

O-F-499D
 February 6, 1985
 SUPERSEDING
 O-F-499C
 January 17, 1963
 (See 6.4)

FEDERAL SPECIFICATION

FLUX, BRAZING, (SILVER BRAZING FILLER METAL, LOW MELTING POINT)

This specification was approved by the Assistant Administrator, Office of Federal Supply and Services, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers low-melting-point fluxes for use with silver brazing filler metal in brazing ferrous and nonferrous metals, excluding light metals and their alloys.

1.2 Classification.

1.2.1 Types. The brazing fluxes covered by this specification shall be of the following types as specified (see 6.2):

- Type A flux - Fluxing agent for aluminum bronze.
- Type B flux - Fluxing agent for general usage except for aluminum bronze.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

Federal Specifications

- QQ-B-654 - Brazing Alloys, Silver.
- PPP-B-576 - Boxes, Wood, Cleated, Veneer, Paper Overlaid.
- PPP-B-585 - Boxes, Wood, Wirebound.
- PPP-B-591 - Boxes, Shipping, Fiberboard, Wood-Cleated.
- PPP-B-601 - Boxes, Wood, Cleated-Plywood.
- PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner.
- PPP-B-636 - Boxes, Shipping, Fiberboard.
- PPP-B-640 - Boxes, Fiberboard, Corrugated, Triple Wall.
- PPP-C-186 - Containers, Packaging and Packing for Drugs, Chemicals, and Pharmaceuticals.
- PPP-T-76 - Tape, Packaging, Paper (For Carton Sealing).

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Federal Standards

- FED-STD-123 - Marking for Shipment (Civil Agencies).
 FED-STD-313 - Material Safety Data Sheets; Preparation
 and Submission of.

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions as outlined under General Information in the Index of Federal Specifications, Standards and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

(Single copies of this specification, and other Federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Seattle, WA.)

(Federal Government activities may obtain copies of Federal standardization documents and the Index of Federal Specifications, Standards and Commercial Item Descriptions from established distribution points in their agencies.)

Military Standards

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by
 Attributes.
 MIL-STD-129 - Marking for Shipment and Storage.

(Copies of military specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

Federal Regulations

- Code of Federal Regulations (CFR)
 CFR Title 29 - OSHA, U.S. Department of Labor, General Industry.
 CFR Title 49 - Department of Transportation (DoT) Rules and
 Regulations for the Transportation of
 Explosives and Other Dangerous Articles.

(The Code of Federal Regulations (CFR) and the Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Reprints of certain regulations and application forms for registration of ecologic poisons may be obtained from the Pesticides Regulation Division, Environmental Protection Agency, Washington, DC 20460.)

2.2 Other publications. The following document forms 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.

ASTM

D 3951 - Commercial Packaging, Practice For. (DoD adopted)

(Application for copies should be addressed to ASTM, 1916 Race Street, 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 and composition.

3.1.1 Brazing fluxes shall be compounded from chemicals of technical grade or better, and shall be free of all foreign substances in excess of the impurities normally contained in the materials.

3.1.1.1 Type A flux shall be composed of technical-grade salts (chlorides, fluorides, and borates) having the following elements and ratios:

Elements	Ratios ^{1/}
Lithium -----	1.0
Potassium -----	23.3
Zinc -----	3.6
Boron -----	9.4
Fluorine -----	24.4
Chlorine -----	13.7
Aluminum -----	0.8

^{1/} Allowable variations permitted for each element, plus or minus 10 percent.

3.1.2 Water content shall not exceed 35 percent by weight.

3.1.3 Sodium shall not be present in sufficient amount to cause glare when used.

3.1.4 The compositions of fluxes shall be so adjusted that the hydrogen-ion concentration (pH) (in the as received concentration) shall be as follows:

Type A - 3.0 to 7.5.
Type B - 7.0 to 10.0.

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3.2 Consistency. Fluxes shall be in the form of a thick creamy paste of uniform consistency and shall not contain lumps or crystals larger than will pass through a U.S. sieve 40-mesh screen. Fluxes shall have a brushable consistency after they have been stirred. Supernatant liquid, if any, shall be mixed in with the bulk of the flux.

3.3 Stability. Stability shall be such that the flux will conform to this specification after storage in the original unopened containers for a 12 month period (see 6.3).

