

MIL-M-4820E (USAF)  
 24 JULY 1979  
 Superseding  
 MIL-M-4820D (USAF)  
 19 April 1974

## MILITARY SPECIFICATION

### MOTOR-GENERATOR, SKID MOUNTED TYPE MD-4

This specification is approved for use by AFLC CASO/LODS, Department of the Air Force, and is available for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers a 50KW frequency converter motor-generator set designated Type MD-4.

#### 2. APPLICABLE DOCUMENTS

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

#### SPECIFICATIONS

##### Military

MIL-M-4803	Motor-Generator, 400 Hz Precise Output, General Requirements For.
MIL-C-83723	Connector, Electrical, Circular, Environment Resisting, General Specification For.

#### STANDARDS

##### Military

MS-90328	Cable Assy, External Electrical power, 115/200 volts, 400 Hertz
MIL-STD-701	Lists of Standard Semiconductor Devices.
MIL-STD-781	Reliability Test: Exponential Distribution.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: AFLC CASO/LODS, Federal Center, Battle Creek MI 49016 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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MIL-STD-808	Finishes Protective and codes, for Finishing Schemes for Ground and Ground Support Equipment.
MIL-STD-882	System Safety Program for Systems and Associated Subsystems and Equipment, Requirements For.
MIL-STD-1562	Lists Of Standard Microcircuits.

## DRAWINGS

Air Force Drawing 7545352

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

## 3. REQUIREMENTS

3.1 General specification. The requirements of MIL-M-4803 apply as requirements of this specification with the exceptions and additions specified herein. When the two specifications conflict this specification shall govern.

3.2 Design.

3.2.1 Basic design. The motor-generator shall be brushless design.

3.2.2 Ratings. The motor-generator shall have a continuous duty 3 phase output rating of 50KW at 0.8 PF when connected in wye or delta, and a continuous duty single phase output rating of 50KW at 0.8 PF when connected in delta. The overload rating shall be as specified in MIL-M-4803.

3.2.3 Parts derating. The maximum application voltage, current and rate of change of current of all solid state components and electronic devices shall not exceed 50 percent of the maximum rating established by the parts manufacturers when the motor-generator is operating at full rated load. The operating temperature of solid state component cases shall not exceed 75 percent of the manufacturers rating in degrees C when the motor-generator is operating at full rated load and in maximum ambient operating temperature.

3.2.3.1 Standard parts. All semiconductor devices shall be selected in accordance with MIL-STD-701 and all microcircuits shall be selected in accordance with MIL-STD-1562. Written permission from the procuring agency is required prior to using any semiconductor device or microcircuit not listed in these standards.

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3.2.4 Reliability. The motor-generator set shall have an upper test level mean time between failure (MTBF), as defined in MIL-STD-781, of 4000 hours and a lower test level MTBF of 1000 hours. In addition, the reliability requirements of Paragraph 3.6.1 of MIL-M-4803 shall be met. For reliability purposes, a failure shall be defined as any condition that causes the equipment to operate outside specification requirements defined herein and in MIL-M-4803.

3.2.5 Maintainability. The motor-generator set shall be designed for ease of repair at all levels of maintenance. Preventive maintenance shall be required no more often than once each 400 operating hours. It shall require a maximum of 30 minutes clock time and one manhour of effort to complete.

3.2.6 Safety. The motor-generator set shall be so designed that there will be no unprotected category I or II hazards as defined in MIL-STD-882.

### 3.3 Performance.

3.3.1 Efficiency. The overall efficiency of the motor-generator set shall be at least 70 percent under rated conditions of operation.

### 3.4 Details of components.

3.4.1 Motor. The drive motor shall be a brushless 3 phase, 220/440V, 60 Hertz synchronous motor of sufficient capacity to drive the generator at its rated single or 3 phase load and at the specified overload. The stator winding shall be brought out to the terminal block for easy reconnection between 220V and 440V. The rms value of the input current at any time shall not exceed 100 amp at 440V or 200 amp at 220V.

