MIL-C-20218F
13 November 1984
SUPERSEDING
MIL-C-20218E
14 June 1968
(See 6.4)

MILITARY SPECIFICATION

CHROMIUM PLATING, ELECTRODEPOSITED, POROUS

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

1. SCOPE

1.1 Scope. This specification covers porous, electrodeposited chromium plating applied to surfaces where a lubricating film must be sustained such as cylinder bores.

1.2 Classification. Unless a specific type of porosity is specified (see 6.2.1), porous chromium plating may be one or more of the following types.

Type I - Channel
Type II - Pin point
Type III - Intermediate
Type V - Macro channel

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specification and standard. Unless otherwise specified, the following specification and standard 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.

SPECIFICATION

MILITARY

MIL-S-5002 - Surfaces Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362 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

STANDARD

MILITARY

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

(Copies of specification and standard required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 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. The materials used shall be such as to produce platings which meet the requirements of this specification.

3.2 General requirements.

3.2.1 Higher strength steel parts. Unless otherwise specified (see 6.2.1), steel parts having an ultimate tensile strength greater than 240 kilopounds per square inch (ksi) shall not be plated without specific approval of the contracting activity.

3.2.2 Stress relief treatment. Steel parts having an ultimate tensile strength of 150 ksi and above, which are machined, ground, cold formed or cold straightened, shall be baked at 375 ± 25 degrees Fahrenheit (°F) for 3 hours or more prior to cleaning and plating for the relief of damaging residual tensile stresses.

3.2.3 Cleaning. Unless otherwise specified (see 6.2.1), steel parts shall be cleaned in accordance with MIL-S-5002 with the exception that the control limits for tensile strength shall be in accordance with 3.2.1 and 3.2.2. Other basis metals shall be cleaned by methods which shall not damage the substrate and shall not interfere with adhesion of the deposit.

3.2.4 Plating application. Unless otherwise specified (see 6.2.1), the plating shall be applied after all basis metal heat treatments and mechanical operations, such as machining, brazing, welding, forming and perforating of the article, have been completed.

3.2.5 Plating process. The deposition of chromium shall be out of a chromic acid bath. It shall operate under conditions that shall produce a satisfactory bond between basis metal and the coating and produce porosity meeting this specification.

3.2.6 Plating thickness. The minimum radial thickness of chromium shall be 0.005 inch and the maximum radial thickness shall be 0.018 inch at any location on surface.

3.2.7 Electrodeposited alloy undercoating. Electrodeposited alloy undercoating system shall be as specified provided its thickness does not exceed 0.062 inch for ordinary strength steel and 0.026 inch for high strength steel (see 3.2.2) and 0.5 inch for cast iron (see 6.2.1). The porous chromium plating electrodeposited over the undercoat shall comply with all the requirements specified herein.

3.2.8 Embrittlement relief. Coated steel parts having a tensile strength of 160 ksi and higher shall be baked within 30 minutes after plating at 375 ± 25°F in accordance with the following schedule:

Minimum baking times

Tensile strength ksi	Time (at temperature) hours
160 - 180	3
180 - 220	8
220 and above	12

3.2.9 Coverage. The area to be plated shall be specified (see 6.2.1). The plating shall cover the entire area specified.

3.2.10 Boundaries. Unless otherwise specified (see 6.2.1), basis metal locations where sharp edges would be conducive to premature loss of adhesion or difficulty in throwing plating shall be rounded to at least 0.031-inch radius.

3.3 Detail requirements.

3.3.1 Porosity.

3.3.1.1 Percent porosity. Unless otherwise specified (see 6.2.1), the surface of the chromium after finishing shall have between 15 and 35 percent porosity over the area swept when tested in accordance with 4.2.2.

3.3.1.2 Porosity deviation. In any 2 inch square, where the average porosity is between 15 and 35 percent, an area 0.5 inch or less in diameter having porosity of less than 15 percent or greater than 35 percent but not exceeding 70 percent is acceptable unless otherwise specified (see 6.2.1). When the specified range of porosity includes percentages greater than 35 percent, then in any 2 inch square a portion thereof not exceeding 0.5 inch in diameter may have a percentage of porosity up to, but not exceeding 75 percent.

