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MIL-B-3743D
16 June 1967
SUPERSEDING
MIL-B-003743C(SHIPS)
5 June 1959
MIL-B-3743B
25 July 1958
(See 6.5)

MILITARY SPECIFICATION

BRUSH, ELECTRICAL CONTACT

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

1. SCOPE

1.1 This specification covers finished brushes for motors, generators and similar machinery for other than aeronautical use.

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 the specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-P-116 - Preservation, Methods of.

FEDERAL

PPP-T-60 - Tape; Pressure Sensitive Adhesive, Waterproof, for Packaging.
PPP-T-76 - Tape, Pressure Sensitive Adhesive Paper, (For Carton Sealing).
PPP-B-566 - Boxes, Folding, Paperboard.
PPP-B-636 - Box, Fiberboard.
PPP-B-640 - Boxes, Fiberboard, Corrugated, Triple-Wall.
PPP-B-676 - Boxes, Set-Up.

STANDARDS

MILITARY

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

FSC 5977

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

OFFICIAL CLASSIFICATION COMMITTEE
Uniform Freight Classification Ratings, Rules and Regulations.

(Application for copies should be addressed to Official Classification Committee, 1 Park Avenue at 33rd Street, New York, N. Y. 10016).

UNITED STATES OF AMERICA STANDARDS INSTITUTE (USAS)
C7.1 - Soft or Annealed Copper Wire, Specifications for.
C64.1 - Brushes for Electrical Machines, (Carbon, Carbon-Graphite, Electrographitic, Graphite, and Metal-Graphite Brushes), Requirements for.

(Application for copies should be addressed to the United States of America Standards Institute, 10 East 40th Street, New York, N. Y. 10016).

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
116 - Carbon Brushes, Test Code for.

(Application for copies should be addressed to the Institute of Electrical and Electronic Engineers, 345 East 47th Street, New York, N. Y. 10017).

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

3. REQUIREMENTS

3.1 Material.-

3.1.1 Form.- Brush material shall be of uniform hardness and homogeneous in texture without hard gritty spots, cracks, flaws or impurities which may adversely affect its operating characteristics. The material shall be free from any lubricant or other compound which will exude at temperatures below 250°C. but shall possess such lubricating or slightly cleaning qualities necessary to reduce wear to a minimum and impart to the commutator a fine polished finish.

3.1.2 Grade.- Material for brushes supplied in equipment shall be a standard commercially available product which is identified by a particular manufacturer's grade designation. The grade shall be listed in the manufacturer's catalog or other available data which describes the general range of intended applications and gives the following grade characteristics:

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(a) Nature of material (electrographitic, graphite, metal-graphite).
(b) Metal content, if any, and nominal percentage.
(c) Resistivity (specific resistance).
(d) Hardness (scleroscope).
(e) Transverse strength (minimum).
(f) Recommended contact pressure, p.s.i. for typical[1/] applications.
(g) Contact voltage drop. } Typical[1/] figures or relative values compared to other grades (for example, high, medium, low).
(h) Coefficient of friction. }
(i) Current carrying capacity. } Typical[1/] values.
(j) Peripheral speed of commutator or collector ring. }

Brushes for replacement purposes shall be of the material (identified by manufacturer's grade designation) specified in the contract or order (see 6.1 and 6.3).

3.1.3 Properties.- The properties of the manufacturer's brush material grade shall be determined by the test specified in 4.2.3.1 either prior to or at the time brushes of the material grade are first supplied under this specification. The properties so determined shall be recognized as the established properties of the grade. Brush material of the same grade produced thereafter shall have these same properties, within the permissible tolerances specified. Once the established values are determined for the properties of a particular grade, they shall remain unchanged unless it can be shown that the originally determined value was erroneous and that no change has been made in the material itself. The following properties and characteristics shall be determined:

(a) Resistivity.
(b) Hardness.
(c) Transverse strength.
(d) Apparent density.
(e) Contact voltage drop.
(f) Coefficient of friction. } Limiting value applies (see 3.1.3.2).
(g) Ash content. }

The numerical values of established properties need not coincide exactly with catalogs or other manufacturer's data (see 3.1.2) for resistivity, hardness, transverse strength and contact voltage drop; however, the differences shall not exceed the tolerances listed in 3.1.3.1.

