INCH-POUND

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PERFORMANCE SPECIFICATION

CONNECTORS, ELECTRICAL, AIRCRAFT STORAGE BATTERY GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers electrical connectors (both plugs and receptacles) for use with aircraft storage batteries.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 or 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 or 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

Comments, suggestions, or questions on this document should be addressed to: the Naval Air Warfare Center Aircraft Division, Code 4L8000B120-3, Highway 547, Lakehurst, NJ 08733-5100 or by email to michael.sikora@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST online database at http://assist.daps.dla.mil.

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-5606	-	Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance. (Inactive for new design)
MIL-PRF-18148/1	-	Plug, Electric, Two-Wire, Aircraft Storage Battery.
MIL-PRF-18148/2	-	Plug, Electric, Four-Wire, Aircraft Storage Battery.
MIL-PRF-23699	-	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number O-156
MIL-PRF-85570	-	Cleaning Compounds, Aircraft, Exterior.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests.
MS3509	-	Receptacles, Electric, Aircraft Storage Battery

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation (see 6.2).

SOCIETY OF AUTOMOTIVE ENGINEERS

SAE-AS20659	-	Terminal, Lug, Crimp Style, Copper, Uninsulated, Ring Tongue, Type I, Class I, For 175 °C Total Conductor Temperature. (DoD adopted)
SAE-AS50861/2	-	Wire, Electrical, Polyvinyl Chloride Insulated, PVC-Glass Nylon, Tin-Coated Copper Conductor, 600-Volt, 105 °C. (DoD adopted)

(Copies of this document are available from www.sae.org or Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. The connectors furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.3 Sequence of tests. The sequence of required tests shall be in accordance with the specification sheet. If a test is not listed in the test table(s) of the specification sheet, then it is not required for the connector.

3.4 Materials and components. Materials or components (see 6.10.1) that are specified shall be in accordance with the applicable specification or the requirement as specified in the specification sheet. Aluminum (see 6.8.1) shall not be used in the construction of any connector covered by this specification. Upon request of the qualifying activity, the manufacturer shall supply a certification of conformity of the material or component. In the absence of certification from the source, a certificate of analysis or certified inspection results will be acceptable.

3.5 Dissimilar metals. Unless protected against electrolytic corrosion, dissimilar metals shall not contact each other (see 6.8.3).

3.6 Mating requirements. Each connector shall meet all requirements of this specification when used with its mating plug or receptacle.

3.6.1 Plugs. Each plug covered under this specification shall mate with any variant of connector receptacles specified in MS3509. Each plug shall be made such that the only way it can be installed correctly in the receptacle is with the proper polarity. The appropriate mating receptacle shall be any variant of MS3509 for the tests specified herein.

3.6.2 Receptacles. Each receptacle covered under this specification shall mate with any variant connector plugs specified in MIL-PRF-18148/1 or /2. The appropriate mating plug shall be any variant of MIL-PRF-18148/1 or /2 for the tests specified herein.

3.7 Potentials and currents. Unless otherwise specified, all potentials and currents mentioned in this specification are average values.

3.8 Design. Requirements for the individual types of connectors are specified in the applicable specification sheets (see 3.1). The design shall conform to the requirements specified below when examined in accordance with the visual and mechanical tests of 4.5.2.

3.8.1 Handles (applies only to plugs). Each plug shall include a handle or handwheel (hereafter included under the term "handle"). The handle shall be within 5 degrees of horizontal when the plug is fully engaged with its mating receptacle. The plug shall be engaged or disengaged solely by turning the handle; other forces shall not be applied to the plug or handle to achieve engagement or disengagement. An automatic and completely self-contained means to retain the plug in the receptacle shall be built into each plug. The handle shall contain not less than two holes for inserting a safety wire as shown in the applicable specification sheet. The locations of the holes are optional except they shall be positioned such that a safety wire can be inserted through the handle and fastened to the hole in one of the bolts that connect the two halves of the plug's shell together.

3.8.2 Electrical connections. Each connector shall include electrical connections as indicated in the applicable specification sheet.

3.8.3 Temperature. The operating and storage temperature extremes shall be 71° ± 2° C (160° ± 3.6° F) for high temperature and -85° ± 1.1° C (-65° ± 2° F) for low temperature.

3.9 General. The connector shall meet the requirements of this specification and applicable specification sheet when examined in accordance with the incoming inspection of 4.5.1 and the visual and mechanical inspection of 4.5.2.

3.9.1 Cleaning. After fabrication, the connector shall be cleaned of smudges; loose, spattered, or excess solder; weld metal; metal chips and mold release agents; or any other foreign material which might detract from the intended operation, function, or appearance of the equipment.