3.3.2 Types of porosity. Porosity shall be induced by electrochemical methods.

3.3.2.1 Channel. Type I chromium plating shall be in accordance with the characteristic network of channel type of surface porosity as shown on figures 1 through 3, inclusive.

3.3.2.2 Pin point. Type II chromium plating shall be in accordance with the characteristic pin point type of surface porosity as shown on figures 4 through 6, inclusive.

3.3.2.3 Intermediate. Type III chromium plating shall be in accordance with the characteristic structure between that of the channel and pin point type of surface porosity as shown on figures 7 through 9, inclusive.

3.3.2.4 Macro channel. Type V chromium plating shall be in accordance with the characteristic surface porosity as shown on figures 10 through 12, inclusive.

3.3.3 Plateaus.

3.3.3.1 Type I, channel. The average plateau size shall be not more than 0.035 inch equivalent diameter, when tested in accordance with 4.2.2.

3.3.3.2 Type V, macro channel. The average plateau size shall not be smaller than 0.003 inch nor larger than 0.007 inch when tested in accordance with 4.2.2 and as shown on figure 13.

3.3.4 Pitting.

3.3.4.1 Pits or unplated areas up to 0.062 inch in diameter, surrounded by an acceptable deposit of chromium, may be present in any number provided that in any 1 square inch (in^2), the porosity including pits is not greater than 40 percent.

3.3.4.2 Pits or unplated areas 0.062 inch and greater in diameter, but not exceeding 0.125 inch in diameter at the finished surface, surrounded by an acceptable deposit of chromium, may be present provided there are not more than three in any 1 in^2.

3.3.4.3 Pits or unplated areas greater than 0.125 inch diameter, but not exceeding 0.25 inch in diameter, measured at the finished surface outside the area swept by the compression rings, shall be acceptable provided there are not more than five such pits or unplated areas and that there are at least 4 inches of acceptable chromium plate between any two pits.

3.3.5 Final dimensions. After the final plating and finishing operation, dimensions shall be taken with a micrometer, and shall conform to dimensions specified in the applicable equipment drawing. The porous chromium plating may be finished to final size by grinding, lapping, honing or such other method, provided the degree of smoothness produced by the finishing process conforms to the applicable requirements of the equipment drawings.

3.3.6 Cleanliness. No loose particles of honing grit, chromium or other foreign matter shall be present.

3.3.7 Adhesion. The plating shall demonstrate good adhesion by its capability to withstand the necessary grinding/honing operations for final dimensions.

3.3.8 Workmanship.

3.3.8.1 Basis metal. The basis metal shall be free from visible defects that will be detrimental to the appearance or protective value of the plating. The basis metal shall be subjected to such cleaning and plating procedures as necessary to yield deposits specified herein.

3.3.8.2 Plating. The plating shall be smooth, fine grained, adherent, uniform in appearance, free from blisters, pits, nodules, excessive edge build-up and other defects except as specified herein. The plating shall show no indication of contamination or improper operation of equipment used to produce the deposit, such as excessively powdered or darkened plating, buildup and other defects. Superficial staining which has been demonstrated as resulting from rinsing or slight discoloration resulting from baking operations to relieve embrittlement, as specified (see 3.2.8), shall not be cause for rejection.

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. Inspection. Each chromium plated part shall be inspected employing such mounting, illumination, optical and mechanical instruments as are necessary to facilitate examination and to verify compliance with the technical requirements specified herein. Any part which fails to conform to any of the requirements specified herein shall be rejected. Any part rejected because of defective plating may be replated provided all the chromium is completely removed prior to replating and the removal process employed has no deleterious effect on the part.

4.2.1 Examination. Each part shall be visually and dimensionally examined to determine the extent to which the chromium plating is in accordance with 3.2.6, 3.2.7, 3.2.9, 3.2.10, 3.3.4, 3.3.5, 3.3.6, 3.3.7 and 3.3.8. The examination shall be conducted also to assure freedom from defects and nonconforming quality characteristics in accordance with table I and MIL-STD-105.