3.4 Performance.

3.4.1 Wettability. Fluxes shall be capable of completely wetting a clean, dry metallic surface (see 4.4.4.1).

3.4.2 Fluxing ability. Fluxes shall be capable of protecting a clean, dry metallic surface from oxidation during heating. Fluxes shall be sufficiently active at a low enough temperature that the flow of silver brazing filler metal shall be unimpeded by any residual metallic oxides when using the following:

- (a) Type A flux and silver brazing filler metal QQ-B-654 flowing and active from 1100 to 1600 degrees Fahrenheit ($^{\circ}$ F).
- (b) Type B flux and silver brazing filler metal QQ-B-654 flowing and active from 1050 to 1600 $^{\circ}$ F.

These functions shall persist throughout the temperature range of brazing operations (see 4.4.4.2.1) and shall not be attended by undue bubbling or gassing. Flux residue shall be easily removable with warm water and a light brushing action or by immersion in a suitable chemical solution (see 4.4.4.2.1 and 4.4.4.2.2).

3.4.2.1 Temperature indications. In the course of applying heat to flux-coated surfaces, increase in temperature of joint members will cause physical changes in the appearance of the flux. The following is presented for information:

Temperature ($^{\circ}$ F)	Indications
200 - 250	Water boils off
550 - 650	Becomes white or puffy
750 - 850	Starts to boil
1000 - 1100	Becomes transparent

3.4.3 Adherence. Flux shall not shrink and ball up or crack upon being heated. When molten, it shall maintain sufficient affinity for a clean metallic surface to insure adherence thereto during heating through a temperature of not less than 1300 $^{\circ}$ F (see 4.4.4.3.1 and 4.4.4.3.2).

3.4.4 Life. The flux shall maintain its activity and continue to exhibit fluxing and adherence ability after 10 minutes at brazing temperature to the extent necessary to conduct the tests as specified in 4.4.4.4.1 or 4.4.4.4.2.

3.4.5 Quality of joints. Lap joints shall be producible, with the low melting filler metals as specified in QQ-B-654 and flux conforming to this specification, in which the aggregate area of defects (voids plus inclusions) shall not exceed 15 percent of the area of the faying surface and the maximum length of a defect shall not exceed 15 percent of the overlap distance (see 4.4.4.5.1 and 4.4.4.5.2).

3.5 Material safety data sheet. The contracting activity shall be provided a material safety data sheet (MSDS) at the time of contract award. The MSDS is form OSHA-20 and found as part of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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 Sampling for quality conformance inspection.

4.2.1 Inspection lot. For purposes of sampling, a lot shall consist of all flux of the same type manufactured as one batch and offered for delivery at the same time. Each batch shall be given a unique code number or designation.

4.2.2 Sampling for examination of filled outer shipping containers. A random sample of shipping containers filled with unit packages shall be selected in accordance with MIL-STD-105 at inspection level I and acceptable quality level = 2.5 percent defective to verify compliance with 4.3.1.

4.2.3 Sampling for examination of filled unit packages. Prior to packing or upon satisfactory completion of examination of filled shipping containers, a representative sample of filled unit packages shall be selected in accordance with MIL-STD-105 at inspection level I and acceptable quality level = 2.5 percent defective to verify compliance with 4.3.2.

4.2.4 Sampling for tests. One jar of flux shall be selected at random and used in the quality conformance tests as specified in 4.3.3.

4.3 Quality conformance inspection.

4.3.1 Examination of filled outer shipping containers. Each of the filled shipping containers selected in accordance with 4.2.2 shall be examined for defects of construction, unsatisfactory markings and proper closure. Any filled shipping container with one or more defects shall be counted a defective unit. If the number of the defective filled shipping containers exceeds the acceptance number for the appropriate sampling plan as specified in MIL-STD-105, the lot represented by the sample shall not be offered for delivery.

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4.3.2 Examination of filled unit packages. Each of the filled unit packages selected in accordance with 4.2.3 shall be examined for marking for weight of contents and for proper closure. Any unit package with one or more defects shall be counted a defective unit. If the number of defective unit packages exceeds the acceptance number for the appropriate sampling plan as specified in MIL-STD-105, the lot represented by the sample shall not be offered for delivery.

4.3.3 Quality conformance tests. The sample selected in accordance with 4.2.4 shall be subjected to the tests specified in 4.4. Quality conformance testing will not be required on subsequent lots of the same batch where documentation shows that the batch previously met all quality conformance tests requirements.