3.9.2 Threaded parts or devices. Screws, nuts, and bolts shall be unplated, corrosion proof, and firmly secured. Screws, nuts, and bolts shall not show evidence of cross threading, mutilation, burrs, or visible defects.

3.9.3 Surfaces. The surfaces shall have a smooth finish. All surfaces shall be free of pits, cracks, blow holes, rough spots, rough or irregular surfaces or sharp edges; or other deformations. All surfaces shall be free of rust, discoloration, and imperfections due to machining processes such as grinding, honing, or lapping. Contacting surfaces shall be free of tool marks, gouge marks, nicks, or other surface-type defects. Interference, binding, or galling shall not be present.

3.9.4 Cleaning, drying, and lubrication. Connectors shall be cleaned by any process, which will accomplish thorough cleaning without damage to the item. Connectors shall be dried by any process that will accomplish thorough drying of the item, provided the process does not injure the item or its function. Moving parts shall be lubricated. Electrical contacting surfaces (such as terminals and pins) shall be lubricated.

3.10 Color and marking. The connectors shall conform to the requirements listed below and in the applicable specification sheet when examined in accordance with the visual and mechanical inspection of 4.5.2. The color and identification marking shall be impervious to the indicated liquids when tested in accordance with 4.5.15.

3.10.1 Color. The color of all parts of the connector that are visible when the item is installed shall be in accordance with the applicable specification sheet (see 6.8.4).

3.10.2 Identification marking. Markings shall be located as shown on the applicable specification sheet. The polarity shall be conspicuously and durably marked on the connector and shall be adjacent to the terminals as shown on the applicable specification sheet. Positive terminal markings shall be impressed or embossed with a "+". Negative terminal markings shall be impressed or embossed with a "-". The assigned PIN shall be impressed or embossed on the connector. If necessary due to space limitations, the PIN may be broken or separated at the slash and the slash omitted. The manufacturer's name or CAGE code shall be impressed or embossed on each item.

3.11 General requirements. The connector, during or after subjection to any tests specified herein, shall not show:

a. Dimensional distortion or bulging beyond specified limits.

b. Cracking, blistering, pitting, softening, rough spots, or discoloration.

c. Mechanical failure of any part, including breaking off, loosening, or rotating.

d. Breakdown of insulation, arcing, stripping of or damage to metal plating, or loosening of protective coating.

e. Corrosion of metal parts. However, if a component (for example, a spring or receptacle pin) is made of 400-series stainless steel, then minor surface corrosion is permitted.

f. Deterioration of identification markings.

g. Shearing, breaking, bending, or deterioration.

h. Significant wear.

3.12 Detail requirements.

3.12.1 Condition of connector and shipping containers. The connector and the shipping container shall not exhibit scratches, gouges, dents, torn material, or other damage when inspected in accordance with 4.5.1. Any such damage may justify termination of further test and inspection.

3.12.2 Visual and mechanical. Connectors shall be in accordance with 3.4 through 3.10, table II, and the applicable specification sheet when subjected to the examination of 4.5.2.

3.12.3 Dimensions. The dimensions of each connector shall be as shown on the applicable specification sheet after the inspection of 4.5.3. Where only maximum or minimum dimensions are shown, the connector need not have the shape shown, but the connector, including all protrusions, shall be contained within the outline shown.

3.12.4 Weight. The weight of each connector shall be as shown on the applicable specification sheet after the inspection of 4.5.4.

3.12.5 Dielectric strength. Breakdown of insulation shall not occur after being tested in accordance with 4.5.6. The connector shall also meet the requirements of 3.11 during and after testing.

3.12.6 Insulation resistance. The calculated resistance shall be not less than 10 megohms after being tested in accordance with 4.5.7. The connector shall also meet the requirements of 3.11 during and after testing.

3.12.7 Operating torque (applies only to plugs). The torque required to engage the plug with its mating receptacle shall be not greater than 11.5 pound-inches after being tested in accordance with 4.5.8. The torque required to disengage the plug from its mating receptacle shall be within the range of 5 to 11.5 pound-inches after being tested in accordance with 4.5.8. The plug shall also meet the requirements of 3.11 during and after testing.

3.12.8 Contact resistance (applies only to plugs). The plug shall perform as follows during the test of 4.5.9.

a. The voltage drop at 1500 amperes shall be not greater than 90 millivolts.

b. The voltage drop at 750 amperes shall be not greater than 45 millivolts.

c. The plug shall also meet the requirements of 3.11 during and after testing.