TABLE I. Classification of defects.

Categories	Defects
Critical:	None defined.
Major:	
101	Porosity type not as specified (channel, pin point, intermediate, macro channel).
102	Electrodeposited coating nonconforming: porosity not within percentage range, materials used in the plating process not suitable for the applicable item: coating not homogeneous or uniform in appearance, not free from nodules or blisters, evidence of "milky" or "burnt" areas, excessive pitting, excessive "tree rooting".
103	Evidence of improper bond with basis metal.
104	Radial thickness of plating less than the allowable minimum.
105	Surface not finish honed, lapped or ground; not suitably smooth; not free from toolmarks, gouges, chatter marks or areas "not cleaned up" at the final finishing operations.
106	Plating not covering the area specified.
107	Edges not properly rounded at ports and ends; excessive edge buildup; surfaces not free of burrs.
108	Dimensions not within requirements of the approved equipment drawings.
109	Unplated surfaces of part nicked, gouged, galled or not free of plating deposits.
110	Evidence of inadequate cleaning; surface voids not free of abrasive or loose material.
111	Evidence of improper removal of defective plating (during rework) having a deleterious effect (when applicable).
112	Unauthorized use of electrodeposited alloy undercoating.
Minor:	None defined.

4.2.2 Porosity. Each part shall be examined microscopically at 50X diameters magnification and compared with photomicrographic standards as shown on figures 1 through 12, inclusive, to determine: (a) whether or not the surface porosity of the plating conforms to the percent porosity, type of porosity, pit size and quantity, and plateau size in accordance with 3.3.3.1 and as shown on figure 13; and (b) when applicable, that the observed porosity is within the range specified in the contract, order or applicable equipment drawings.

4.2.3 Test for cleanliness of plating. Strips of pressure sensitive tape, approximately 2 inches by 3/4 inch shall be applied to representative areas of the surface. Upon removal, there shall be no evidence of particles adhering to the tape.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

6.1 Intended use. Electrodeposited chromium plating, covered in this specification, is intended for use on surfaces where a lubricating film must be sustained.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number and date of this specification.
(b) Whether a specific type is required (see 1.2).
(c) Permission to plate parts over 240 ksi tensile strength (see 3.2.1).
(d) Method of cleaning of steel, if other than specified (see 3.2.3).
(e) If plating application is other than specified (see 3.2.4).
(f) Undercoating system, composition and thickness (see 3.2.7).
(g) Area to be plated (see 3.2.9).
(h) Instances where rounding of edges is prohibited (see 3.2.10).
(i) An alternative limiting range of porosity when required (see 3.3.1.1).
(j) If porosity deviation is other than specified (see 3.3.1.2).

6.2.2 The manufacturer of the basis metal parts should provide the plating facility with the following data:

(a) Strength level of steel parts (see 3.2.1 and 3.2.2).
(b) Heat treatment for stress relief, whether it has been performed or is required (see 3.2.2).

6.3 Porous chromium platings.

6.3.1 The photomicrographic standards of porosity (see figures 1 through 12 inclusive) represent fields for illumination such that the plateaus of chromium plate appear bright and the surface voids (channels or pits) appear black.

6.3.2 Types I, II, III and V porous chromium platings are interchangeable and equal in serviceability. Type designations are for the purpose of guidance in determining which set of photomicrographic standards to use for inspection and as identification of porosity type. Types I, II, III and V are suitable as replacements for type IV which is no longer used.