3.4.2 Generator. The generator shall be a brushless 3 phase, 120/208V, 400 Hertz alternator. Stator leads shall be brought to the terminal board so that the generator may be easily reconnected for either a wye or delta connection. When connected in wye, rated voltage shall be 208 line-to-line and 120V line-to-neutral. When connected in delta, rated voltage shall be 120V line-to-line.

### 3.4.3 Control cabinet.

3.4.3.1 Meters. The ammeter and voltmeters shall be 3½ inch sealed meters with black markings on a white scale. No special limit markings are required.

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3.4.3.1.1 Ammeter instruction. Instructions for reading current when the generator is connected in wye or delta shall be permanently and legibly marked either above or below the ammeter.

3.4.3.1.2 Output voltmeter. The output voltmeter shall read line-to-neutral voltages on the generator side of the output contactor.

3.4.3.2 Voltage regulator. The regulator shall meet the following criteria:

- a. The regulator shall consist of plug-in printed circuit board assemblies which are readily removable for repair. The circuit board plug-in connectors shall be keyed to prevent any mismatching of boards. A universal extender board shall be provided with each set to facilitate trouble-shooting of the voltage regulator circuit boards while the set is operating. The circuits shall be contained in a ventilated housing provided with a removable cover and a single type MIL-C-83723 connector containing both the input and output circuits, to permit removal of the voltage regulator without disturbing the interface wiring.
- b. The voltage regulator shall contain an adjustable line drop compensation system.
- c. The voltage regulator shall contain all control circuitry to provide overvoltage and undervoltage protection for the connected load.
- d. The voltage regulator shall have an inherent response time of less than .001 second.
- e. The voltage regulator in combination with the motor-generator excitation system shall meet the performance criteria specified in MIL-M-4803.

3.4.3.3 Direct current power source. A source of 28 V DC power, other than batteries, shall be provided for actuating the external power contactor in an aircraft. This source shall be capable of continuously supplying 3 amperes, and the positive lead shall be connected to the output terminal block E stud through a single pole, double throw, center off selector switch referred to in paragraph 3.4.4.2. The negative lead shall be suitably grounded.

#### 3.4.4 Electrical hardware.

3.4.4.1 Delta neutral. The  $T_2$  terminal shall be connected to  $T_0$

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terminal when the generator is connected in delta .

3.4.4.2 Terminals. The output terminal block shall contain three 3/8 inch studs designated A, B, C, one 1/2 inch stud designated N, and two 5/16 inch studs designated E, F. The studs shall be suitable for connection to an MS 90328-28 cable assembly. Studs A, B, C, N shall be connected to generator terminals T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>0</sub>, respectively, and N stud shall not be grounded at the motor-generator set. E stud shall be connected through a single pole, double throw, center off selector switch to direct current positive (28 VDC), open circuit (Off) or ground (Gnd). F stud shall not be connected to the motor-generator set.

3.5 Dimensions. The motor-generator set shall not exceed 96 inches in length, 45 inches in width, and 40 inches in height.

3.6 Weight. The motor-generator set, including control cabinet and base, shall weigh not more than 3500 pounds.

3.7 Finishing and protective coatings. Cleaning, treating, painting, plating and anodic films shall be in accordance with MIL-STD-808, as supplemented by Air Force Drawing 7545352.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 General. The inspection and testing of this motor-generator set shall be in accordance with MIL-M-4803, with the following addition .

4.2 Reliability demonstration. The contractor shall demonstrate achievement of reliability requirements by conducting reliability testing subsequent to successfully completing all other pre-production testing. If a reject decision is reached at any time during the demonstration the test shall be halted, the contractor, at his own expense, shall accomplish the necessary corrective action to eliminate all identified failure modes, and shall restart the reliability demonstration from the beginning. Detailed requirements for this demonstration are listed in subparagraphs 4.2.1 thru 4.2.7.

4.2.1 Procedure. Four motor-generator sets shall be used for this demonstration. Since only one unit is required for preproduction tests, the other three units must complete the individual tests before they can be used in the reliability demonstration. Test cycles of 16 hours on, 8 hours off shall be used, with only equipment "on" time counting towards the total test time of 2,500 hours. Accept-reject criteria are as follows; 1 failure, accept; 2 failures, reject. All four units shall accumulate approximately the same amount of "on" time during the

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reliability demonstration (625 hours per unit). During each 16-hour operating period, the units shall be operated at normal input voltage with 0.8 power factor lagging loads as follows:

- a. 8 hours at 100% rated 3 phase load.
- b. 6 hours at 100% rated 1 phase load.
- c. 2 hours of operation subdivided into eight fifteen minute cycles. Each cycle will consist of three minutes at 125% rated 3 phase load and 12 minutes at no load.

Contractor shall monitor output voltage, current and frequency of each unit during testing.

4.2.2 Test conditions. All units shall be tested at the contractor's facility in an exposed outdoor location at existing ambient temperatures. No vibration or temperature cycling of the equipment is required.

4.2.3 Maintenance. One preventive maintenance action will be accomplished on each equipment after it has completed 400 hours of "on" time to demonstrate contractor's compliance with requirements of paragraph 3.2.5. No other routine or scheduled maintenance will be allowed during the reliability demonstration.

4.2.4 Communication. Contractor shall inform the procuring activity at least 30 days prior to the scheduled reliability demonstration of date testing will begin. Once demonstration has begun, contractor shall notify Government by telephone of all equipment failures within 24 hours after their occurrence. When the exact time of failure cannot be determined, failure will be assumed to have occurred one minute after last operational check.

4.2.5 Test records. Contractor shall keep a separate record of each equipment's failures during the demonstration. As a minimum, this record shall list the equipment operating time between failures, the clock time required to isolate cause of failure, repair, reassemble and verify correction of failure, the symptoms leading to discovery of the failure, skill level(s) of technician(s) required to make the repair, cause(s) of failure, corrective action necessary (if any) to eliminate future failure of this type, and total manhours required to complete the repair.

4.2.6 Disposition of test units. Upon successful completion of the reliability demonstration, contractor shall inspect, clean, and check all units for continued proper operation, and then

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prepare them for delivery to locations specified by the Government.

4.2.7 Test report. Results of this demonstration shall be documented in a final report (CDPL DI-R-7034). This report must be approved by the Government before any production units may be delivered by the contractor.

## 5. PREPARATION FOR DELIVERY

5.1 General. Preparation for delivery shall be in accordance with MIL-M-4803 and as specified herein.

5.2 Marking of shipments. The shipment marking nomenclature shall be as follows:

Motor-Generator Set, Type MD-4: Output 50KW at 0.8PF,  
400 Hertz, 120/208V, 3 PH; Input 60 Hertz, 220/440V, 3  
PH; Skid Mounted Specification MIL-M-4820E (USAF)  
Mfr's Part Nr. \_\_\_\_\_

## 6. NOTES

6.1 Ordering data. Ordering data should be in accordance with MIL-M-4803.

6.2 Power Rating. The motor-generator is rated for either a single phase load connected between two leads of a delta connection or a 3 phase load from either wye or delta connections. This effectively underrates the alternator when supplying 3 phase loads. However, the nameplate rating is intended to indicate the capability of the motor-generator regardless of whether the load is 3 phase or single phase. The motor size is based on maximum rated load.

6.3 Reclaimed material. The use of reclaimed materials shall be encouraged to the maximum extent possible within the quality limits required by this document and to fulfill compliance with the Resource Conservation/Recovery Act of 1976 (Public Law 94-580) dated 21 Oct 76.

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

Custodian:  
Air Force - 99

Preparing Activity:  
Air Force - 99

Reviewer:  
DLA - GS

(Project Nr. 6125-F190)

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