3.12.9 Receptacle strength test. The terminal blocks shall not break off, loosen, or rotate with respect to the pin after being tested in accordance with 4.5.10. The pins shall not come loose from the body of the receptacle after being tested in accordance with 4.5.10. The

receptacle and its components shall not sustain any damage from the forces applied to the receptacle after being tested in accordance with 4.5.10. The receptacle shall also meet the requirements of 3.11 during and after testing.

3.12.10 Life. If the plug's contact sockets are plated, then the plating shall be intact after being tested in accordance with 4.5.11.1. The plug shall also meet the requirements of 3.12.7 and 3.12.8. If the receptacle's electrical contact pins are plated, then the plating shall be intact after being tested in accordance with 4.5.11.2. The receptacle's mechanical engagement pins shall not show significant wear after being tested in accordance with 4.5.11.2. The connector shall also meet the requirements of 3.11 during and after testing.

3.12.11 Temperature shock. The connector shall not show damage after being tested in accordance with 4.5.12. The connector shall also meet the requirements of 3.12.5. The plug shall also meet the requirements of 3.12.7 and 3.12.8. The connector shall also meet the requirements of 3.11 during and after testing.

3.12.12 Mechanical shock. The connector shall not show damage after being tested in accordance with 4.5.13. The connector shall also meet the requirements of 3.12.5. The connector shall also meet the requirements of 3.11 during and after testing.

3.12.13 Vibration. The connector shall not show damage after being tested in accordance with 4.5.17. The connector shall also meet the requirements of 3.12.5. The plug shall also meet the requirements of 3.12.7 and 3.12.8. The connector shall also meet the requirements of 3.11 during and after testing.

3.12.14 Humidity. The connector shall not show damage after being tested in accordance with 4.5.14. The connector shall also meet the requirements of 3.12.6. The plug shall also meet the requirements of 3.12.7 and 3.12.8. The connector shall also meet the requirements of 3.11 during and after testing.

3.12.15 Immersion and salt fog resistance. The connector shall not exhibit deleterious effects indicated in table III during or after the tests of 4.5.15 and 4.5.16. The connector shall also meet the requirements of 3.10 and 3.11 during and after testing. The plug shall also meet the requirements of 3.12.6, 3.12.7, and 3.12.8. The receptacle shall also meet the requirements of 3.12.6 and 3.12.9.

3.12.16 Air-tightness (applies only to receptacles). The receptacle shall not leak after being tested in accordance with 4.5.18. The receptacle shall also meet the requirements of 3.11 during and after testing.

4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in the applicable specification sheet. The specification sheets also list the order in which the tests shall be conducted. If a test is not listed in the test table(s) of the specification sheet, then it is not required for the connector. The samples shall be representative of the items intended to be supplied under this specification. The samples shall not be produced with the use of any equipment or procedure not normally used in production of the battery. Three connectors shall be furnished for inspection. In addition, two samples each of all metal parts that have been plated shall also be furnished for inspection. The plated parts shall have been treated and processed as they would be for fabrication of finished connectors. All samples shall be marked with identifying information in accordance with 3.10.2. A qualification sample that fails any of the examinations or tests specified herein shall be cause for the qualifying activity to refuse to conduct additional testing until the defects revealed by the inspection have been corrected.

4.3 Conformance inspection. Conformance inspection shall consist of the examinations and tests specified in the applicable specification sheet. The specification sheets also list the order in which the tests shall be conducted. If a test is not listed in the test table(s) of the specification sheet, then it is not required for the connector. Connectors produced under this specification shall successfully complete conformance inspection. Units shall be formed into inspection lots (see 6.10.2 and 6.10.3). The sample size for conformance inspection shall be as shown in table IV. Connectors produced under this specification shall be identical in every respect to the qualification sample tested and found satisfactory, except for changes previously approved by the Government. Any unapproved changes from the qualification sample shall constitute cause for rejection.

4.4 Inspection conditions. Unless otherwise specified in the description of the test, all inspections shall be performed in accordance with the following test conditions.

4.4.1 Temperature and storage conditions. Connectors, components, and materials that will undergo testing shall be temperature-stabilized for not less than 2 hours before electrical tests are initiated. During the entire period in the environmental chamber, elevate the connector by not less than 0.75 inch from the floor of the chamber for full air circulation. Unless otherwise specified in the description of the test, room temperature shall be 25° ± 5° C (77° ± 9° F), high temperature shall be 71° ± 2° C (160° ± 3.6° F) and low temperature shall be -85° ± 1.1° C

(-65° ± 2° F). Unless otherwise specified in the description of the test, all measurements and tests shall be made at room temperature, room ambient pressure, and room ambient humidity.

