

MIL-E-7080B

6 JUNE 1962

SUPERSEDING

MIL-E-7080A

5 SEPTEMBER 1956

MILITARY SPECIFICATION**ELECTRIC EQUIPMENT, AIRCRAFT,
SELECTION AND INSTALLATION OF**

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 This specification covers the requirements for the installation and selection of electric equipment in piloted aircraft.

1.2 Electric equipment shall be construed to include electric power generation and utilization equipment, and control and protective devices.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS**FEDERAL**

L-P-406 — Plastics, Organic;
General Specifications, Test Methods.

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MIL-R-26 — Resistors, Fixed, Wire-wound (Power Type).

MIL-S-61 — Shunts, Instrument External, 50-Millivolt (Lightweight Type).

MIL-S-3950 — Switches, Toggle.

MIL-C-5026 — Cutout Relay, Aircraft Generator.

MIL-B-5087 — Bonding; Electrical (for Aircraft).

MIL-W-5088 — Wiring, Aircraft, Installation of.

MIL-E-5272 — Environmental Testing, Aeronautical and Associated Equipment, General Specification for.

MIL-F-5372 — Fuse, Enclosed Link, Aircraft, 400 Cycle AC.

MIL-L-5667 — Lighting Equipment, Aircraft Instrument Panel, General Specification for Installation of.

MIL-C-5809 — Circuit Breakers, Trip-Free, Aircraft, General Specification for.

MIL-E-6051 — Electrical - Electronic Systems Compatibility and Interference Control Requirements for Aeronautical Weapon Systems, Associated Subsystems and Aircraft.

MIL-G-6099 — Generators and Regulators, Air-Cooled, A-C, Aircraft General Specification for.

MIL-R-6106 — Relays, Electric, Aircraft, General Specification for.

MIL-B-6146 — Batteries; Storage Shielded, General Specification for.

MIL-G 6162 — Generators, 30-Volt, Direct Current, Aircraft Engine Driven, General Specification for.

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MIL-I-6181 — Interference Control Requirements, Aircraft Equipment.

MIL-L-6503 — Lighting Equipment, Aircraft, General Specification for Installation of.

MIL-L-6723 — Lights, Aircraft, General Specification for.

MIL-L-6730 — Lighting Equipment, Exterior, Installation of Aircraft (General Specification).

MIL-S-6743 — Switches; Push Button and Limit.

MIL-S-6744 — Switch Assemblies and Actuators, Push Button and Limit.

MIL-S-6746 — Switches, Rotary, Shielded, Aircraft Ignition.

MIL-R-6749 — Rheostats; Aircraft Power.

MIL-A-6752 — Ammeters, Voltmeters, and Loadmeters; Direct Current.

MIL-V-6753 — Voltmeters; 0-150 Volt, 330 to 1200 Cycles, Alternating Current.

MIL-S-6807 — Switch, Rotary, Selector, General Specification.

MIL-R-6809 — Regulator, Voltage, 30-Volt, Direct Current Generator, General Specification for.

MIL-I-7032 — Inverter, Aircraft, General Specification for.

MIL-C-7115 — Converter, Aircraft, General Specification for.

MIL-F-7179 — Finishes and Coatings; General Specification for Protection of Aircraft and Aircraft Parts.

MIL-G-7703 — Guard, Switch.

MIL-C-7762 — Compasses, Installation of.

MIL-M-7969 — Motors, Alternating Current, 400-Cycle, 115/200 Volt System, Aircraft, Class A and B, General Specification for.

MIL-M-8609 — Motors, Direct-Current, 28-Volt System, Aircraft, Class A and B, General Specification for.

MIL-S-8834 — Switches, Toggle, Positive Break, Aircraft, General Specification for.

MIL-F-15160 — Fuses; Instrument, Power, and Telephone.

MIL-F-15733 — Filters, Radio Interference.

MIL-L-18276 — Lighting, Aircraft Interior; Installation of.

STANDARDS**MILITARY**

MIL-STD-143 — Specifications and Standards, Order of Precedence for the Selection of.

MIL-STD-203 — Cockpit Controls; Location and Actuation of, for Fixed Wing Aircraft.

MIL-STD-250 — Cockpit Controls; Location and Actuation of, for Helicopters.

MS 3106 — Connector, Plug, Electric, Straight.

MS 3107 — Connector, Plug, Electric, Quick Disconnect.

MS 25018 — Receptacle—Jet Starting Power.

MS 25043 — Cap — Electrical Connector Receptacle, Dust.

MS 33539 — Installation Clearance — Type XII Drive, (Generator-Wide Speed Range).

MS 33540 — Safety Wiring, General Practices for.

MS 33590 — Circuit Breaker Installation.

MS 33630 — Switch, Toggle, Installation of.

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AN 2552 — Receptacle — External Power, 28 Volt DC.

AN 3114 — Receptacle, External Power 115/200 Volts, 3 Phase.