3.1.3.1 Tolerance of properties.- The tolerances listed in table I, applied to the established values of material properties, shall not be exceeded in material of the same manufacturer's grade supplied under this specification.

[1/] The term "typical" as used in this specification refers to normal conservative ratings that apply when other interdependent conditions are also "typical". The typical values are not intended to be considered as maximum or limiting values; it is recongized that they may be exceeded when other conditions existing in a particular application are favorable.

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Table I - Allowable tolerances for brush material properties.

Property	Tolerance - percent, plus or minus	
	Electrographite, carbon, carbon-graphite	Graphite Metal Graphite
Resistivity	25	40
Hardness	20	30
Transverse strength	35	35
Apparent density	7	7
Contact voltage drop	20	25

3.1.3.2 Limitations on coefficient of friction and ash content.- Coefficient of friction and ash content shall not exceed the following:

Coefficient of friction:	0.50	
Ash content:	Electrographite	-1.5 percent
	Carbon, carbon-graphite and graphite	-3.0 percent

3.2 Construction of finished brushes.- Brushes shall be as described (see 6.1). Methods of describing brushes are by the procedure of USAS C64.1 or a detailed drawing.

3.2.1 Brush size and configuration.- Brush size and configuration (shape clips, terminals, and so forth) shall be in accordance with USAS C64.1.

3.2.2 Shunts.- Shunts shall be copper wire conforming with USAS C7.1. Shunt diameters and lengths shall be in accordance with USAS C64.1.

3.2.2.1 Shunt insulation.- Shunts shall be provided with insulation, when specified (see 6.1). Insulation shall be flexible and of a type suitable for the intended application.

3.2.2.2 Shunt attachment.- Shunts shall be attached to the brush material by tamped or riveted connections, as specified (see 6.1), in such a way that the flexibility of the shunt is not affected. Shunt connections shall not be adversely affected by continuous operation of the brush at commutator or collector ring temperatures of 185°C. The shunt connection resistance specified in 3.2.2.3 shall not be exceeded at temperatures up to 185°C.

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3.2.2.2.1 Tamped connections.- Mercury in any form shall not be used in the tamping material.

3.2.2.2.2 Riveted connections.- Rivets shall be spun so that a well rounded head is produced on both sides. The rivet heads shall be recessed so as not to protrude beyond the sides of the brush.

3.2.2.3 Resistance of shunt connection.- The resistance of the shunt connection is defined as:

$$R = \frac{V}{I} A$$

Where: R = Resistance of shunt connection in milliohm-square inches.
V = Millivolt drop between test points, USAS C64.1 test.
I = Test current in amperes, USAS C64.1 test.
A = Cross-sectional area (width times thickness of brush) in square inches.

If a brush has shunts at more than one location, the requirements for shunt connection resistance apply separately to each shunt connection when tested with all terminals connected together.

3.2.2.3.1 Resistance of shunt connection prior to temperature cycling tests.- Resistance of shunt connections (at room temperature) shall not exceed the following:

(a) Electrographite, carbon and carbon-graphite materials: 4.0 milliohm-square inches.
(b) Graphite and metal-graphite brush materials:

$$2.0 - \left(\frac{1.8M}{30+M}\right) \text{ milliohm-square inches.}$$

Where M = Metal content of brushes in weight percent (example: M=50 for metal-graphite brushes with 50 percent metal by weight).

3.2.2.3.2 Resistance of shunt connection after temperature cycling (see 4.4.12).- Resistance of shunt connections (at room temperature) after temperature cycling shall not exceed 4 times the maximum permissible resistance prior to temperature cycling tests.

3.2.2.4 Strength of shunt connection.- The shunt shall not separate from the brush material upon application of a mechanical pull of 1 pound per 100 circular mils of total shunt cross-sectional area or 80 pounds total, whichever is least.

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3.2.3 Clips.- Where used, clips, except those of corrosion-resisting, material, shall be tinned after blanking or bending. Tinning shall be accomplished by electrodeposition (minimum thickness-0.0005 inch) or by a hot dip process. Thinning shall be smooth, adherent and free from blisters, pits or other visible defects.

3.2.3.1 Hammer clips.- Hammer clips should be used where considered necessary to limit hammer wear on the top of the brush or to obtain proper pressure.

3.2.3.2 Guide clips and lifting clips.- Guide clips and lifting clips shall not be used except where approved by the command or agency concerned.

