preproduction acceptance at the contractor's plant. Preproduction samples which do not meet all the requirements of this specification shall be rejected and returned to the contractor. Before submitting another preproduction sample, full particulars concerning previous rejection and the action taken to correct the defects shall be made available to the contracting officer. Articles to be plated under this specification will not be considered for acceptance until approval of the preproduction samples has been obtained.

4.4 Lot acceptance inspection. Lot acceptance samples shall conform with the sampling procedures and tests specified herein.

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

4.4.2 Sampling for visual examination. Unless otherwise specified in the contract or order, samples for visual examination shall be obtained in accordance with MIL-STD-105, inspection level III, AQL (acceptable quality level) = 1.0 percent defective.

4.4.2.1 Visual examination. Samples selected in accordance with 4.4.2 shall be visually examined for compliance with the workmanship requirements (3.10).

4.4.3 Sampling for thickness, adhesion, finish and embrittlement relief. Unless otherwise specified in the contract or order, samples for thickness, adhesion, finish, and embrittlement relief shall be composed of a minimum of four plated articles selected at random from each lot.

4.4.3.1 Use of equivalent specimens. Unless otherwise specified in the contract or order, equivalent specimens may be included in a lot as substitutes for plated articles that are not suited to the tests specified herein. Equivalent specimens shall be of the same basis metal; shall be prepared for plating in the same manner as the article it is to represent and shall be plated concurrently with the article. Controllable conditions that affect the plating should be as nearly as possible the same for the equivalent specimens as for the represented article. The substitute specimens shall be 1 by 4 by 0.04 inches.

4.5 Test procedures.

4.5.1 Thickness of plating. For nondestructive measuring of plating thickness, procedures in accordance with Fed. Test Method No. 151, method 520 (electronic test) or ASTM B 529 (eddy current) may be used. For destructive measuring, the microscopic method in accordance with ASTM B 487 may be used. At the option of the supplier, other instruments such as those using the principle of beta radiation back scatter or x-ray fluorescence may be used. For plating thickness less than 0.0001 inch, microscopic, magnetic, or eddy current methods should not be used.

4.5.2 Adhesion test. The samples shall be repeatedly bent through an angle of 180 degress on a diameter equal to the thickness of the specimen until fracture of the basis metal occurs. Following fracture, it shall not be possible to detach areas of the coating by use of a pointed instrument. If the edge of the ruptured plate can be peeled back or if separation between rhodium or underplating and the basis metal, or any plating from each other can be seen at the point of rupture, when examined at 4 diameters magnification, adhesion is not satisfactory. The formation of cracks that do not result in flaking or peeling of the deposit shall not be considered as nonconforming to this requirement.

4.5.3 Finish test. When the rhodium plates surface is to be tested for reflectivity, a device similar to the one shown in figure 1 shall be used. The angle of reflection and incidence shall be measured at 45 degrees plus or minus 2 degrees. A flat surface shall be used for reflectivity tests.

4.5.4 Embrittlement relief. Samples of parts as specified in 4.4.3, which will be subjected to sustained tensile load in use, shall be subjected to a sustained tensile load equal to 80 ± 5 percent of the tensile yield strength of the material. The parts shall be held under the load for at least 100 hours and then examined for cracks. The lot shall be rejected if any plated part develops cracks. Parts which require special fixtures, extreme loads to comply with the above requirements, or where maximum design yield load is not known, may be represented by separate specimens. The configuration shall be in accordance with figure 8 of ASTM E 8. The notched specimens shall be subjected to a sustained tensile load equal to 75% 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.

4.6 Rejection.

4.6.1 Examination for defects. Any sample unit having one or more defects shall be rejected. If the number of nonconforming sample units in the sample exceeds the accpetance number specified in 4.4.2, the entire lot shall be rejected.

4.6.2 Thickness, adhesion, finish and embrittlement relief tests. A lot shall be rejected for failure to meet any of the test requirements when tested in accordance with 4.5.

4.7 Retest. Individual plated articles or lots of plated articles rejected as defective may be reprocessed and resubmitted for testing under conditions specified by the procuring agency.

5. PACKAGING

5.1 Packaging Requirements. Preparation for delivery shall be as specified by the detailed specification covering the item or order. If there are not detailed specifications, preparation for delivery shall be as specified in the contract or order.

6. NOTES

6.1 Intended use. Rhodium plating of metallic parts is intended to protect articles from corrosion, prevent galling of sliding electrical contacts, furnish a highly decorative finish and provide a mirror surface which is highly reflective and non-tarnishing.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number and date of this specification.
(b) Class of plating required (see 1.2).
(c) Whether a preproduction sample is required (see 3.1).
(d) If surface is required for reflective purposes (see 3.9).
(e) Sampling plan and acceptable quality level (see 4.4.2).
(f) Preparation for delivery requirements (see 5.1).

6.3 Application of rhodium. The article to be plated shall be placed in a plating bath in such a position that the surface to be plated will be completely covered by the solution. The temperature and concentration of the plating bath shall be established and accurately controlled together with voltage and current density in order to meet the requirements of this specification and the specified thickness.