4.4.2 Test equipment and inspection facilities. Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ANSI-Z540.1

4.4.3 Accuracy of electrical indicating instruments. All voltmeters and ammeters shall be accurate within ± 0.5 percent of the full scale reading. The range of analog type meters shall be such that the readings are taken on the upper half of the scale. Timers shall be accurate within ± 0.5 percent. The sensitivity of voltmeters shall be not less than 5000 ohms per volt.

4.4.4 Tolerances.

4.4.4.1 Resistance tolerances. In all tests involving discharge through a resistance, the total circuit resistance shall be accurate within ± 0.5 percent.

4.4.4.2 Current variances. The current shall vary not more than ± 1 percent.

4.5 Methods of inspection. The tests on each connector shall be performed in the order listed in the applicable specification sheet. The following tests and examinations shall be performed as described as follows.

4.5.1 Incoming inspection. Examine the connector and shipping container for the requirements of 3.12.1.

4.5.2 Visual and mechanical inspection. Examine samples of the test item for the requirements of 3.12.2 and to determine compliance with all requirements of this specification or specification sheet which have no specific tests.

4.5.3 Dimensions. Measure the dimensions of the connector. Examine the connector for the requirements of 3.12.3.

4.5.4 Weight. Weigh each connector. Examine the connector for the requirements of 3.12.4.

4.5.5 Plug preparation procedure. Unscrew the two bolts on the body of the plug and separate the shell halves to access the interior. Solder a 20-gauge insulated copper wire to the SAE-AS20659 terminal lugs which attach 000-gauge SAE-AS50861/2, type 2 power cables to the studs on each bus. Ensure there is no interference with the body of the connector that would cause a force on the bus and electrical socket. Torque each nut to the manufacturer's recommended torque value to fasten the cable lug to the bus. Connect the other end of the cable

to the mating receptacle. The voltage taps and power cables will remain on each sample throughout the remainder of the test sequence, except for the immersion and salt fog tests.

4.5.6 Dielectric strength test. Apply a potential of 2500 ± 500 volts of any frequency up to 600 Hertz between the electrical connections of the connector for 61 ± 1 seconds. Determine if a sudden discharge of the electric potential occurs. Examine the connector for the requirements of 3.12.5.

4.5.6.1 Dielectric strength test at room temperature. Stabilize the connector at room temperature (see 4.4.1). Perform the test of 4.5.6 with both the connector and the environment at room temperature.

4.5.6.2 Dielectric strength test at low temperature. Stabilize the connector at low temperature (see 4.4.1). Perform the test of 4.5.6 on the cold connector in a room temperature environment.

4.5.6.3 Dielectric strength test at high temperature. Stabilize the connector at high temperature (see 4.4.1). Perform the test of 4.5.6 on the hot connector in a room temperature environment.

4.5.7 Insulation resistance test. Apply a potential having an effective value of 500 ± 100 volts at any frequency up to 600 Hertz for 61 ± 1 seconds between the electrical connections of the connector. Measure the maximum current. Calculate the resistance by dividing the applied potential by the current measured. Examine the connector for the requirements of 3.12.6.

4.5.7.1 Insulation resistance test at room temperature. Stabilize the connector at room temperature (see 4.4.1). Perform the test of 4.5.7 with both the connector and the environment at room temperature.

4.5.7.2 Insulation resistance test at low temperature. Stabilize the connector at low temperature (see 4.4.1). Perform the test of 4.5.7 on the cold connector in a room temperature environment.

4.5.7.3 Insulation resistance test at high temperature. Stabilize the connector at high temperature (see 4.4.1). Perform the test of 4.5.7 on the hot connector in a room temperature environment.

4.5.8 Operating torque test (applies only to plugs). Slowly torque the plug handle while engaging the plug completely with its mating receptacle. Measure the maximum torque value. Using the same wrench, slowly torque the plug handle while disengaging the plug completely from its mating receptacle. Measure the maximum torque value. Examine the plug for the requirements of 3.12.7.

4.5.8.1 Operating torque test at room temperature. Mate the plug and receptacle. Stabilize both connectors at room temperature (see 4.4.1). Perform the test of 4.5.8 with both connectors and the environment at room temperature.

4.5.8.2 Operating torque test at low temperature. Mate the plug and receptacle. Stabilize both connectors at low temperature (see 4.4.1). Perform the test of 4.5.8 on the cold connectors in a room temperature environment.

4.5.8.3 Operating torque test at high temperature. Mate the plug and receptacle. Stabilize both connectors at high temperature (see 4.4.1). Perform the test of 4.5.8 on the hot connectors in a room temperature environment.