3.2.4 Springs furnished as part of brushes.- Springs when furnished as a part of small brushes used in cartridge type brush holders shall be of the helical compression type. Spring design shall be in accordance with USAS C64.1.

3.2.4.1 Spring material.-

3.2.4.1.1 Brushes with shunts and springs.- Spring material shall be one of the following:

(a) Corrosion-resisting steel, AISI types 301, 302 or 304.
(b) Carbon steel plated with chromium, nickel, cadmium, tin, or zinc and baked after forming.
(c) Sheath-core bimetal wire (steel core, copper sheath).
(d) Copper-beryllium alloy conforming to the following chemical requirements may be used in applications where its temperature will not exceed 300°F.:

Beryllium: 1.80-2.05 percent.
Nickel, cobalt or both: 0.20 percent maximum.
Nickel plus cobalt plus iron: 0.60 percent maximum.
Copper plus beryllium plus additive elements: 99.50 percent minimum.

3.2.4.1.2 Brushes with springs but without shunts.- Spring material shall be as described in 3.2.4.1.1.(c) or (d).

3.2.5 Dimensional tolerances.- Dimensional tolerances for brushes shall be in accordance with USAS C64.1.

3.2.6 Marking.- Brushes having a thickness or width of 1/2 inch or more shall be marked with the brush manufacturer's name or trade-mark, or identification symbol and grade designation. Small brushes should also be marked if sufficient space can be found for legible marking. Marking shall be applied, if possible, near the top of the brush so that it will not be worn away.

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3.3 Workmanship.- The workmanship shall be of the best commercial practice. Brushes shall show no evidence of chips or flaws which would adversely affect their performance in service. Cracked or broken brushes are not acceptable.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection.- Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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.- A lot shall consist of all brushes of the same material grade and the same physical configuration submitted for inspection at the same time.

4.2.2 Sampling for group A examination and tests.- A random sample of finished brushes shall be selected from each inspection lot and subjected to each of the group A examination and tests listed in 4.3.1 with lot acceptance based on sampling inspection requirements in accordance with MIL-STD-105, inspection level II. Acceptable quality level equals 4.0 percent defective.

4.2.3 Sampling for group B tests.- Samples of finished brushes or brush material, as required, shall be selected from each inspection lot and subjected to each of the group B tests listed in 4.3.2 with lot acceptance based on sampling inspection requirements in accordance with MIL-STD-105, inspection level S-3. Acceptable quality level equals 4.0 percent defective. Samples of finished brushes shall be selected at random from each inspection lot. Brush material test specimens may be cut from finished brushes or cut from bulk material (plate stock) set aside for this purpose when brushes are cut. Since the tests are destructive in nature, any brushes required for test purposes shall be in addition to those to be supplied for a contract or order. Test samples shall be discarded upon completion of testing.

4.2.4 Sampling for group C tests.-

4.2.4.1 Brush material tests.- Group C testing of each brush material grade serves to establish its properties and characteristics and to provide a periodic check to determine whether these properties and characteristics remain unchanged. Group C tests shall be conducted prior to or at the time the material grade is first supplied under this specification. Thereafter, group C tests need not be repeated when supplying the same material grade on subsequent contracts or orders unless a period of 2 years or more has elasped since the previous tests. Samples for testing need not be selected from a particular

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inspection lot, but must be currently manufactured material of that grade. For the first (original) group C test, data already available or accumulated from previous testing of the same grade material by the specified methods may be used in lieu of formal testing to establish the material properties. The number of samples used for group C tests shall be at the option of the manufacturer.

4.2.4.2 Tamped shunt connection tests.- The suitability of each distinct type of tamped shunt connection shall be determined. (A distinct type of tamped shunt connection is defined as a tamped shunt connection made using a specific process and materials). Group C tests shall be conducted prior to or at the time the shunt connection is first used for brushes supplied under this specification. Thereafter, group C tests need not be conducted on shunt connections that have previously passed the tests unless a change is made in the production process or materials. Tests shall be conducted on sample brushes having shunts attached by normal production techniques. See 4.4.12 for details of test specimens.