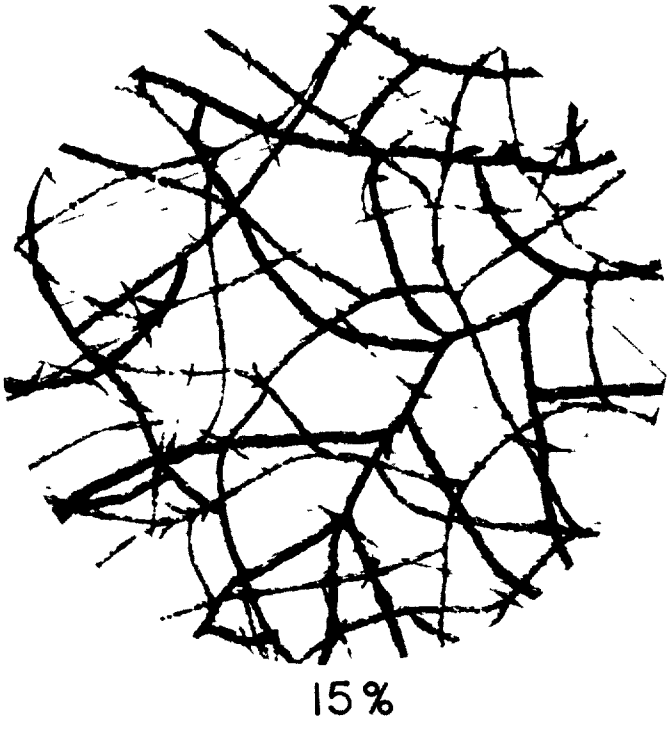
6.4 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:
Army - ME
Navy - SH

Review activity:
Army - MR

User activity:
Army - AT

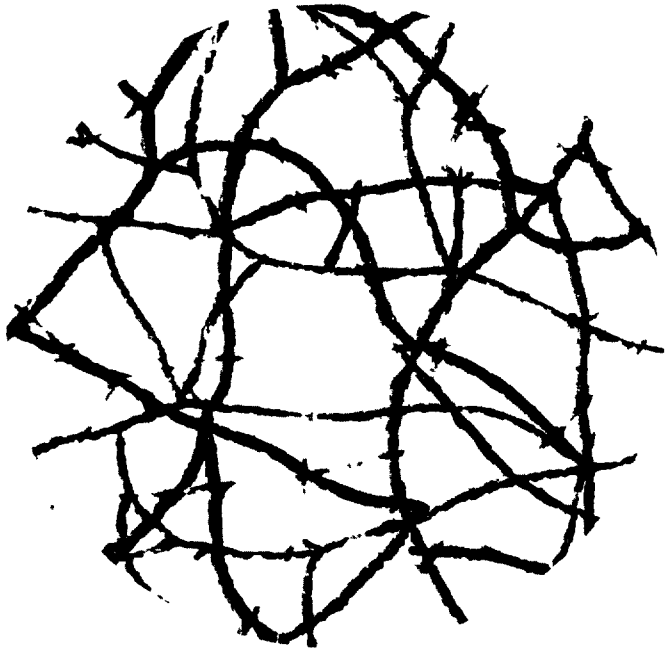
Preparing activity:
Navy - SH
(Project MFFP-0299)



SH 3839

Magnification: 50X

FIGURE 1. Type I, channel, 15 percent.

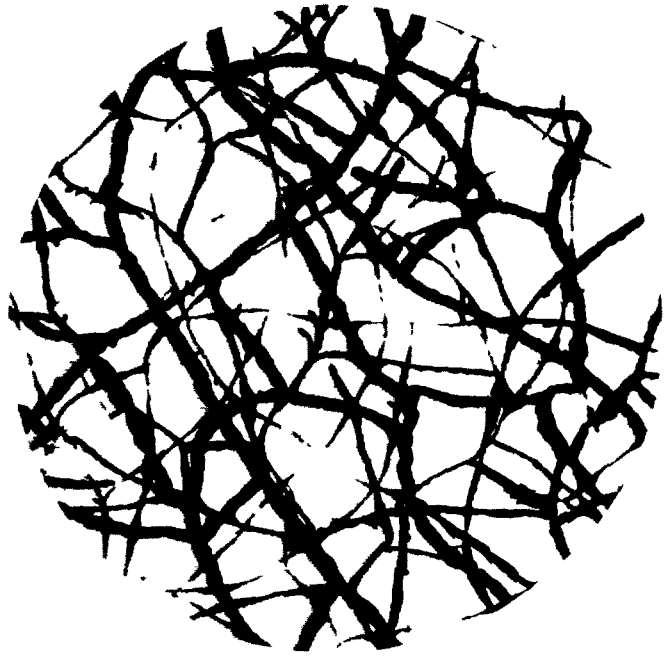


20 %

SH 3840

Magnification: 50X

FIGURE 2. Type I, channel, 20 percent.