AN 3117 — Receptacle—Fuel Nozzle Grounding.

AN 3156 — Clamp—Battery Hold-Down.

AND 10305 — Installation Clearance — Type XII and Type XVII Drive (Generator-Power Take-Off).

AND 10343 — Installation Clearance Type XVI Drive.

AND 10439 — Receptacle Installation — Fuel Nozzle Grounding.

AND 10441 — Battery Installation.

DRAWINGS

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53A6232 — Connector-Receptacle Power Outlet Electric Test Equipment.

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

3. REQUIREMENTS

3.1 General requirements.

3.1.1 *Detail specification.* In case of conflict between the requirements of this specification and the type or detail specification for a particular aircraft or aircraft part, the type or detail specification shall prevail.

3.1.2 *Deviations.* Deviations from this specification desired by the contractor (substitution of equipment, material, or installation) shall be specifically brought to the attention of the procuring activity by letter concurrent with or prior to forwarding the design data for approval.

3.1.2.1 *Design objective.* Items of this specification which are identified as "design objectives," are intended as guides, and therefore, procuring activity approval is not required for deviations from them. However, if required by the Government inspector, the contractor shall furnish evidence that due consideration has been given to attain these objectives.

3.1.3 *Contractor's specification.* Material and equipment conforming to contractor's specifications may be used, provided the contractor's specification is approved by the procuring activity and provided no military specification exists. The contractor shall provide substantiating test data and, when required by the procuring activity, shall provide samples for test. The use of contractor's specifications shall not constitute waiver of Government inspection. Contractor's specifications shall follow the format for military specifications. When a detail or general military specification exists for the class of material required, the contractor's specification shall reference the existing military specification and set forth only the needed new requirements and deviations.

3.1.4 *Workmanship.* All details of workmanship shall be in accordance with high-grade aircraft electric equipment and accessory installation practices.

3.1.5 *Government-furnished aircraft equipment.* Unless otherwise authorized by the procuring activity, material and equipment furnished by the Government shall be installed without modification.

3.1.6 *Modification.* The contractor shall not alter, rework, or modify equipment built to Government specifications, unless authorized by the procuring activity, and such modification shall be subject to Government inspection.

3.1.7 *Materials.*

3.1.7.1 *Metals.* Metals used in the installation of electric equipment in aircraft shall

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be of the corrosion-resistant type or shall be suitably protected to resist corrosion and electrolytic action during normal service life. Finish and coating shall be in accordance with Specification MIL-F-7179.

3.1.7.1.1 Dissimilar metals. Dissimilar metals shall not be used in intimate contact unless suitably protected against electrolytic corrosion. When it is necessary that any combination of such metals be assembled, an interposing compatible material shall be used. Dissimilar metals are defined in table I.

3.1.7.2 Nonmetals. Nonmetals used, including plastics, fabrics, and protective finishes, shall be moisture- and flame-resistant to the maximum extent practicable, commensurate with other aircraft design requirements, shall not support fungus growth, shall not support combustion nor give off noxious gases in harmful quantities, and shall not be adversely affected by weathering, aircraft fluids, temperatures, and ambient conditions encountered during operation of the aircraft.

3.1.7.2.1 Plastic material. Plastic insulating materials used shall not form current-conducting tracks when subjected to arcs such as those caused by interrupting heavy short-circuit currents. The material shall withstand the "Arc Resistance" test of Method 4011 of Specification L-P-406.

3.1.7.3 Selection of materials. Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with Standard MIL-STD-143, except as specified in 3.1.7.3.1.

3.1.7.3.1 Standard parts. Standard parts (MS, AN, or JAN) shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers. Commercial utility parts, such as screws, bolts, nuts, and cotter pins, may be used, provided they possess suitable properties and are replaceable by the standard parts (MS, AN, or JAN) without alteration, and

provided the corresponding standard part numbers are referenced in the parts list and, if practicable, on the contractor's drawings. In the event there is no suitable corresponding standard part in effect on date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

3.1.8 Installation.

3.1.8.1 Reliability. The installation of the electric equipment, including accessories, shall be reliable and compatible with associated equipment and material. The equipment shall be so selected as to be suitable for the environment in which it must perform under the operating requirements of the system of which it is a part.

3.1.8.2 Fire hazard. Electric equipment installed in an environment having explosive vapors present shall conform to the requirements of the explosion-proof (aeronautical) tests of Specification MIL-E-5272.

TABLE I. *Grouping of metals*¹

Group I	Group II	Group III	Group IV
(Most anodic) Magnesium alloys	Aluminum Aluminum alloys Zinc Cadmium	Zinc Cadmium Steel Lead Tin	Copper and its alloys Nickel and its alloys Chromium Stainless steel Gold Silver Titanium Ruthenium (Most cathodic)

¹ Where reference is made to a metal in a particular group, the reference applies to the metal on the surface of the part, that is, zinc means zinc castings, as well as zinc electroplate, zinc hot dip, or zinc metal spray.

Contact between a member of any one group and another member of the same group shall be considered as similar. Contact between a member of one group and a member of any other group shall be considered as dissimilar. Zinc and cadmium are compatible with both groups II and III.

Unless specifically approved by the procuring activity, all unlisted metals shall be considered dissimilar with respect to each other and with respect to any of the materials listed above.

Different metals in contact, even though similar, shall be employed in assemblies in such manner that the smaller part is cathodic, or protected, and the larger part is anodic, or corroded, if any corrosion takes place.

3.1.8.3 *Grounding.*

3.1.8.3.1 *Static ground.* When required, provision shall be made for the discharge of accumulated charges of static electricity by automatically bringing the aircraft to ground potential on landing, and thus preventing shock to personnel and damage to the aircraft by controlling the point of discharge. The static ground device shall be so installed as to be bonded to the aircraft structure and shall provide electric contact with the ground. The device shall be adjustable or replaceable to compensate for normal wear, and shall not protrude from the aircraft during flight, except on landing and takeoff, if retractable landing gear is employed.

3.1.8.3.2 *Fuel nozzle grounding receptacles.* Fuel nozzle grounding receptacles shall be in accordance with Standard AN 3117 and shall be installed in accordance with Standard AND 10439.

3.1.8.3.3 *Internally grounded equipment.* The mounting attachment of internally grounded equipment shall be capable of carrying full-load current, with a voltage drop low enough to prevent stray currents to ground by other paths being large enough to damage bearings, etc.

3.1.8.3.4 *Switchgear cases.* Provision shall be made to protect against an internal fault to an electrical equipment metal case from disrupting the power system. Switchgear (such as relays, circuit breakers, and switches) having metal cases for mounting, and which are in power feeders to busses or in unprotected circuits, shall be so installed that the case is electrically isolated from ground, except for a suitable small gage jumper wire which shall be provided between the case and ground to provide a current return path for internally grounded devices and for bonding in accordance with Specification MIL-B-5087.

3.1.8.4 *Bonding.* Bonding of the equipment shall be in accordance with Specification MIL-B-5087.

3.1.8.5 *Radio interference.* Electric equipment shall be installed in a manner to insure conformance of the aircraft with Specification MIL-E-6051. Electrical equipment to be installed in the aircraft shall be equipped for radio interference reduction in accordance with Specification MIL-I-6181.

3.1.8.5.1 *Filters.* Radio noise filters shall be installed only when necessary to insure compliance with Specification MIL-E-6051.

3.1.8.5.1.1 *Type filter.* Filters shall be of an internally grounded type conforming to Specification MIL-F-15733. Capacitor-type filters shall be used in all installations, except those special cases where it is demonstrated that this type of filter is not adequate.

3.1.8.5.1.2 *Filter installation.* Filters shall be so installed that they are located as near to the interference source as practicable and may be mounted on the interference source upon approval of the procuring activity. The connecting wire between the filtered line and the filter shall be as short as practicable and in no case exceed 4 inches.

3.1.8.6 *Compass deviation.* Electric equipment shall be so installed as not to cause compass deviations in excess of those allowed in Specification MIL-C-7762.

3.1.8.7 *Mounting and location.* Electric equipment shall be mounted, installed, and so located as not to be subject to conditions exceeding the limits specified in the applicable equipment specification and to conform to the following requirements.

3.1.8.7.1 *Clearance.* Clearance shall be provided in accordance with the installation clearance drawing for the equipment. Where no drawing exists, the space provided shall be no less than the dimensions shown on the maximum envelope drawing for the equipment, plus adequate additional clearance to allow for maintenance and proper ventilation.

3.1.8.7.1.1 *Shock-mounted units.* The envelope determined by the maximum movement

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of shock-mounted units shall clear surrounding structure and the maximum envelope of adjacent shock-mounted equipment by at least ¼ inch. Shock-mounted units shall not be mounted or installed in any manner other than that for which the shock mounts are designed. Cables shall be of sufficient length to allow operation of shock mounts. The cooling means or any other attachments shall not interfere with satisfactory shock-mount operation.

3.1.8.7.2 Environmental protection consideration. Electric equipment shall be so installed as to be protected from the environmental conditions which will exist in the operation of the aircraft, such as moisture, humidity, vibration, shock, sand and dust, altitude, temperature, leakage of vapors and liquids, and any expected combination of ambient conditions. Consideration shall be given the aircraft temperature environment for each of the conditions specified in 4.5 when electric equipment is selected. Forced air cooling shall be provided where necessary.

3.1.8.7.3 Physical protection consideration. Electric equipment shall be so installed as to be protected from physical damage, such as that caused by abrasion, crew movements, loading and shifting of cargo, ejection of shell cases and clips, excessive ram air pressures, loading of armament, and maintenance of equipment. Equipment shall be installed with consideration to protection of exposed terminals by orientation or insulating material covers. Equipment shall not be located below drip points and tube fittings carrying fluids.

3.1.8.7.4 Maintenance. Provision shall be made for ease of maintenance, including installation, removal, adjustment, inspection, terminal accessibility, and plug removal. Rotating equipment shall be installed in a manner to facilitate periodic inspection.

3.1.8.7.4.1 Quick-disconnect mounting. Quick attach-detach disconnects may be used

to facilitate maintenance subject to procuring activity approval.

3.1.8.7.5 Operation. Electric equipment shall be installed which has been selected with regard to the expected cyclic operating conditions, electric load, mechanical loads, and other characteristics essential to give the required operational life. The minimum acceptable service life for aircraft electric equipment shall be 1,000 flight hours, and the contractor shall advise the procuring activity of any equipment which will not conform to this requirement and of the recommended replacement or overhaul time. The term "flight hours" does not include ground operating time.

3.1.8.7.6 Safetying. Electric equipment shall be properly secured by means of safety wire, cotter pins, locknuts, or other means approved by the procuring activity. Adhesive tapes (such as friction, medical, rubber, or similar types) shall not be used. Safety wiring practice shall be in accordance with Standard MS33540.

3.1.8.7.7 Mounting hardware. Machine screws or bolts of suitable length and diameter shall be used for mounting electric equipment. Whenever the undersurface of the mounting is inaccessible, nut plates shall be used. Self-tapping screws shall not be used for mounting electric equipment or for making electric connections.

3.1.8.7.8 Rotating equipment. The mounting of rotating equipment shall be sufficiently rigid to prevent damage owing to motion with respect to its mounting. Rotating equipment which is mechanically linked to operate with other devices shall be so mounted as to prevent damage to the mating equipment, coupling, or associated device.

3.1.8.7.9 Vulnerability. Consideration shall be given to the shielding offered by major pieces of structure or equipment. In multiple installations, equipment shall be separated to prevent a single element of combat damage from disabling all similar components.

3.2 Detail requirements. The following detail requirements apply to specific items of equipment. In case of conflict with the general requirements, the detail requirements shall apply.

3.2.1 Wiring. All wiring shall be installed in accordance with Specification MIL-W-5088.

3.2.2 Regulators. Voltage regulators for generators shall be in accordance with Specification MIL-R-6809 for direct current (dc) and Specification MIL-G-6099 for alternating current (ac).

3.2.2.1 Location of regulators. Regulators shall be so mounted as to be accessible for maintenance and adjustment while the engine is running. Regulators shall be so ventilated that the ambient temperature around the regulator does not exceed the allowable temperature altitude range of regulator operation. In bomber- and cargo-type aircraft, regulators shall be accessible in flight.

3.2.2.2 Mounting. Carbon-pile regulators shall be so mounted that they are not subjected to vibration exceeding that defined in the detail equipment specification and so that the longitudinal axis of the carbon stacks are in a horizontal plane. The longitudinal axis of the carbon pile shall also be in the direction of minimum acceleration in the horizontal plane.

3.2.2.3 Regulation point. The voltage shall be regulated at a point as near as practicable to the main bus.

3.2.3 Generator control panels. Generator control panels shall be installed as required by the procuring activity.

3.2.3.1 Mounting. Generator control panels shall be mounted in an environment and in such manner that the specification limitations are not exceeded. They shall be accessible for maintenance and adjustment while the aircraft is on the ground and the engines are running.

3.2.4 Batteries. Batteries installed in aircraft shall conform to Specification MIL-B-6146 or as approved by the procuring activity.

3.2.4.1 Battery installations. Batteries shall be installed in accordance with Standard AND10441 (sump jar installation shall not be provided in naval aircraft) and with hold-down clamps conforming to Standard AN 3156. Batteries shall be substantially horizontal while the aircraft is in level flight. Batteries designed for high-rate discharge, such as those used on jet aircraft, shall be installed in a manner approved by the procuring activity.

3.2.4.1.1 Disconnect. A quick-disconnect device shall be provided at the battery terminals for disconnecting the battery from the electrical system, to facilitate maintenance.

3.2.4.1.2 Battery location. Lead-acid batteries shall be so located and installed that the following features are effected:

- (a) Electrolyte level in individual cells may be visually inspected without removing the battery.
- (b) Specific gravity of each cell may be tested with a standard hydrometer without completely removing the battery.
- (c) It is readily accessible for servicing from outside without necessitating complete removal of any part of the aircraft.

3.2.4.1.3 Battery electrolyte, protection. To prevent corrosion of the aircraft by battery electrolyte, the following shall be accomplished:

- (a) The battery shall be installed in an electrolyte-resistant container, or suitable protection against battery electrolyte shall be applied in accordance with Specification MIL-F-7179 to all surfaces within 12 inches of the battery and to

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surfaces further removed which are subject to electrolyte spillage, spray, or fumes.

- (b) Equipment shall not be located where it may be contacted by electrolyte spillage, spray, or fumes.
- (c) As a design objective, the battery shall be installed in a compartment which has provisions for maintaining the battery at approximately 60° F. (15.6° C.) during ground and flight operations.

3.2.4.1.4 Venting provisions. The inlet and outlet hoses shall be so located as to maintain, in flight, a pressure drop of not less than 0.1 and not more than 1.5 pounds per square inch (psi) between the battery vent tubes to permit the flow of fresh air into the battery case to exhaust fumes. The inlet tube shall be brought out above the level of the battery, and the outlet tube shall be brought out below the level of the battery.

3.2.4.1.5 Pressurization. Pressurization shall be provided, when required, to prevent loss of electrolyte on account of boiling. A minimum pressure value shall be determined and this pressure applied by allowing air to flow through the battery. This flow of air shall produce not less than 0.1- and not more than 1.5-psi pressure drop across the battery vent tubes.

3.2.5 Converters. Converters shall be in accordance with Specification MIL-C-7115 and as approved by the procuring activity.

3.2.6 Inverters. Inverters shall be in accordance with Specification MIL-I-7032.

3.2.6.1 Mounting of inverters. Inverters shall be installed in accordance with Specification MIL-I-7032.

3.2.7 Motors. Motors shall be in accordance with Specification MIL-M-8609 for dc systems and Specification MIL-M-7969 for ac systems.

3.2.8 Generators. Generators shall be in accordance with Specification MIL-G-6099 for ac, and Specification MIL-G-6162 for dc or of a type approved by the procuring activity.

3.2.8.1 Clearance. To facilitate interchangeability, a minimum generator installation clearance conforming to that shown on Standard AND10305, AND10343, or MS 33539, as applicable, shall be provided, even though the generator specified does not require those clearances.

3.2.8.2 Accessibility. The generator shall be so positioned and installed that:

- (a) The terminals are readily accessible for maintenance and inspection.
- (b) The window strap or end bell, or both, can readily be removed for brush and commutator inspection.
- (c) The generator may readily be removed for servicing.
- (d) Hydraulic lines and other tubing do not interfere with periodic inspection.

3.2.8.3 Cooling. When required by the generator design, means shall be provided for forced cooling. The amount of cooling air required and the installation of the duct shall be as specified by the procuring activity. The cooling air duct shall have sufficient flexibility to allow for the maximum possible relative movement between the generator and duct, shall not impose stresses on the generator, and shall be designed to minimize the possibility of water or foreign material entering the generator.

3.2.8.4 Remote driven generators. The installation of remote driven generators and their drives shall be contingent upon the procuring activity's approval.

3.2.9 Lighting equipment. Lighting equipment shall be in accordance with Specification MIL-L-6723. The installation of exterior lighting equipment shall be in accordance

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with Specification MIL-L-6780. Installation of instrument lighting shall be in accordance with Specification MIL-L-5667. In addition, lighting for Air Force aircraft shall be in accordance with Specification MIL-L-6503, and for Naval aircraft in accordance with Specification MIL-L-18276, or as otherwise approved by the procuring activity.

3.2.10 Power receptacles.

3.2.10.1 External. External power receptacles for 28-volt dc service power shall conform to Standard AN2552. External power receptacles for 115/200-volt ac service power shall conform to Standard AN3114. Receptacles for jet engine starting shall be in accordance with Standard MS25018.

3.2.10.1.1 Installation of receptacles. The receptacles shall be located to facilitate accessibility from the ground and to minimize hazards to personnel from operation of the aircraft engines and from fuel vent overflow. External power receptacle shall be located behind the same access door or behind separate access doors which are located within 5 feet of each other. The door shall be so hinged and designed that it will automatically stay closed when not in use and shall open against the slip-stream. The door may be an access door provided for other purposes, except that the receptacles shall not be installed in wheel wells or bomb bays. The access door shall be adequately identified, substantially as follows: "External Power Receptacle, 28 volts dc; 115 volts, 400-cycle ac." Suitable protection shall be provided to prevent inadvertent shorting of the pins or terminal studs. If the receptacles are installed side-by-side, there shall be at least 2½ inches, center-to-center of the pins, separating them.

3.2.10.1.2 Electrical protection. The installation shall provide means to isolate the receptacle from the aircraft bus whenever:

- (a) The mating plug is disengaged.
- (b) Reversed dc polarity exists at the plug.

- (c) Reversed phase sequence exists at the plug.
- (d) An open phase exists in the external power source.

3.2.10.2 Internal. When required by the procuring activity, internal receptacles shall be installed to provide ac or dc as follows:

3.2.10.2.1 For Naval aircraft.**(a) Ac utility power receptacles.**

- (1) Type: Receptacle outlets for 115/200-volt 3Ø and 115-volt 1Ø, 400-cycle power shall mate with plug, Part No. MS3106-20-4P. The receptacle shall be capped with Part No. MS25043-20C.
- (2) Connections: The receptacles shall be wired so that contacts A, B, C, and D are respectively connected to phases T₁, T₂, T₃, and neutral. Single-phase receptacles shall be wired so that contacts A and D are respectively connected to phase T₁ and to neutral. Each line, except neutral, shall be protected by a 7.5-ampere circuit breaker.
- (3) Identification: The receptacles shall be identified as "115/200-volt AC Utility Receptacle" or "115-volt AC Utility AC Receptacle," as applicable.

(b) Dc utility power receptacles.

- (1) Type: Receptacle outlets for 28-volt dc power shall mate with plug MS3106-16-11P. The receptacle shall be capped with Part No. MS25043-16C.
- (2) Connections: The receptacle shall be wired so that pin "A" is grounded (negative) and pin "B" is positive (+28 volts). The positive line shall be protected with a 7.5-ampere circuit breaker.
- (3) Identification: The receptacle shall be identified as "28V DC Utility Receptacle"

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(c) *Test receptacles.* Test receptacles shall be provided for checking each ac and dc power source. The receptacle shall be connected to the prime source and its associated conversion equipment if the prime source is either ac or dc. When there are both ac and dc prime sources, the receptacle shall be connected to both these sources.

- (1) *Type:* The receptacle shall mate with plug MS3107A16S-8P. A suitable protective cap shall be provided for each receptacle.
- (2) *Connections:* The receptacle shall be wired so that contacts A, B, C, D, and E are respectively connected to T₁, T₂, T₃, ground (ac neutral, dc negative), and 28-volt dc positive. Each line, except the ground shall be protected by a 5-ampere fuse.
- (3) *Identification:* The receptacle shall be identified as "Power System Test Receptacle," and shall include voltage information.

3.2.10.2.2 For Air Force Aircraft.

- (a) Internal receptacles shall comply with Drawing 53A6232.
- (b) *Identification:* Each power receptacle shall be permanently identified as "Power Receptacle." In addition, the identification shall include the following: Voltage, phase, frequency and volt-ampere or current rating, as applicable.

3.2.10.3 Power receptacle. Each power receptacle shall be permanently identified as "Power Receptacle." In addition, the identification shall include the following: Voltage, phase, frequency, and volt-ampere or current rating, as applicable.

3.2.11 Meters. Ac and dc meters, such as ammeters, voltmeters, voltammeters, wattvarmeters, and frequency meters shall conform to Specifications MIL-A-6752 and MIL-

V-6753, or shall be approved by the procuring activity. Ammeter shunts shall conform to Specification MIL-S-61.

3.2.11.1 Installation of meters. The installation and location of meters shall be such as to afford good visibility and to minimize effects of parallax. Adequate shock mounting shall be provided if the meters are installed where they will be subject to vibration which exceeds the limits of the meter specification.

3.2.11.2 Installation of shunts. Ammeter shunts shall not be used as terminal blocks. Two ammeters may be connected to one shunt.

3.2.12 Switches.

3.2.12.1 Toggle switches. Toggle switches shall be installed for manual operation only, without toggle extensions, and shall be in accordance with Specifications MIL-S-3950 and MIL-S-8834.

3.2.12.1.1 Lever-lock switches. Lever-lock switches shall be in accordance with Specifications MIL-S-3950 and MIL-S-8834. Such switches shall be used when a requirement exists on positive locking to prevent inadvertent operation of critical or hazardous circuits.

3.2.12.2 Accessibility. Toggle switches shall be accessible for operation in flight, except switches used for ground operation only. Care shall be exercised in grouping and locating switches to prevent improper selection and inadvertent operation.

3.2.12.3 Installation of switches. Switches shall be installed in accordance with Standard MS33630. Switch orientation shall be in accordance with Standard MIL-STD-203 or MIL-STD-250, as applicable.

3.2.12.4 Guards. When switch guards are used in lieu of lever-lock toggle switches to prevent accidental operation, they shall be in accordance with Specification MIL-G-7703.

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3.2.12.5 Additional switch space. Space shall be provided on each switch panel containing four or more switches for the subsequent installation of two spare switches. The space for spare switches will be determined by the equipment and circuit data available on the date of the aircraft mockup inspection.

3.2.12.6 Limit and pushbutton switches. Limit and pushbutton switches shall not be adapted from any switch designed for toggle operation. They shall be in accordance with Specifications MIL-S-6743 and MIL-S-6744.

3.2.12.6.1 Adjustment. Limit switch adjustment shall have a positive lock and adjustment, be readily accessible, and not require special tools for servicing. The assembly shall be sufficiently rigid to prevent rough service handling from misaligning the adjustment. The installation shall also be sufficiently rigid to prevent misoperation owing to flexure of structure or relative motion between the switch actuator and striker. The bending of a tab to adjust a limit switch is not satisfactory.

3.2.12.6.2 Landing-gear control and warning. Sealed limit switches shall be used on all exposed landing-gear-control and landing-gear-warning systems where limit switches are required.

3.2.12.7 Ignition switches. Ignition switches shall be so installed that they are accessible for control, and not subject to inadvertent operation. Multi-engine aircraft shall be equipped with an individual ignition switch for each engine. These switches shall be in accordance with Specification MIL-S-6746.

3.2.12.7.1 Training aircraft installation. Where the cockpit arrangement is such as to require a second ignition-control position, only one ignition switch shall be installed. The second control position shall consist of a switch handle and indicator plate mechanically linked to the ignition switch.

3.2.12.8 Rotary switches. Rotary switches shall be so installed that the extreme counter-

clockwise position is the "Off" position, and that the switch case will not rotate with respect to the mounting panel. Rotary switches shall be in accordance with Specification MIL-S-6807.

3.2.13 Circuit protective devices. Circuit protective devices shall be used for protection of all circuits at the point of power take-off or a maximum of 1 foot of wire from the busses. Circuits shall be individually protected, except certain nonvital circuits, such as those used only on the ground, which may be protected by a common protective device. Those circuit protective devices which directly affect safety of flight shall be accessible in flight to the pilot or crew.

3.2.13.1 Types of circuit protective devices. Circuit breakers, fuses, and current limiters of approved type shall be used, as required, by distribution system and circuit design.

3.2.13.2 Capacity. The capacity of the circuit protecting device shall be such that it will:

- (a) Prevent wire damage under short-circuit conditions. Also, in load circuits it shall prevent wire damage (including objectionable smoke) under overload conditions.
- (b) Prevent damage to circuit interrupting devices, such as switches and relays, in the wiring up to the load equipment.
- (c) Isolate a fault to prevent interrupting power to nonassociated equipment by providing bus protection.
- (d) Coordinate with other protective devices in the distribution system.

It is not intended to provide equipment protection by means of circuit-protecting devices which connect wiring to the bus, except the protection incidentally achieved by keeping the circuit-protecting device capacity as low as possible without the occurrence of nuisance outages caused by inrush current and high ambient temperature.

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3.2.13.3 Circuit breaker. Trip-free-type circuit breakers in accordance with Specification MIL-C-5809 shall be installed.

3.2.13.3.1 Switch breakers. Switch breakers shall be used only where circuit protection and circuit control in one unit is desirable or required.

3.2.13.3.1.1 Guards on switch breakers. Guards shall not interfere with the overload operation of switch breakers.

3.2.13.3.2 Installation of circuit and switch breakers. Circuit breakers shall be installed in accordance with Standard MS33590. Switch breakers shall be so mounted that the handle of the switch breaker is down or to the rear, ("rear" shall be interpreted in terms of "operator" position) when the breaker is in the "Off" position. Circuit breakers shall be grouped by function within any one type of power bus.

3.2.13.3.3 Additional circuit breaker space. Space shall be provided on breaker panels for the installation of at least one additional circuit breaker for each group of 10 or fraction thereof installed. The space for spare circuit breakers shall be determined by the equipment and circuit data available at the aircraft mockup inspection.

3.2.13.4 Fuses. Current-limiter (high-melting-point) type fuses shall be used for short-circuit protection in a multichannel system network. This type fuse shall also be used for backup short-circuit protection in load circuits where the interrupting capacity of circuit breakers may be inadequate. When fuses are selected for overload protection, they shall be the low-melting-point type. Fuses shall be in accordance with Specification MIL-F-5372 for high-melting point or Specification MIL-F-15160 for low-melting point.

3.2.13.4.1 Fuseholder marking. The fuse rating for each circuit shall be plainly marked at a suitable location adjacent to the fuseholder and shall be readable with fuse in place.

3.2.13.4.2 Fuse ratings. Fuses shall be of such rating as to carry the heaviest load to be encountered on the circuit. Where motor starting currents are severe, fuse capacity shall be sufficient to carry at least 70 percent of the locked-rotor current of the largest motor drawing current through the fuse. If multiple-wire feeders are involved, this requirement shall apply to the remaining wires after one of them has been eliminated by prior damage.

3.2.13.4.3 Location of fuses. Fuses shall be so located that checking and replacement can be easily accomplished.

3.2.14 Rheostats and resistors. Rheostats shall conform to Specification MIL-R-6749. They shall be installed in such manner as to prevent rotation of the rheostat body with respect to the mounting panel. Resistors shall be in accordance with Specification MIL-R-26 and shall be so installed that the heat dissipated will not affect other equipment.

3.2.15 Relays. Relays shall conform to Specification MIL-R-6106 and the applicable drawings. Reverse current relays shall be in accordance with Specification MIL-C-5026.

3.2.15.1 Application. Relays shall be installed for the control of circuits that are at such distance from the electric power source that a lower weight or greater safety factor is achieved. Relays shall also be installed to provide adequate switching capacity when manual control switches of the proper size or rating are not available, or to provide proper sequence of operation not readily obtainable by manual control switches. Intermittent duty relays shall not be installed in circuits where the relays will be subject to a duty cycle greater than that for which the relay is rated. When selecting relays for low-current application, particular attention shall be given to assure that the contacts are satisfactory for the service intended.

3.2.15.2 Installation of relays. Relays shall be so installed that tightening of the bus or cable to the terminals will not cause damaging strain on the relay.

3.2.16 Generator circuit disconnect. The generator circuit disconnect device shall be located as close to the main bus as practicable.

3.3 Identification of equipment. Electric equipment shall be identified on the adjacent structure as to the name and function of the equipment. This requirement is abrogated for that equipment whose name and function is obvious, and for the equipment which is of a classified nature. Inspection covers leading to electric equipment shall bear identification of the equipment to which the cover leads. Names shall be selected to minimize misunderstanding, and shall be consistent with identification used on wiring diagram and in maintenance handbooks.

3.3.1 Special identification. In addition to the above, items of equipment which are identical in function and appearance but different in some critical manner not readily apparent, and therefore not interchangeable, such as generators having opposite directions of rotation, shall be plainly identified on the adjacent structure.

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of tests. All the tests required herein for the testing of electric equipment installation are classified as acceptance tests, for which necessary sampling techniques and methods of testing are specified in this section.

4.2 Installation mockup. Prior to delivery of the first aircraft and in time to permit needed changes, the contractor shall conduct an electric equipment installation mockup for inspection by the procuring activity. At this mockup, the contractor shall demonstrate electric equipment installation and specific practices for which deviations are required. This mockup may be conducted on a production aircraft.

4.3 Inspection of first aircraft. The electric equipment installation of the first complete aircraft shall be inspected at the contractor's plant by the contractor under supervision of

the Government inspector to determine conformance with this specification. The electric equipment installation of the first complete aircraft shall also be subject to inspection and approval by the procuring activity.

4.4 Changes in electric equipment installation. Aircraft in which changes have been made in the electric equipment installation shall be inspected at the contractor's plant by the contractor under the supervision of the Government inspector to determine compliance with this specification.

4.5 Checks. The equipment temperature requirements shall be checked against the aircraft environment for each of the following conditions:

- (a) Altitude: From sea level to operating ceiling, at 20,000-foot intervals.
- (b) Airspeed: Both maximum and minimum for each altitude.
- (c) Surrounding air temperature (ambient plus ram rise plus rise owing to heat dissipating equipment): Maximum and minimum for each airspeed and altitude.
- (d) For blast-cooled equipment—ram rise temperature (ambient plus ram rise): Maximum and minimum for each altitude and airspeed.
- (e) For blast-cooled equipment—available ram pressure and airflow (pounds per minute): Maximum and minimum for each altitude and airspeed.
- (f) Effects of engine speed.
- (g) Time and frequency of each operating cycle.
 - (1) If high temperatures dictate the use of a special cooling system, this system shall be checked for all expected environmental conditions as stated in 4.5 (a) through (g).
 - (2) The equipment cooling requirements shall be based on altitude

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chamber data, flight test data, or standard derating curves which are approved by the procuring activity.

- (3) To the greatest possible extent, testing shall be done under pressure and airflow corresponding to design operating conditions.
- (4) The contractor can forego the above checks if it can be substantiated that the equipment has been satisfactorily operated in production aircraft under similar altitude-temperature conditions.

4.6 Individual tests.

4.6.1 Inspection shall be conducted by the contractor on each aircraft to insure compliance with the requirements of this specification.

4.6.2 Circuit. Such tests as are necessary shall be conducted by the contractor on each circuit to demonstrate that the complete electric installation conforms to the requirements specified herein, and that satisfactory operation and functioning of all electric equipment results.

5. PREPARATION FOR DELIVERY.

5.1 This section is not applicable to this specification.

6. NOTES

6.1 Intended use. The requirements covered by this specification are intended for

use in installing electric equipment in aircraft. The installation of electronic equipment is covered by Specification MIL-I-8700.

6.2 Wiring installation. Interconnection wiring between electric and electronic equipment should be installed in accordance with Specification MIL-W-5088.

6.3 International standardization. Certain provisions (see 3.2.10.1) of this specification are the subject of international standardization agreement ABC AIR STD 12/6. When amendment, revision, or cancellation of this specification is proposed, the departmental custodians will inform their respective Departmental Standardization Offices so that appropriate action may be taken respecting the international agreement concerned.

Notice. When Government drawings, specifications or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodians:

Army—TC
Navy—Wep
Air Force—AFSC
International interest (see section 6)

Preparing activity:

Navy—Wep

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