4.5.9 Contact resistance test (applies only to plugs). This test shall consist of the following steps.

a. Preparation: Connect the pins of an MS3509 receptacle with a copper shorting bar that has a minimum cross-sectional area not less than that of the receptacle pins. Attach voltage taps to the contact pins on the battery side of the mating receptacle. Engage the plug with the mating receptacle. Attach the plug's cables to the power supply. Attach the receptacle's voltage taps to appropriate instrumentation.

b. Apply a current of 1500 ± 30 amperes for 60 +2, -0 seconds.

c. Turn the current flow to zero amperes. Turn off the power supply. Let the connector stand at room temperature for not less than 60 minutes.

d. Apply a current of 750 ± 15 amperes for 5 ± 0.1 minutes.

e. Turn the current flow to zero amperes. Turn off the power supply. Let the connector stand at room temperature for not less than 60 minutes.

f. Measure the following:

(1) Monitor the potential difference between the tap soldered to the cable lug attached to the 000-gauge cable on the plug's positive bus and the corresponding tap on the back of the receptacle's contact pin. Note the largest potential difference.

(2) Monitor the potential difference between the tap soldered to the cable lug attached to the 000-gauge cable on the plug's negative bus and the corresponding tap on the back of the receptacle's contact pin. Record the largest potential difference.

(3) The applied current.

g. Examine the plug for the requirements of 3.12.8.

4.5.9.1 Contact resistance test at room temperature. Mate the plug and receptacle. Stabilize both connectors at room temperature (see 4.4.1). Perform the test of 4.5.9 with both connectors and the environment at room temperature.

4.5.9.2 Contact resistance test at low temperature. Mate the plug and receptacle. Stabilize both connectors at low temperature (see 4.4.1). Perform the test of 4.5.9 on the cold connectors in a room temperature environment.

4.5.9.3 Contact resistance test at high temperature. Mate the plug and receptacle. Stabilize both connectors at high temperature (see 4.4.1). Perform the test of 4.5.9 on the hot connectors in a room temperature environment.

4.5.10 Receptacle strength test (applies only to receptacles). This test shall consist of the following steps.

a. Stabilize the receptacle at room temperature (see 4.4.1). Perform the test of 4.5.10 with both the receptacle and the environment at room temperature.

b. Retaining pins: Engage a test screw with the receptacle. Apply a tension of 500 ± 50 pounds for 5 ± 1 seconds. Release the tension. Gradually apply the following torque to the handle of the test screw until the indicated value is reached. Apply a torque of 10 ± 1 pound-feet to the screw for 5 ± 1 seconds. Examine the receptacle for the requirements of 3.12.9.

c. Contact pins: Slowly apply the following forces until the indicated values are reached. Apply a torque of 50 ± 5 pound-inches about the axis of each contact pin by applying the torque to the terminal blocks. Apply the torque in one direction for 5 ± 1 seconds. Apply the torque in the opposite direction for 5 ± 1 seconds. Examine the receptacle for the requirements of 3.12.9.

4.5.11 Life test.

4.5.11.1 Life test (applies only to plugs). Attach a 000-gauge cable to the connector. At the beginning of the test, lightly lubricate the contact pins of the appropriate mating receptacle, the plug's electrical contact sockets, and the plug's worm gear with a cotton swab dipped in light lubricating oil. Engage the plug with the receptacle and mount the combination such that the axis of the contact pins is horizontal. A cycle is one engagement and one disengagement of the plug and receptacle. Perform 5000 cycles by hand at a rate not greater than 30 cycles per minute. Every 500 cycles, wipe clean the plug contact sockets, the receptacle contact pins, and connector worm with a clean soft cloth and relubricate. Every 1500 cycles, replace the receptacle with a new one. Examine the plug for the requirements of 3.12.10. Perform the tests of 4.5.8.1 and 4.5.9.1. Examine the plug for the requirements of 3.12.10.

4.5.11.2 Life test (applies only to receptacles). At the beginning of the test, lightly lubricate the contact pins of the receptacle, the plug's electrical contact sockets, and the plug's worm gear with a cotton swab dipped in light lubricating oil. Engage the plug with the receptacle and mount the combination such that the axis of the contact pins is horizontal. A cycle is one engagement and one disengagement of the plug and receptacle. Perform 1500 cycles by hand at a rate not greater than 30 cycles per minute. Every 500 cycles, wipe clean the plug contact sockets, the receptacle contact pins and the connector worm shaft with a clean soft cloth and relubricate. Examine the receptacle for the requirements of 3.12.10.