4.4 Tests.

4.4.1 Composition.

4.4.1.1 Water content. Weigh to the nearest centigram a 3-gram sample of well-mixed material in a tared 50 milliliter (mL) beaker. Nest the beaker with sample in a mass of silica gel (freshly activated gel with a small quantity of blue gel dispersed to indicate activity) placed in a desiccator. Cover the desiccator tightly and allow to remain for 24 hours. Reweigh the beaker and calculate the percentage of water as follows for conformance with 3.1.1:

$$\text{Percentage water} = \frac{(A - B)}{A} \times 100$$

where:

A = original weight of sample.

B = weight of sample after drying.

4.4.1.2 pH value. The pH of the flux, as received, shall be determined by any convenient method normally yielding results accurate within 10 percent of the value determined for conformance with 3.1.2.

4.4.1.3 Sodium. A soft, blue oxyacetylene torch flame played across a flux-coated piece of metal shall not cause a strong sodium glare. In case of question an atomic absorption determination may be made, in which case the sodium lines shall not be stronger than those obtained from a pure flux to which 0.04 percent sodium (as borax) has been added. Conformance with 3.1 shall be checked.

4.4.1.4 Principal elements (type A). The principal elements for type A flux shall be determined by the wet gravimetric or spectographic method.

4.4.2 Consistency. Conformance with 3.2 shall be visually checked by lightly brushing a 2 ounce sample (approximately) through a U.S. sieve 40 mesh screen and inspecting for any residual large particles on the screen. The flux shall also be tested for wettability and application (brushability) as specified in 4.4.4.1.

4.4.3 Stability. A flux sample heated in a suitable noble metal (gold, silver, platinum) crucible to 1600°F shall not, while held at this temperature for 30 minutes, change perceptibly in physical characteristics. On cooling, type A and type B flux shall remain in the liquid phase at 1100 and 1050°F respectively.

4.4.4 Performance tests.

4.4.4.1 Wettability - types A and B. A 1/16-inch thick by 1-1/4 by 4-inch sheet of plain carbon-steel shall be polished with a medium fine grade of coated abrasive paper or cloth until bright, then oiled with light petroleum oil, then carefully wiped dry with a clean dry cloth. A 1/2-inch wide flux brush generously coated with flux shall be drawn lengthwise across the surface. The coating of flux deposited shall be uniform and continuous, and shall be free from water breaks or other areas of nonadherence. Satisfactory and unsatisfactory flux coatings are shown on figure 1.

4.4.4.2 Fluxing ability.

4.4.4.2.1 Type A. Sheets 1-1/4 inches square and approximately 1/16-inch thick of aluminum bronze (2 to 7-1/2 percent aluminum) shall be polished with a medium-fine grade of coated abrasive paper or cloth. The cleaned test panel shall then be coated with a continuous layer of flux (0.7 gram evenly distributed.) A 1/2-inch length of 1/16-inch diameter silver brazing-filler metal wire, grade IV as specified in QQ-B-654, separately coated with flux, shall be placed on each fluxed metal specimen. The pieces shall be placed flat, fluxed side up, on a 1/16-inch thick copper sheet and held in a furnace at 1300°F for 1 minute after the test specimen reaches temperature. The furnace should be of sufficient size that temperature recovery is rapid. The molten brazing filler metal shall spread to cover an area not smaller than 0.25 square inch.

4.4.4.2.2 Type B. Sheets 1-1/4 inches square and approximately 1/16-inch thick of copper, stainless steel, and low carbon steel shall be polished and tested as specified in 4.4.4.2.1. The molten brazing filler metal shall spread out on each of the three metals to cover an area not smaller than 0.25 square inch.

4.4.4.3 Adherence.

4.4.4.3.1 Type A. A degreased and emiered (#3-0) surface of a 1/16-inch thick by 1-1/4 by 2-1/2 inches aluminum bronze sheet (2 to 7-1/2 percent aluminum) shall be generously coated with flux and placed in an inclined position (the long side approximately 60 degrees from horizontal) in a furnace operating at 1300°F. Upon removal after 3 minutes total elapsed time, not more than 20 percent of the vertical surface shall have become denuded of flux (see figure 2).

4.4.4.3.2 Type B. A buffed and degreased surface of a 1/16-inch thick by 1-1/4 by 2-1/2-inch plain carbon steel sheet shall be generously coated with flux and placed in an upright position (approximately 90 degrees from horizontal) in a furnace operating at 1300°F. Upon removal after 3 minutes total elapsed time, not more than 15 percent of the vertical surface shall have become denuded of flux (see figure 2).