4.3 Quality conformance inspection.-

4.3.1 Group A examination and tests.- Each of the brushes selected in accordance with 4.2.2 shall be subjected to each of the examinations and tests specified herein and the results compared to the requirements of this specification and the brush details specified in the contract or order. If a brush fails to conform with the specified requirements for both group A attributes, it shall be considered as nonconforming. If the number of nonconforming brushes in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

Group A examination and tests	Reference paragraph
Visual and dimensional examination	4.4.1
Resistance of shunt connection	4.4.2

4.3.2 Group B tests.- The brushes and material specimens selected in accordance with 4.2.3 shall be subjected to the tests specified herein and the results compared to the requirements of this specification and the established properties of the material grade. If the brush or brush material fails to conform with this specification for each group B attribute considered separately (the same samples may be used in testing for different attributes) it shall be considered as nonconforming. If for any attribute the number of nonconforming brushes or brush material samples exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

Group B tests	Reference paragraph
Hardness	4.4.3
Resistivity	4.4.4
Strength of shunt connection	4.4.5
Transverse strength	4.4.6
Uniformity of texture	4.4.7

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4.3.3 Group C tests.-

4.3.3.1 Brush material tests.- Brush material specimens and sample brushes selected in accordance with 4.2.4.1 shall be subjected to the following tests:

Group C tests	Reference paragraph
Hardness	4.4.3
Resistivity	4.4.4
Transverse strength	4.4.6
Uniformity of texture	4.4.7
Apparent density	4.4.8
Ash content	4.4.9
Contact voltage drop	4.4.10
Coefficient of friction	4.4.10
Temperature	4.4.11

When group C tests are first performed on a material grade, the following properties of that grade shall be established from test data as specific numerical values: Hardness, resistivity, transverse strength, apparent density, and contact voltage drop. The method of determining a specific numerical value for each of these properties is at the option of the manufacturer. The manufacturer may also select the test equipment and procedures where they are not specified; however, subsequent group C tests shall be performed using the same or identical equipment and the same procedures as the original tests. Results of the uniformity of texture, ash content, coefficient of friction and temperature tests shall be compared with the specification requirements. Once the properties and characteristics of a material grade are established from the original tests, the results of subsequent tests for hardness, resistivity, transverse strength, apparent density and contact voltage drop shall be compared to the established values. Failure of the material to completely conform to this specification or variation of properties in excess of specified tolerances applied to established values shall result in rejection of all material of that grade until the causes of failure have been corrected and the material successfully retested (all group C brush material tests).

4.3.3.1.1 Test report (original tests).- The following data on properties of a brush material grade shall be assembled into a test report, copies of which shall be furnished to Government activities upon request:

(a) Tabulation of material grade properties as established for:
  (1) Hardness.
  (2) Resistivity.
  (3) Transverse strength.
  (4) Apparent density.
  (5) Contact voltage drop.
(b) Tabulation of measured values of:
  (1) Coefficient of friction.
  (2) Ash content.
(c) Results of uniformity of texture test.

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(d) Results of temperature test.
(e) Complete test data and description of means used to determined established values.
(f) Data on test equipment, procedures and conditions under which operating tests are conducted (see 4.4.10.3(c)).

4.3.3.2 Tamped shunt connection tests.- Testing of tamped shunt connections (see 4.2.4.2) shall be in accordance with 4.4.12. If all test specimens meet the specified requirements (see 3.2.2.3 and 3.2.2.4), the tamped connection under test is considered acceptable for shunts within the size range covered. If one specimen should fail to completely conform with this specification, tests may be repeated using specimens other than those originally tested. If 2 or more specimens should fail to completely conform with this specification, the shunt connection under test shall be considered unsuitable for the proposed range of shunt sizes.

4.3.3.2.1 Test report.- The test data from the tamped shunt connection suitability test (see 4.4.12) shall be assembled into a test report, copies of which shall be furnished to Government activities upon request. If a manufacturer uses more than one type of tamped shunt connection, the test report shall suitably identify the type covered by the test.

4.4 Examination and tests.-

4.4.1 Visual and dimensional examination.- Each finished brush sample shall be visually and dimensionally examined to verify conformance with all the requirements of this specification and the contract or order which do not involve tests.

4.4.2 Resistance of shunt connection.-Resistance of shunt connections shall be measured in accordance with USAS C64.1 to determine conformance with 3.2.2.3.

4.4.3 Hardness.- The scleroscope hardness shall be measured in accordance with USAS C64.1.

4.4.4 Resistivity.- Resistivity (specific resistance) shall be measured in accordance with USAS C64.1.

4.4.5 Strength of shunt connection.-

4.4.5.1 Equipment.- The following equipment is required:

(a) Tension device with a suitable pressure gage or scale.
(b) Clamping means for connecting to the brush material and to the shunt.

4.4.5.2 Procedure.- The respective clamping means shall be secured to the brush material and to the shunt. In the case of brushes having riveted connections, the clamp shall not be placed on a rivet. In the case of tamped connections, the pull shall be in the direction of the axis of the tamping hole. Tension shall be applied at a steady rate to avoid impact until the required tension (see 3.2.2.4) is reached.

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4.4.6 Transverse strength.- Transverse strength shall be measured in accordance with USAS C64.1.

4.4.7 Uniformity of texture.- Homogeneity of texture shall be determined by carefully examining the broken surfaces of fracture of samples used in the transverse strength test.

4.4.8 Apparent density.- Density shall be measured in accordance with USAS C64.1.

4.4.9 Ash content.- Ash content shall be measured in accordance with USAS C64.1. Ash content measurements on finished material may be omitted as group B tests if the material manufacturer employs a method of sampling raw materials to control ash content of the finished product within the specified limit.

4.4.10 Operating characteristics.- Contact voltage drop and coefficient of friction shall be measured under conditions that simulate typical operation. Except as specified hereafter, details of equipment and test procedures may be selected by the manufacturer. Publication IEEE No. 116 may be consulted, if desired, for guidance on measurement of contact drop and coefficient of friction; however, use of the equipment or procedures described therein is not mandatory. Tests conducted subsequent to the original tests in which the established values of material properties are determined shall be performed using the same or identical equipment and the same procedures as the original tests.

4.4.10.1 Equipment.- Brushes shall be installed in brush holders in a test machine having a revolving commutator or test ring for simulation of actual operating conditions. Rings used for tests on commutator brush grades shall have axial slots like those of a commutator.

4.4.10.2 Test conditions.- Tests shall be conducted under the following conditions:

(a) Ambient temperature of the testing space shall be maintained at 75°F. ± 5°F. and relative humidity maintained at 40 percent plus or minus 10 percent.
(b) Brush current density shall be approximately the typical value (see 3.1.2).
(c) Peripheral speed of the commutator or test ring shall be approximately the typical value (see 3.1.2).
(d) Brush holder springs shall be adjusted to provide the recommended brush contact pressure (see 3.1.2) for a typical application.

4.4.10.3 Test procedures.-

(a) Prior to the test, the commutator or ring shall be cleaned and polished. Brushes shall be carefully seated and the test machine shall be operated for a minimum of 24 hours or longer if necessary to fully seat the brushes and form a good film before contact drop and coefficient of friction measurements are begun.

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(b) Contact voltage drop and coefficient of friction (or brush friction torque) shall be measured either continuously or at regular periodic intervals (not exceeding 2 hours of operation) during a minimum operating period of 48 hours. Shutdowns are permitted at the end of the normal working day but the brushes, commutator or ring shall not be disturbed. Measurements of contact voltage drop at these periodic intervals (or similar intervals taken from a continuous recording) shall be numerically averaged in order to obtain a specific value. Once an established value of contact voltage drop has been determined (see 4.3.3.1), the results of subsequent tests shall be compared with the established value to determine conformance with the specified requirements.

(c) The following test conditions shall be recorded:
   (1) Brief description of test machine including positive identification such as serial number.
   (2) Brush size, number of brushes, and angle with respect to commutator or test ring.
   (3) Commutator or test ring material, diameter, width, and number and size of axial grooves.
   (4) Ambient temperature and relative humidity.
   (5) Peripheral speed.
   (6) Brush temperature.
   (7) Brush current.
   (8) Brush pressure.

4.4.11 Temperature.- Sample brushes shall be heated to 250°C. for 8 hours and examined hourly during the test to determine if they are free from substances which exude onto the surface of the material (see 3.1.1). The presence of such a substance shall be cause for rejection.

4.4.12 Tamped shunt connection suitability- Test specimen shall be brushes having shunts attached by normal production techniques. Samples for testing shall consit of:

(a) Three specimens with shunt of smallest diameter intended for the type of connection.
(b) Three specimens with shunt of largest diameter intended for the type of connection.
(c) Three specimens with intermediate diameter shunt for the type of connection.

For each specimen, the size of the brush material shall be typical of brushes which would normally use shunts of the respective sizes. The brush material grade used for test specimens shall be representative of materials for which the type of connection is intended. If a particular type of connection is intended for both non-metal and metal-graphite brushes, test shall be conducted with both materials. Each specimen shall be subjected to the following tests, conducted in the order listed:

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(a) Resistance of shunt connection (see 4.4.2). Specimen shall not be heated prior to this test.
(b) Specimen shall be subjected to temperature cycling consisting of 5 heating-cooling cycles wherein for each cycle the specimen is heated in an oven to 185°C. for 1-1/2 hours and allowed to cool to room temperature. Resistance of shunt connection shall be measured (see 4.4.2) at room temperature after temperature cycling.
(c) Strength of shunt connection (see 4.4.5).

4.5 Inspection of preparation for delivery.- The packaging, packing, and marking shall be inspected for compliance with section 5 of this document.

5. PREPARATION FOR DELIVERY

5.1 General.-

5.1.1 Pairs, sets and kits.- Brushes furnished in pairs, sets or kits under a single Federal stock number shall be unit packaged as one pair, one set or one kit, as applicable.

5.1.2 Cushioning.- Cushioning shall be employed, as required to insure compliance with the general and physical protection requirements of MIL-P-116.

5.1.3 Exterior containers.- Exterior containers shall be of minimum tare and cube consistent with the protection required and shall contain equal quantities of identical items to the maximum extent possible.

5.2 Preservation and packaging.- Preservation and packaging shall be level A or level C, as specified (see 6.1).

5.2.1 Level A.-

5.2.1.1 Cleaning.- Brushes shall be cleaned in accordance with MIL-P-116, process C-1.

5.2.1.2 Drying.- Brushes shall be dried in accordance with MIL-P-116.

5.2.1.3 Preservative application.- None required.

5.2.1.4 Unit packaging. Brushes shall be packaged in accordance with MIL-P-116, submethod IC-3 with two brushes in each bag except as specified in 5.1.1.

5.2.1.5 Intermediate packaging.- Brushes, packaged as specified in 5.2.1.4. shall be placed in intermediate containers conforming to PPP-B-566, PPP-B-636 or PPP-B-676. Box closure shall be in accordance with the applicable box specification. Intermediate containers shall be uniform in size and shape, shall be of minimum tare and cube and shall contain multiples of five unit packages, not to exceed 100 packages or 10 pounds. No intermediate packaging is required when the total quantity shipped to a single destination is less than 100 units.

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5.2.2 Level C.- Brushes shall be packaged in a manner that will afford adequate protection against corrosion, deterioration and physical damage during shipment from supply source to first receiving activity. This package may conform to the supplier's commercial practice for retail distribution when it meets the requirements of this level.

5.3 Packing.- Brushes furnished as repair parts for particular equipment shall be packed as specified by the equipment specification. Bulk quantities of brushes for stock shall be packed level A, B or C as specified by the contract or order (see 6.1).

5.3.1 Level A. The packaged brushes shall be packed in fiberboard containers conforming to PPP-B-636, weather resistant, style optional, special requirement or PPP-B-640, class 2. In lieu of the closure and waterproofing requirements in the appendix of PPP-B-636, closures and waterproofing shall be accomplished by sealing center seams, corners and manufacturer's joints with waterproof tape, 2 inches minimum width, conforming to PPP-T-60, class 1 or PPP-T-76. Reinforcing shall be applied in accordance with the appendix to PPP-B-636, using non-metallic or tape banding only.

5.3.2 Level B.- Unless otherwise specified, the packaged brushes shall be packed in fiberboard containers conforming to PPP-B-636, class domestic, style and use requirements optional or PPP-B-640, class 1. Closures and reinforcing shall be in accordance with the appendix to the applicable container specification.

5.3.3 Level C.- Packing shall be accomplished in a manner which will insure acceptance by common carrier at the lowest rate and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity for early installation. The shipping containers or method of packing shall conform to the Uniform Freight Classification Ratings, Rules and Regulations or other carrier regulations as applicable to the mode of transportation and may conform to the suppliers commercial practice when it conforms to the requirements of this level.

5.4 Marking.- In addition to any special marking required by the contract or order, each unit package, intermediate and exterior shipping containers shall be marked for shipment in accordance with MIL-STD-129. Intermediate packages and exterior shipping containers shall also be marked with the manufacturer's part number and brush material grade designation.

6. NOTES

6.1 Ordering data.- Procurement documents should specify the following:

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(a) Title, number and date of this specification.
(b) Brush material manufacturer's grade designations (see 6.2 and 6.3).
(c) Material for brushes for replacement purposes (see 3.1.2).
(d) Description of brush in accordance with USAS C64.1 or reference to a detailed drawing (see 3.2). Descriptive data should include the following:
  (1) Brush size (thickness, width, length).
  (2) Bevels and/or radii or other details in accordance with USAS C64.1.
  (3) Connection type.
  (4) Clip type, if used.
  (5) Shunt location.
  (6) Bevelled corner or edge (if used in combination with shunt).
  (7) Shunt length.
  (8) Shunt size.
  (9) Terminal type.

  If this data is not available, a manufacturer's name and part number, if known, may be referred to for the physical and dimensional description.

(e) Description of springs, if required (see USAS C64.1 for list of spring design information).
(f) Whether shunt insulation is required (see 3.2.2.1).
(g) Whether tamped or riveted connections are required for shunt attachment (see 3.2.2.2).
(h) Level of packaging and packing and any special marking required (see 5.2 and 5.3).
(i) If quality conformance inspection in accordance with supplier's commercial practice may be substituted (see 6.4).

6.2 Brushes supplied in equipment.- Brushes shall be of a material grade that provides satisfactory equipment operation under the intended service conditions.

6.2.1 Brush application guidelines for electrical equipment designers.- Insofar as practicable, equipment should be designed for and supplied with brushes of a material grade that is suitable for a wide range of equipment types and applications. It is also desirable that the brush chosen for a particular application have a commonly used physical configuration (size and shape). Material grades that are useful only for very selective applications and special brush features such as slots, notches, grooves, shoulders, partial bevels, and so forth should be avoided wherever it is feasible to do so. Equipment manufacturers are urged to use the minimum number of brush grades and configurations that will perform satisfactorily in the equipment they expect to supply. The use of brushes identical to those previously furnished in equipment is encouraged. When the design of the equipment is such as to preclude the use of brushes identical to those previously furnished in equipment, brushes conforming with MIL-STD-408 should be used to the maximum practicable extent.

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6.3 Brushes for replacement purposes.- In order to assure continued operation of electrical machines with their original performance, the use of replacement brushes identical to those originally supplied in the machines is recommended. Alternate or substitute brush material grades should be used only when approved by the command or agency concerned, where such approval is based on:

(a) Recommendation of the alternate or substitute brush material by the equipment manufacturer.
(b) Testing of equipment under design conditions using brushes of alternate or substitute material.

Brushes of different grades should not be mixed on the same commutator or collector ring even though the brush grades may be approved alternates. All brushes on a single commutator should be replaced at one time, except in the case of replacement of small numbers of mechanically damaged or defective brushes.

6.4 Substitution of quality conformance inspection in accordance with supplier's commercial practice.- When purchasing small quantities of brushes for immediate replacement purposes, and the dollar value is relatively small (less than $300 is suggested amount), the Government purchasing activity, at its discretion, may permit substitution of quality conformance inspection in accordance with supplier's commercial practice in lieu of the inspection of section 4 of this specification. Such substitution should not be permitted for brushes intended for critical applications (when failure of equipment would endanger life or adversely affect the accomplishment of a military mission). Quality conformance inspection in accordance with section 4 of this specification is required unless the substitution of supplier's commercial practice is specifically authorized by the contract or order.

6.5 CHANGES FROM PREVIOUS ISSUE. THE EXTENT OF CHANGES (DELETIONS, ADDITIONS, ETC.) PRECLUDE THE ANNOTATION OF THE INDIVIDUAL CHANGES FROM THE PREVIOUS ISSUE OF THIS DOCUMENT.

Custodians:
Army - ME
Navy - SH
Air Force - 85
Review Activities:
Army - ME, EL
Navy - SH
Air Force - 85
Users activities:
Army - MU
Navy - AS, MC

Preparing activity:
Navy - SH
(Project 5977-0017)

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SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated on reverse hereof)*.

SPECIFICATION

ORGANIZATION *(Of submitter)*		CITY AND STATE
CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT $

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)*	DATE

DD FORM 1426, 1 APR 63 (NAVSHIPS OVPRT 12-66) REPLACES NAVSHIPS FORM 4883, WHICH IS OBSOLETE