4.5.12 Temperature shock test. Subject the connector to the temperature shock test of MIL-STD-810, method 503.1, procedure I, except that exposure periods shall be 30 ± 5 minutes. The low-temperature environment shall be -57 ± 2 °C (-70 ± 3.6 °F), and the high-temperature environment shall be 71 ± 2 °C (160 ± 3.6°F). Examine the connector for the requirements of 3.12.11. Perform the test of 4.5.6.1. Examine the connector for the requirements of 3.12.11. Subject plugs to the tests of 4.5.8.1 and 4.5.9.1. Examine the plug for the requirements of 3.12.11.

4.5.13 Mechanical shock test. Support the 000-gauge power cables at a point 1.0 ± 0.1 foot below and 1.0 ± 0.1 foot to the side of the axis of the handle of the plug. Connect the plug or receptacle to its mating connector and mount the combination to the vibration fixture. Support the plug only by the receptacle. Apply the shocks to the plug through the receptacle only. Subject the connectors to the shock test of MIL-STD-810, method 516.2, procedure I, figure 516.2-1, amplitude a (basic design), and time duration c. Examine the connector for the requirements of 3.12.12. Perform the test of 4.5.6.1. Examine the connector for the requirements of 3.12.12.

4.5.14 Humidity test. Subject the connector to ten cycles of the humidity test of MIL-STD-810, method 507.1, procedure II, figure 507.1-2. Examine the connector for the requirements of 3.12.14. Perform the test of 4.5.7.1. Examine the connector for the requirements of 3.12.14. Subject the plug to the tests of 4.5.8.1 and 4.5.9.1. Examine the plug for the requirements of 3.12.14.

4.5.15 Immersion. Remove the voltage tap wires and power cables from the plug. Reassemble the plug (less taps and cables).

4.5.15.1 Test solutions. Unless otherwise indicated by the applicable specification sheet, the test solutions and periods are:

a. An aqueous solution of potassium hydroxide of 1.30 ± 0.04 specific gravity for 4 ± 0.2 hours. Blue and black receptacles shall be tested for 168 hours at 66° ± 2 °C (150° ± 3.6 °F).

b. An aqueous solution of sulfuric acid of 1.10 ± 0.05 specific gravity for 4 ± 0.2 hours.

c. A 50 percent aqueous solution of ethylene glycol for 20 ± 1 hours.

d. MIL-PRF-5606 aircraft hydraulic fluid for 20 ± 1 hours. Note: Do not perform step 4.5.15.2.b.

e. MIL-PRF-23699 aircraft engine lubricating oil for 20 ± 1 hours. Note: Do not perform step 4.5.15.2.b.

f. MIL-PRF-85570 Type I exterior aircraft cleaner, 1 part cleaner to 10 parts tap water, for 20 ± 1 hours.

4.5.15.2 Test procedure. This test shall consist of the following steps.

a. Measure the major dimensions of each specimen with a micrometer. Weigh each specimen on a chemical balance. Place the specimen in a vessel with a lid. Completely immerse the specimen in the room temperature test solution of 4.5.15.1.a, cover the vessel, and allow the vessel to stand at room temperature for the indicated length of time (see 4.4.1 and 4.5.15.1).

b. Rinse the specimen in water. However, do not rinse the specimens of 4.5.15.1.d and 4.5.15.1.e.

c. Wipe dry. Examine the identification marking. Inspect all samples for evidence of cracks or blisters. Measure and weigh the samples. Calculate the percentage change in major dimensions and weight. Examine the item for the requirements of 3.12.15.

d. Repeat steps 4.5.15.2.a through 4.5.15.2.c for each of the indicated test solutions of 4.5.15.1 in turn.

e. Subject the plug to the tests of 4.5.7.1, 4.5.8.1, and 4.5.9.1. Examine the plug for the requirements of 3.12.15.

f. Subject the receptacle to the tests of 4.5.7.1 and 4.5.10. Examine the receptacle for the requirements of 3.12.15.

4.5.16 Salt fog test. Ensure all connectors are uncovered and oriented away from direct salt fog spray. Subject the connector to the salt fog test of MIL-STD-810, method 509.1, procedure I for 48 ± 2 hours. After completion of the test, clean any salt residue from the connector by flushing the connector with distilled water and wiping dry. Examine the connector for the requirements of 3.12.15. Subject the plug to the tests of 4.5.7.1, 4.5.8.1, and 4.5.9.1. Examine the plug for the requirements of 3.12.15. Subject the receptacle to the tests of 4.5.7.1 and 4.5.10.. Examine the receptacle for the requirements of 3.12.15.