6.4 Safety caution. In making up the plating bath, it is important that the acid be added to the water before adding the rhodium concentrate to prevent precipitation of rhodium compound of hydrolysis. Never add water to the concentrated acid, as explosive steaming may occur and throw acid from the container.

6.5 Handling. Plated parts should be handled with clean gloves and wrapped in neutral tissue paper for temporary storage.

6.6 Supersession data. This specification includes the requirements of Missile Purchase Description MPD-592B dated 31 January 1961 and MIL-R-46085A dated 18 June 1964. Table I gives cross-references between these documents.

Table I. Thickness cross-reference

MPD-592B	MIL-R-46085(MR)	MIL-R-46085A
Class 1	Class 1	Class 1
2	1	
3	2	2
4	2	
5	3	3
6	4	4
7	5	5

Note: No change in classification between MIL-R-46085A and MIL-R-46085B.

Custodian:

Army - MR
Air Force - 20
Navy - AS

Review interest:

Army - AR,
Air Force - 70, 99
Navy - AS

User interest:

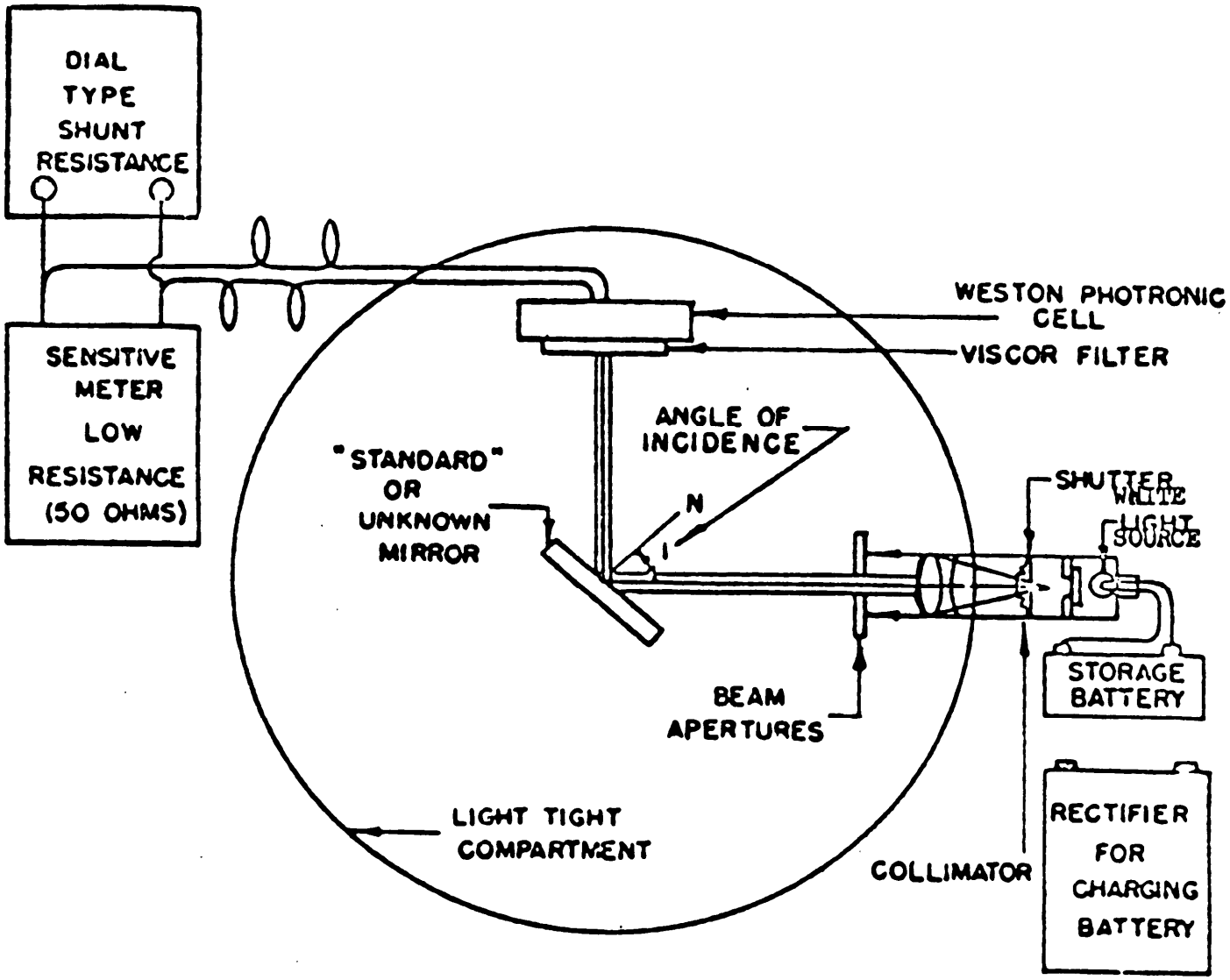
Army - MI

Preparing activity:

Army - MR

Project No. MFFP-0161

(KBWP# ID-0525A/DISK 0117A. FOR AMMRC USE ONLY)



THE LOAD RESISTANCE OF THE PHOTOCELL IS REDUCED BY METER ADJUSTMENT SHUNT.

FIGURE 1
FINISH TEST

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-R-46085B	

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

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