30 %

SH 3841

Magnification: 50X

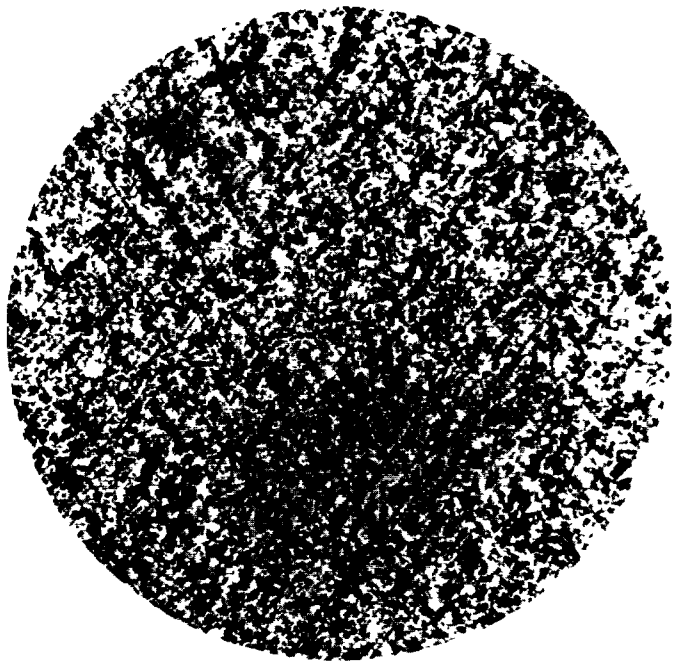
FIGURE 3. Type I, channel, 30 percent.

15%

SH 3845

Magnification: 50X

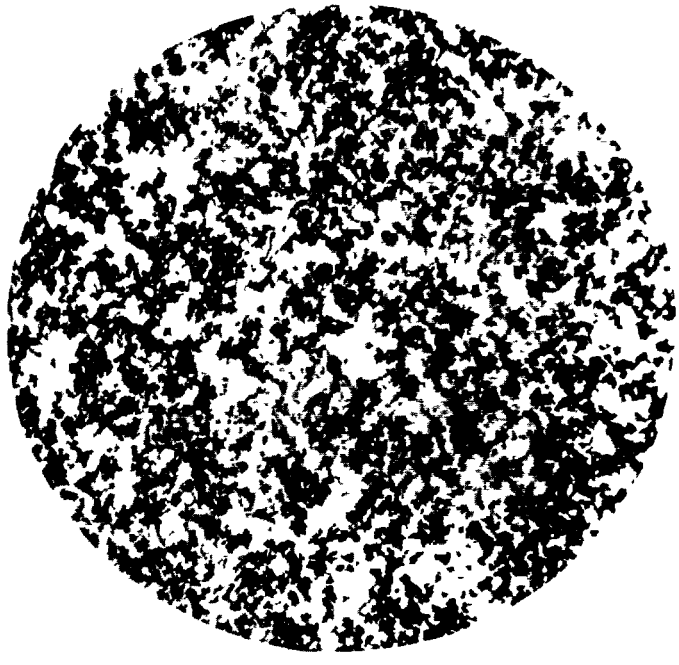
FIGURE 4. Type II, pin point, 15 percent.



SH 3846

Magnification: 50X

FIGURE 5. Type II, pin point, 20 percent.

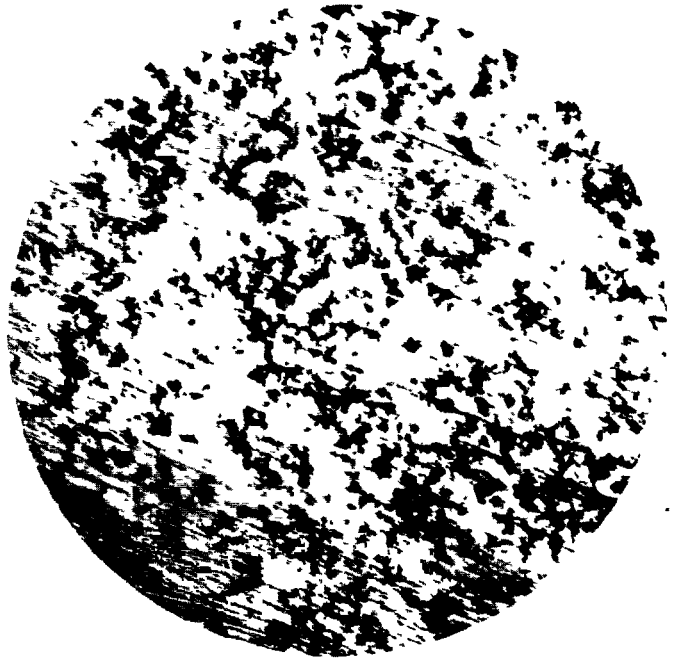


30 %

SH 3847

Magnification: 50X

FIGURE 6. Type II, pin point, 30 percent.

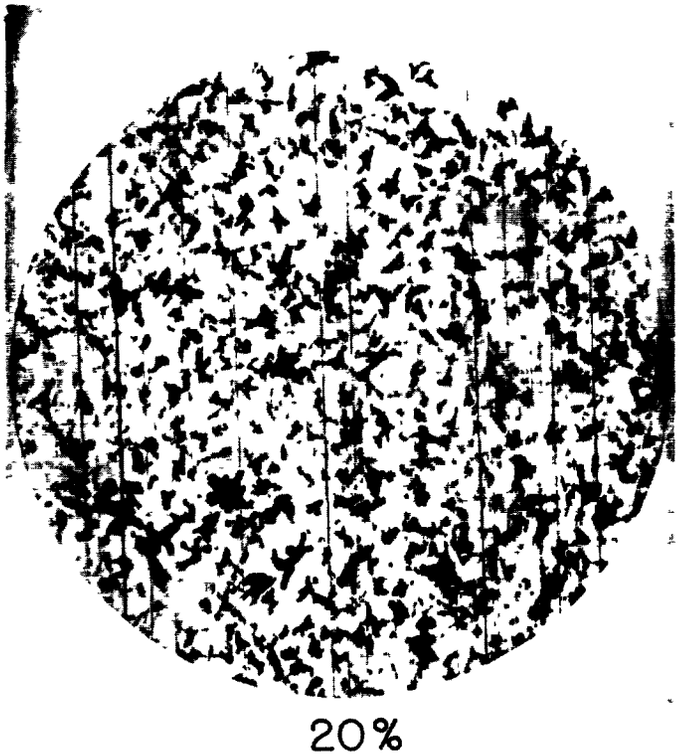


15%

SH 3851

Magnification: 50X

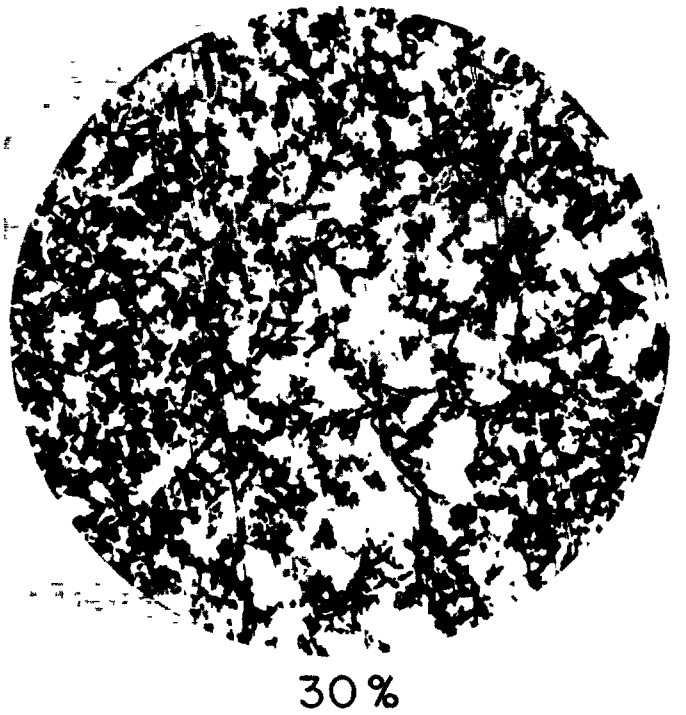
FIGURE 7. Type III, intermediate, 15 percent.



SH 3852

Magnification: 50X

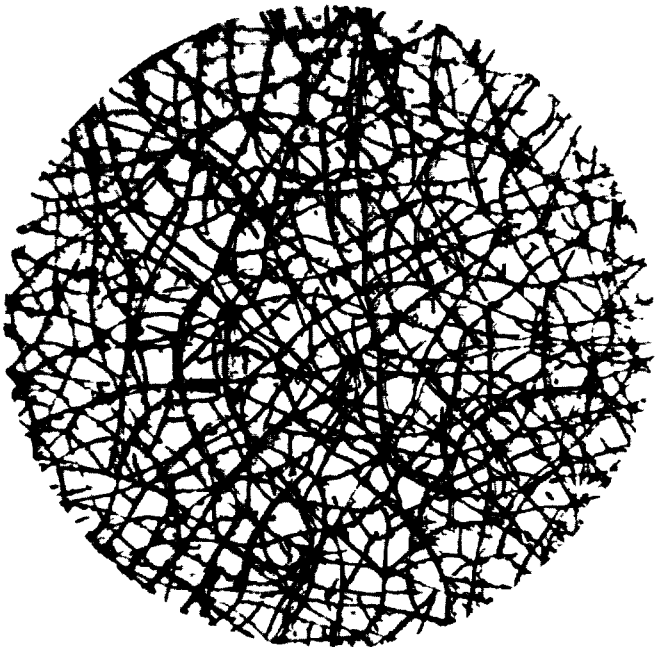
FIGURE 8. Type III, intermediate, 20 percent.



SH 3853

Magnification: 50X

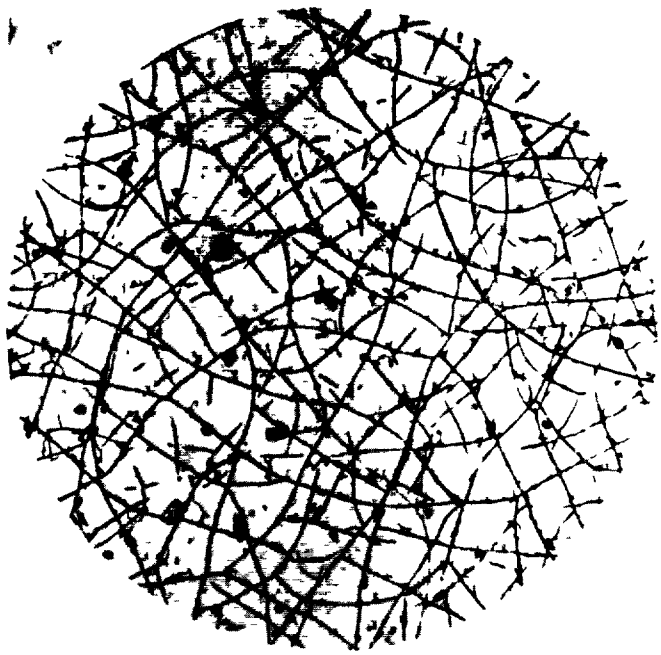
FIGURE 9. Type III, intermediate 30 percent.