4.5.17 Vibration test. Attach 000-gauge cables to the plug during this test.

4.5.17.1 Plugs. Support the 000-gauge cables at a point 1.0 ± 0.1 foot below and 1.0 ± 0.1 foot to the side of the axis of the handle of the plug. Engage the plug with its mating receptacle for the duration of the test. Mount the combination to the vibration fixture. Support the plug only by the receptacle. Apply the vibration to the plug through the receptacle only. Subject the connectors to an applied acceleration of ±10 *g* or an applied double amplitude of 0.10 inch (whichever is less) between 5 and 500 Hertz. Perform the vibration in all three axes for three hours per axis with a logarithmic frequency-change rate in 15-minute cycles. Examine the plug for the requirements of 3.12.13. Perform the test of 4.5.6.1. Examine the plug for the requirements of 3.12.13. Perform the tests of 4.5.8.1 and 4.5.9.1. Examine the plug for the requirements of 3.12.13.

4.5.17.2 Receptacles. Mount the receptacle to the vibration fixture. Engage the receptacle with its mating plug for the duration of the test. Support the 000-gauge cables on the vibration fixture at a point 1.0 ± 0.1 foot below and 1.0 ± 0.1 foot to the side of the axis of the handle of the plug. Subject the connectors to an applied acceleration of ±10 *g* or an applied double amplitude of 0.10 inch (whichever is less) between 5 and 500 Hertz. Perform the vibration in all three axes for three hours per axis with a logarithmic frequency-change rate in 15-minute cycles. Examine the receptacle for the requirements of 3.12.13 Perform the test of 4.5.6.1. Examine the receptacle for the requirements of 3.12.13;

4.5.18 Air-tightness test (applies only to receptacles). Mount the receptacle on an airtight box. Connect the box to a source of air pressure. Apply a pressure of 2.0 ± 0.2 pounds per square inch to the inside of the box. Submerge the assembly in water. Examine the receptacle for the requirements of 3.12.16.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The connectors covered by this specification are used in fixed-wing and rotary-wing military aircraft. The connectors covered by this specification are considered

military unique because they are required to withstand exposure to prolonged periods to extreme seagoing environments not encountered by civilian aircraft.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of the specification and applicable specification sheet.

b. Solicitations and contracts should cite Revision C of MIL-STD-810.

c. Packaging requirements (see 5.1).

d. Connector required, including PIN, NSN, and quantity.

e. Qualification testing and conformance inspections are required as indicated herein and should not be waived (see table IV for the quantity of samples required).

h. Responsibility for inspection and sample selection (see 6.7).

i. Whether a certificate of conformity is required (see 3.4).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL 18148, whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Crane Division, Naval Surface Warfare Center, Global Deterrence and Defense Department, Power and Circuit Board Technologies Division, Code GXSL, 300 Highway 361, Crane, IN 47522-5001.

6.4 Application for qualification. Applicants obtain the approval of the qualifying activity before submitting samples for qualification inspection. The process starts when the manufacturer applies for qualification by letter to the qualifying activity indicated in 6.3. SD-6, “Provisions Governing Qualification” provides guidance concerning the necessary information and certification. Copies of SD-6 are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

6.5 Conformance inspection. Conformance inspection by the qualifying activity will be limited to the amount deemed necessary to determine compliance with the contract and will be limited in severity to the definitive quality assurance provisions established in this specification and the contract. The amount of conformance inspection by the qualifying activity may be adjusted to make maximum use of the contractor's quality control system and the quality history

of the product (see 4.3). Any or all qualification tests may be performed on conformance inspection samples if the manufacturer has not supplied the product to the procuring activity for a period greater than 2 years, or if the qualifying activity suspects that the product no longer conforms to prescribed requirements.

6.6 Conformance inspection costs. An estimate of the qualifying activity's cost for testing for single service procurements, for use by a contractor at time of preparation of bids, may be obtained from the Crane Division, Naval Surface Warfare Center, Global Deterrence and Defense Department, Power and Circuit Board Technologies Division, Code GXSL, 300 Highway 361, Crane, IN 47522-5001.

6.7 Responsibility for inspection and sample selection. The qualifying activity (see 6.3) performs qualification inspection on samples furnished by the contractor. The Government selects samples for conformance inspection. The qualifying activity conducts conformance inspection for quality conformance. The Government reviews and examines the contractor's inspection procedures and inspection records as necessary.

6.8 Design practices and lessons learned.

6.8.1 Corrosive nature of potassium hydroxide (KOH). The aqueous solutions of potassium hydroxide used for nickel-cadmium battery electrolyte have high ionic conductivity and low freeze points. These properties give nickel-cadmium batteries their high power and ability to perform well at low temperatures. However, this electrolyte has very reactive and corrosive properties. Potassium hydroxide attacks aluminum, glass, many plastics, rubber compounds, and the corrosion preventive compound used on batteries. Plastics which are not dissolved may absorb the electrolyte, swell, and lose both mechanical and dielectric properties.