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4.4.4.4 Life.

4.4.4.4.1 Type A. A 1/16-inch thick by 1-1/4 inch square specimen of aluminum bronze (2 to 7-1/2 percent aluminum) shall be prepared in the same manner as specified in 4.4.4.2.1, and coated with 0.7 gram of flux. The flux coated specimen shall be placed in a flat position in a furnace operating at 1300°F. After 10 minutes total elapsed time, a 1/2-inch length of 1/16-inch diameter silver-brazing filler metal conforming to grade IV of QQ-B-654, not fluxed, shall be dropped onto the center of the hot test piece. The furnace shall then be closed for 1/2 minute longer, after which the piece shall be removed. The filler metal shall have flowed to wet the specimen, but no specified area need be covered.

4.4.4.4.2 Type B. Using type B flux, a specimen of carbon steel with dimensions specified in 4.4.4.2.2 shall be prepared and subjected to the same conditions of testing specified in 4.4.4.4.1. The filler metal shall have flowed to wet the specimen, but no specific area need be covered.

4.4.4.5 Joint quality.

4.4.4.5.1 Type A. One face of each of four 1/16-inch thick by 1-1/4 by 4 inches aluminum bronze strips (2 to 7-1/2 percent aluminum) shall be polished with a medium-fine grade of coated abrasive. These faces shall then be coated with a uniform application of type A flux and assembled in pairs with the longitudinal edges overlapped 1/2 inch and separated 0.005 inch by means of a small piece of shim stock at each end. Small "C" clamps may be applied to outer surfaces over shims to hold strips in position. Using suitably fluxed preplaced silver brazing filler metal preforms (0.062-inch diameter by 1 inch long) conforming to grade IV of QQ-B-654, one joint shall be fabricated by torch and one by furnace. Joints shall be peeled apart and examined visually for conformance with 3.4.5.

4.4.4.5.2 Type B. Using type B flux, flat carbon-steel strips 1/16 by 1-1/4 by 4 inches shall be prepared, joined and tested; and the results evaluated as specified in 4.4.4.5.1.

4.5 Certificate of test. A certificate of quality conformance inspection shall be furnished for each lot. The certificate shall be signed by a responsible company employee verifying that the quality conformance examinations and tests were conducted and that all requirements of this specification have been met.

4.6 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government acquisition.)

5.1 Packaging. Packaging shall be level A, C or commercial, as specified (see 6.2).

5.1.1 Level A packaging.

5.1.1.1 Unit packaging. Brazing flux shall be furnished in 8 ounce or 1 pound capacity as specified (see 6.2), glass or plastic jars of the wide-mouth type, equipped with screwcap closure and shall conform to class 1, style 2 of PPP-C-186. The closure shall be either plastic or combination metal and seals which shall not affect or be affected by the product packaged. The cap shall be tightened to the degree required to prevent loss of contents by evaporation or leakage during handling, shipment and storage.

5.1.1.2 Intermediate packaging. The jars shall be intermediate packaged in fiberboard boxes conforming to PPP-B-636, type CF, class-weather-resistant, in quantities as specified by the procuring activity. The boxes shall be provided with pads, partitions, and liners made from double-faced corrugated fiberboard of the same material as used in the box. The bottom and top pads shall be not more than 1/16 inch smaller than the inside length and width of the box. Partitions shall be half-slotted style and full height. The cells formed by the partitions shall be of size that the unit containers contact all four sides of the cell and, if required, additional cushioning shall be effected by insertion of cellulose wadding or similar non-hygroscopic material to prevent movement within the boxes. The liners shall be of one-piece construction covering the sides and ends of the box and shall be the same height as the partitions. Corrugation for the liner shall be horizontal. When tape is used, closure shall be accomplished using two strips conforming to PPP-T-76. Tape shall be of 2 inch width and shall be applied to top and bottom seams. If the bottom of the container is closed with staples or adhesive, only a single piece of tape on the top seam is required.

5.1.2 Level C. The material shall be packaged as specified for level A except that intermediate packages shall be of the domestic (non-weather-resistant) type or grade.

5.1.3 Commercial. Brazing flux shall be furnished in 8 ounce or 1 pound capacities as specified (see 6.2) and shall be packaged in accordance with ASTM D 3951 and in conformance to DoT regulations.

5.2 Packing. Packing shall be level A, B, C or commercial as specified (see 6.2).

5.2.1 Level A. Flux packaged as specified (see 5.1) shall be packed in containers conforming to any one of the following specifications with container type or class (if not specified herein) style or grade selection at the option of the contractor:

<u>Specification</u>	<u>Type or class</u>
PPP-B-585	Class 3
PPP-B-601	Overseas type
PPP-B-621	Class 2

Boxes shall be closed, strapped or banded in accordance with the applicable box specification or appendix thereto. The gross weight of the boxes shall not exceed 200 pounds.

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5.2.2 Level B. Flux, packaged as specified (see 5.1) shall be packed in containers conforming to any one of the following specifications with container type or class (if not specified herein) style or grade selection at the option of the contractor:

<u>Specification</u>	<u>Type or class</u>
PPP-B-576	Class 2
PPP-B-585	Class 2
PPP-B-591	Weather-resistant
PPP-B-601	Domestic type
PPP-B-621	Class 1
PPP-B-636	Weather-resistant
PPP-B-640	Weather-resistant

Box closure and reinforcement shall be in accordance with the applicable box specification or appendix thereto with method V closure applicable to PPP-B-636 boxes. The gross weight of wood and wood-cleated boxes shall not exceed 200 pounds. Fiberboard boxes shall not exceed the weight limitations of the box used.

5.2.3 Level C. Flux, packaged as specified (see 5.1) shall be packed in containers as specified for level B except that the containers shall be of the domestic non-weather resistant, non-waterproof type or grade and method I closure shall apply for PPP-B-636 boxes.

5.2.4 Commercial. Flux, packaged as specified in 5.1 shall be packed in accordance with ASTM D 3951.

5.3 Marking.

5.3.1 Levels A, B and C. In addition to any special marking required (see 6.2), unit, intermediate and exterior containers shall be marked in accordance with MIL-STD-129 for military agencies and FED-STD-123 for civil agencies.

5.3.2 Commercial. Commercial marking shall be in accordance with ASTM D 3951 and shall include DoT markings as applicable.

5.3.3 Special marking. Each unit and intermediate container (when applicable) shall include date of manufacture.

5.3.4 Warning label. Each unit and intermediate container and exterior containers shall have affixed thereto such warning labels and markings as may be required by DoT regulations and CFR 29-OSHA.

6. NOTES

6.1 Intended use.

6.1.1 Type A flux. Type A flux is intended for use with silver brazing filler metals as specified in QQ-B-654 which flow below 1600°F in brazing aluminum bronze joints by torch, furnace or induction methods.

6.1.2 Type B flux. Type B flux is intended for use with silver brazing filler metals as specified in QQ-B-654 which flow between 1050 and 1600°F in brazing ferrous and nonferrous metals (light metals and alloys and aluminum bronze excluded) by the heating methods specified in 6.1.1. A higher melting point flux should be used with brazing alloys flowing at a temperature above 1600°F.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type of flux (see 1.2.1).
- (c) Levels of packaging and packing required (see 5.1 and 5.2).
- (d) Size of container required (see 5.1.1 and 5.1.4).
- (e) Special marking required (see 5.3.1).

6.2.1 Flux should be ordered by the pound.

6.3 Inspection after delivery. The stability requirement as specified in 3.3.1 specifies the manufacturer's responsibility as being 12 months from the date of manufacture. It is the responsibility of the consignee to verify conformance to this requirement. Twelve months should not be taken as a limit on the useful life of the flux unless actual test results indicate unsatisfactory performance for the intended applications.

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.

MILITARY INTERESTS:

Custodians

Army - AR
Navy - SH
Air Force - 20

Review Activities

Army - EA, AR, ME, MI, ER
Air Force - 99
DLA - GS

User Activities

Army - AT
Navy - MC

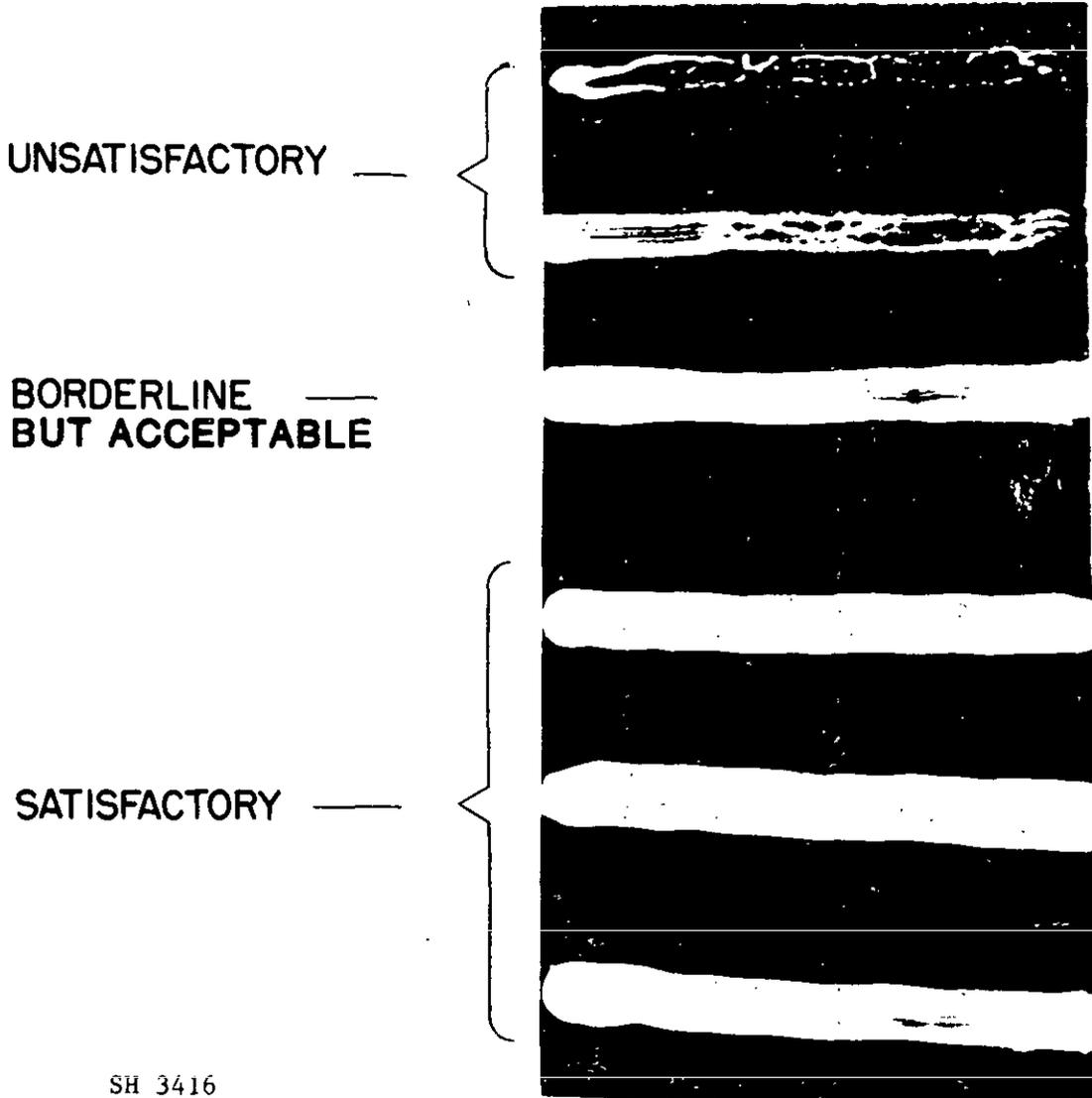
CIVIL AGENCY COORDINATING ACTIVITIES:

GSA - FSS
NASA - MSF

PREPARING ACTIVITY:

Navy - SH
(Project 3439-0534)

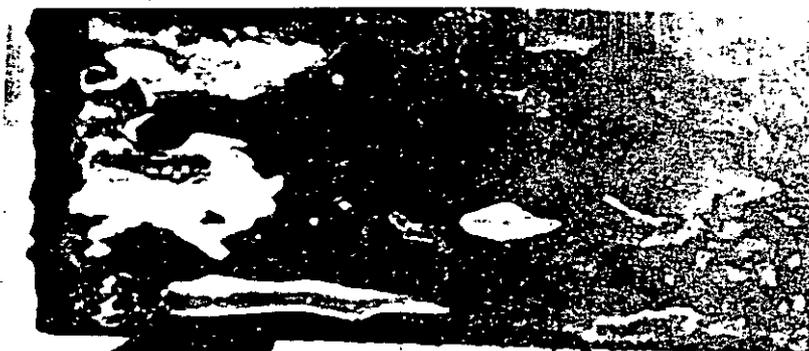
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SH 3416

FIGURE 1. Wettability test.

UNSATISFACTORY——



SATISFACTORY——



SH 3417

SH 3417

FIGURE 2. Molten adherence test.