SH 12653

Magnification: 50X

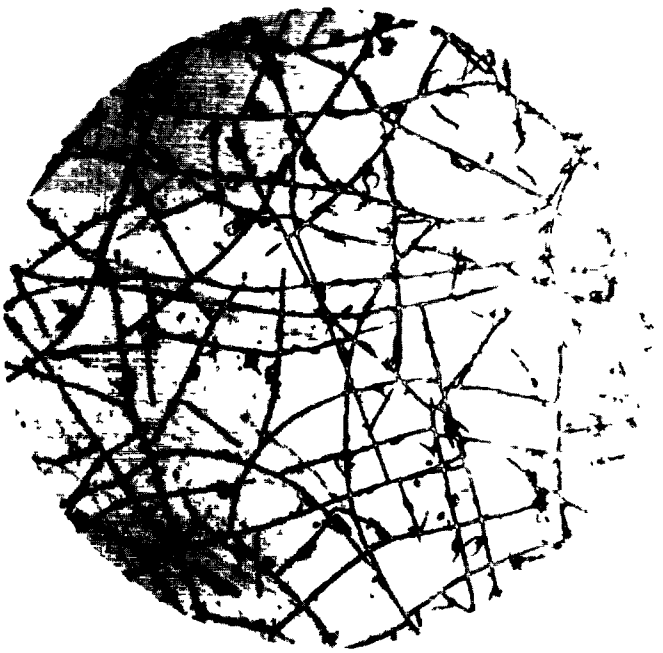
FIGURE 10. Type V, macro channel.



SH 12654

Magnification: 50X

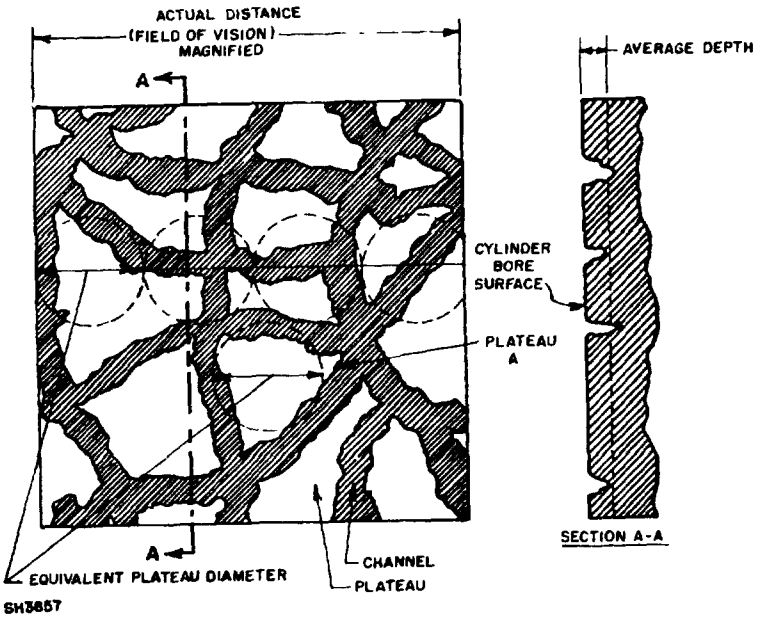
FIGURE 11. Type V, macro channel.



SH 12655

Magnification: 50X

FIGURE 12. Type V, macro channel.



AVERAGE PLATEAU SIZE DETERMINATION

A SELECT A PLATEAU OF AVERAGE SIZE.
B. COUNT THE NUMBER OF PLATEAUS OF THE SIZE SELECTED ABOVE WHICH COULD BE PLACED IN A STRAIGHT LINE ACROSS THE FIELD OF VISION.
C. DIVIDE THE ACTUAL DISTANCE COVERED BY FIELD OF VISION BY NUMBER OF PLATEAUS DETERMINED UNDER "B", THE RESULT OF WHICH WILL BE CALLED THE AVERAGE EQUIVALENT PLATEAU DIAMETER.

FIGURE 13. Plateau size determination (type I, channel and type V, macro channel).

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1 DOCUMENT NUMBER	2 DOCUMENT TITLE
MIL-C-20218F	Chromium Plating, Electrodeposited, Porous

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