6.8.2 Elastomers and potassium hydroxide. Items that have passed the testing required for qualification and have worked acceptably in practice have used ethylene propylene rubber when elastomers are needed. Neoprene is attacked by potassium hydroxide and can soften, swell, and split.

6.8.3 Dissimilar metals. MIL-STD-889 provides methods for protecting joined dissimilar metals.

6.8.4 Color. For safety reasons, users must quickly and easily determine whether a battery is a nickel-cadmium or a lead-acid battery. Therefore, a Navy color coding system in place since the 1960s has required that a red container be used for lead-acid batteries and a blue one for nickel-cadmium batteries (see 3.10.1). The color code extends to the connectors used with aircraft batteries. The colors reflect the litmus paper indications for acid and alkaline substances, respectively.

6.8.5 Additional information. See NAVSO P-3676, Navy Primary and Secondary Batteries: Design and Manufacturing Guidelines, for additional information on nickel-cadmium

batteries. Copies are available from Customer Service (Code 033343), Naval Inventory Control Point, 700 Robbins Avenue, Philadelphia, PA 19111.

6.9 Supersession data. See the applicable specification sheets for connector supersession information.

6.10 Definitions.

6.10.1 Components. Components will include, but will not be limited to, springs, receptacle pins, terminal posts (blocks), mechanical engagement pins, and electrical contact sockets (see 3.4).

6.10.2 Inspection lot. The quantity of connectors of any one type, produced at any one place of manufacture, submitted at one time to quality conformance inspection (see 4.3).

6.10.3 Unit. A single, individual item, such as one connector (see 4.3).

6.11 Part or identifying number (PIN). The PINs (see 6.2) for connectors acquired to this specification are identical to the PINs used by the now-cancelled MS sheets that formerly covered the connectors. Those PINs were created as follows: MSXXXXX-Y with "MSXXXXX" representing the MS sheet number and "Y" indicating any variation of the connector on a particular MS sheet.

6.12 Subject term (key word listing).

Plug
Receptacle
Terminal

6.13 International standardization agreement implementation. This specification implements NATO STANAG 3660AE, “Aircraft Main Battery Electric Plug.” When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at http://assist.daps.dla.mil.

6.14 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

TABLE I. Material and component requirements and inspections.

Material or components	Applicable requirements	Method of inspection paragraph
Metals and metallic components (see 6.10.1).	3.11, 3.12.15	4.5.15, 4.5.7.1
	3.11, 3.12.15	4.5.16, 4.5.7.1
Non-metallic components, elastomeric materials, and plastics (including polyamide and molded plastic parts).	3.11, 3.12.14	4.5.14, 4.5.7.1
	3.11, 3.12.15	4.5.15, 4.5.7.1
	3.11, 3.12.15	4.5.16, 4.5.7.1

TABLE II. Identification of defects.

Number	Description	Method of inspection
1	Electrical contact surfaces obstructed by foreign material or insulation compounds	Visual
2	Pitting or blow holes	Visual
3	Location and polarity of terminals not as specified	Visual
4	Terminal and identification markings not as specified	Visual
5	Seal missing or defective	Visual
6	Corrosion. However, if a component (for example, a spring or receptacle pin) is made of 400 series stainless steel, then minor surface corrosion is permitted on that component.	Visual
7	Particles of foreign material	Visual
8	Insulators or insulation missing or damaged	Visual
9	Burrs	Visual
10	Improper color on outside of connector	Visual
11	Loose or missing hardware	Visual
12	Foreign objects inside connector	Visual
13	Improper lubrication	Visual

TABLE III. Immersion and salt fog requirements.

Affected part of the connector	Deleterious effects
External and internal parts	Cracking, pitting, chipping, scaling, blistering, corrosion (however, if a component [for example, a spring or receptacle pin] is made of 400-series stainless steel, then minor surface corrosion is permitted), or other deleterious effects
Electrical parts	Functional degradation
Plastic materials	Change more than 2.5 percent in weight or 2.0 percent in any major dimension (length, width, or height)
Identification markings	Smudging, smearing, chipping, crazing, or other deleterious effects

TABLE IV. Sample sizes for testing.

Inspection lot size	Quantity of connectors to be provided for testing	Subgroup sample size	
		I	II
1 through 280	2	1	1
281 through 500	4	2	2
501 through 3,000	6	3	3
3,001 through 10,000	8	4	4

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 85
DLA - CC

Preparing activity:
Navy - AS

Agent:
Navy - SH

Reviewer activities:
Army - CR, MI
Air Force - 99
DLA - GS

(Project 5935-2008-196)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil.