INCH-POUND
MIL-DTL-53135 (ME)
9 September 1996

DETAIL SPECIFICATION

AUXILIARY POWER UNIT,

10 KW, 120/240 VAC, 60 HZ

This specification is approved for use within the USA Communications-Electronics Command, Logistics and Readiness Center, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This detail specification covers the requirements for a 10 kW Auxiliary Power Unit, 120/240 VAC, 60 Hz, hereinafter called "APU". The APU is a power source consisting of a self-contained engine and generator, including remote controls, capable of producing electrical power when connected to its host's source of fuel and starting power.

1.2 APU ratings. Rated voltage shall be 120 and 240 volts alternating current (VAC). Rated frequency shall be 60 Hz. Rated power factor shall be 0.8. Rated speed shall be 3,600 rpm. Rated power shall be 10 kW at 0.8 power factor (pf) lagging. The APU shall be re-connectable for the following voltages:

a. 120-volt, single-phase, 2-wire
b. 120/240-volt, single-phase, 3-wire

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are needed to meet the requirements specified in sections 3 and 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 documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: USA COMMUNICATIONS ELECTRONICS COMMAND, BELVOIR RDE CENTER, ATTN: AMSEL-LC-IEW-D-ED, 10115 GRIDLEY RD, STE 228, FT BELVOIR VA 22060-5849 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6115

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 listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

A-A-52557	Fuel Oil; Diesel; For Posts, Camps and Stations

DEPARTMENT OF DEFENSE

MIL-L-2104	- Lubricating Oil, Internal Combustion Engine, Tactical Service.
MIL-T-5624	- Turbine Fuels, Aviation, Grades JP-4 and JP-5.
MIL-A-11755	- Antifreeze, Arctic-type.
MIL-A-46153	- Antifreeze, Ethylene Glycol, Inhibited, Heavy Duty, Single Package.
MIL-F-46162	- Fuel, Diesel, Referee Grade.
MIL-L-46167	- Lubricating Oil, Internal Combustion Engine, Arctic.
MIL-A-53009	- Additive, Antifreeze Extender, Liquid Cooling Systems.
MIL-T-83133	- Turbine Fuel, Aviation, Kerosene Type, Grade Jp-8.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-451	- Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference.
MIL-STD-705	- Generator Sets, Engine-Driven, Methods of Tests and Instructions.
MIL-STD-882	- System Safety Program Requirements.
MIL-STD-1472	- Human Engineering Design Criteria for Military System, Equipment and Facilities.

HANDBOOKS

DEPARTMENT OF DEFENSE

MIL-HDBK-705	- Generator Sets, Electrical, Measurements and Instrumentation.

(Unless otherwise indicated, copies of federal and military specifications and standards are available form the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2.2 Other Government drawings and publications. The following other Government drawings and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation (see 6.2).

DRAWINGS

ME

TA 13230E6218 - Auxiliary Power Unit, 10 KW, 120/240 VAC, 60 Hz.

(Copies of drawings are available from the: US Army Communications-Electronics Command, RDE Center, Command, Control & Systems Integration Directorate South, ATTN: AMSEL-RD-C2-PD-PA, 10108 Gridley Rd, Ste 1, Fort Belvoir, VA 22060-5817.)

PUBLICATIONS

DETAILED TEST PLAN FOR FIRST ARTICLE PREPRODUCTION TEST (FAPT) OF TACTICAL QUIET GENERATOR SETS, Nuclear Effects Directorate, US Army White Sands Missile Range, dated December 1989.

(Requests for this document must be referred to: US Army Communications-Electronics Command, RDE Center, Command, Control & Systems Integration Directorate South, ATTN: AMSEL-RD-C2-PD-PA, 10108 Gridley Rd, Ste 1, Fort Belvoir, VA 22060-5817.)

US Army Nuclear and Chemical Agency Memorandum, dated 17 April 1987, Subject: NUCLEAR SURVIVABILITY CRITERIA FOR THE COMMERCIAL GENERATOR SET AND ASSEMBLAGES.

(Requests for this document must be referred to: US Army Nuclear and Chemical Agency, ATTN: MONA-NU, 7500 Backlick Road, Building 5073, Springfield, VA 22150-3198.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of the documents not listed in the issue of the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ASQC Z 1.4 - Sampling Procedures and Tables for Inspections by Attributes.

(Application for copies should be addressed to: AMERCN NATL STANDS INST, 1430 BROADWAY, NEW YORK NY 10018.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

MG1 - Motors and Generators.

(Application for copies should be addressed to the National Electrical Manufacturers Association, 2101 L Street, NW, Washington DC 20037.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, 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 Description. The APU shall consist of a diesel-fueled engine, generator with excitation system, governing system, protection system, and other devices as required to achieve a complete APU. The APU shall be in accordance with Drawing TA13230E6218 and as specified herein. The APU shall be capable of functioning as a component of the Standardized Integrated Command Post System (SICPS) Rigid Wall Shelter or the Joint Tactical Area Communications System (JTACS). The APU power distribution, fuel source, and batteries shall be a part of the host system.

3.1.1 Drawings. The drawings forming a part of this specification are end product drawings that shall be used by the contractor to provide APUs that meet the requirements of this specification. No deviations from the prescribed dimensions or tolerances are permissible without the prior approval ot the contracting officer. Where tolerances could cumulatively result in incorrect fits, the contractor shall provide tolerances within those prescribed on the drawings to ensure correct fit, assembly, and operation of the APU. Any data (e.g., shop drawings, layouts, flow sheets, processing procedures, etc.) prepared by the contractor or obtained from commercial vendor to support fabrication and manufacture of the production APU shall be made available, upon request, for inspection by the contracting officer of the designated representative.

3.1.2 Size and weight. APU size and operational weight (see 6.4.13) shall not exceed:

Height 28.00 inches	Length 40.00 inches
Width 27.00 inches	Weight 509 pounds

3.1.3 Reliability. The minimum acceptable Mean-Time-Between-Failure (MTBF) for the APU shall be 400 hours with an 80 percent lower confidence limit.

3.2 First article (reproduction model). When specified (see 6.2), one separate generator with excitation system and five APUs shall be furnished for examination and testing within the time frame specified (see 6.2) to prove prior to starting production that the contractor is capable of producing APUs that comply with the requirements of this specification. Examination and tests shall be as specified in 4.3. Unless otherwise specified (see 6.2), all examination and tests specified in 4.3 shall be conducted by the contractor subject to surveillance and approval by the Government.

3.3 First article (production model). When specified (see 6.2), one separate generator with excitation system and five or more APUs shall be subjected to first article inspection in accordance with 4.4.

3.4 Materials. Materials shall be in accordance with the drawings.

3.5 Design. The APU shall be as specified in 3.1 and as described below.

3.5.1 Engine. The engine, including all systems and components, shall comply with applicable Environmental Protection Agency (EPA) regulations and meet the requirements as specified herein. The engine shall be designed to operate at 3,600 rpm continuously at rated load (see 6.4.6).

3.5.1.1 Oil temperature. Oil temperature in the oil sump shall stabilize within a temperature range recommended by the engine manufacturer under all operating conditions specified herein.

3.5.1.2 Starting aids. The engine shall be equipped with a 24-volt direct current (DC) glow plug in each cylinder and a 24-volt DC heater in the intake manifold.

3.5.2 Cranking system. Teh cranking system shall be 24 volts DC, negative ground. The APU shall not be damaged (see 6.4.3) in the event polarity of the battery cables is reversed.

3.5.3 Governing system The governing system shall provide the frequency performance as specified herein. Any loss of input signal to the governing system shall not cause the APU to operate at more than 115 percent of the rated speed.

3.5.3.1 Frequency regulation. The governing system shall maintain the frequency regulation (see 6.4.17) within a bandwidth of 3 percent of rated frequency from no load to rated load and from rated load to no load.

3.5.3.2 Frequency short-term steady-state stability (30 seconds). At every constant load from no load to rated load, the system shall maintain the frequency within a bandwidth equal to 2 percent of rated frequency. The system shall not permit periodic speed variations, even though within the allowable 2-percent band.

3.5.3.3 Frequency long-term steady-state stability (4 hours). At any constant load from no load to rated load, the system shall maintain the frequency within a bandwidth equal to 3 percent of rated frequency in a 4-hour period.

3.5.3.4 Frequency transient performance. Following any sudden increase in load, including from no load to rated load, the governing system shall re-establish stable engine operating conditions (see 6.4.5) within 3 seconds, and the maximum transient frequency change below the new steady-state frequency (undershoot) shall not be more than 3 percent of rated frequency. Following any sudden decrease in load, including from rated load to no load, the governing system shall reestablish stable engine operating conditions within 3 seconds. The maximum transient frequency change above the new steady-state frequency (overshoot) shall not be more than 4 percent of rated frequency.

3.5.3.5 Frequency adjustment. An engine- or governr-mounted speed adjustment device shall permit adjustment of ±3 percent of rated frequency at all load conditions from no load to rated load. It shall not be possible to adjust the frequency to a value which will result in any damage to the APU.

3.5.3.6 Frequency drift. With the APU operating at constant load and voltage, a change in ambient temperature of up to 60 °F in an 8-hour period shall not cause the frequency to change by more than 2 percent.

3.5.4 Generator and excitation system. The generaor and excitation system (exciter, voltage regulator, and other accessories necessary to control the output voltage) shall meet the requirements as specified herein.

3.5.4.1 Voltage performance. The generator, including excitation system and voltage regulation system, shall automatically maintain the output voltage limits as specified herein.

3.5.4.1.1 Voltage regulation. The voltage regulation (see 6.4.17) from no load to rated load and from rated load to no load shall not be more than 3 percent of the rated voltage for all voltage connections throughout the voltage ranges specified in 3.5.4.1.5.

3.5.4.1.2 Voltage short-term stability. At every constant load from no load to rated load, the voltage shall remain within a bandwidth equal to 2 percent of rated voltage.

3.5.4.1.3 Voltage drift. With the APU operating at constant load and speed, a change in ambient temperature up to +60 °F in an 8-hour period shall not cause the voltage to change by more than 2 percent of rated voltage, APU temperature stabilization being accomplished at both the initial and final ambient temperature conditions.

3.5.4.1.4 Voltage dip and rise for rated load. Performance of the APU under transient conditions (as measured by a magnetic oscillograph) shall be as follows: With the APU initially operating at rated speed and rated voltage, and following any sudden change in load from no load to rated load, the output voltage shall not dip more than 20 percent of rated voltage and shall reach stable conditions within 1 second. Overshoot or undershoot of the final voltage shall not exceed the initial voltage transient in amplitude. The above requirements shall also apply when the load is suddenly changed from rated load to no load, except that the initial voltage transient shall involve a voltage rise not to exceed 30 percent of rated voltage.

3.5.4.1.5 Voltage adjustment range. The minimum voltage adjustment range shall be 114 to 126 volts when operating at 120 volts rated, and 228 to 252 volts when operating at 240 volts rated. This voltage adjustment range shall apply for all loads between no load and rated load, rated power factor at rated frequency, under all environmental conditions. It shall not be possible to adjust the voltage to a value which results in any damage to the APU.

3.5.4.1.6 Voltage waveform. The deviation factor for the line-to-line and line-to-neutral voltage waveform for each voltage connection shall be not more than 6 percent, nor shall any single voltage harmonic be more than 2 percent. In addition, there shall be no evident discontinuities, spikes, or notches in the waveform when viewed on an oscilloscope having a bandwidth of DC to 1.5 Megahertz (MHz) and usable viewing screen of 8 x 10 cm. The oscilloscope gain shall be adjusted such that one cycle of voltage wave covers approximately the entire viewing screen.

3.5.4.1.7 Voltage unbalance. Wiht the APU operating at rated voltage and frequency and no load, the maximum difference between the two halves of the single-phase voltage shall be not more than 2.5 percent of rated voltage under the condition of a unity pf load, applied across the 120-volt section of the 240-volt winding, of 50 percent of rated current and no other load on the APU.

3.5.4.1.8 Voltage modulation. The voltage modulation of the output voltage for any load up to and including rated load shall not exceed 3 percent. This requirement shall apply to all line-to-line and line-to-neutral voltages.

3.5.4.1.9 Voltage long-term stability (8 hours). At constant ambient temperature, constant barometric pressure, constant frequency and any constant load from no load to rated load, the voltage shall remain within a bandwidth of 4 percent of rated voltage in an 8-hour operating period.

3.5.5 Generator. No damage shall result from running the APU at its low idle speed (see 6.4.16) for a period of one hour with the excitation system energized and the APU temperature stabilized in an ambient of 49 °C (120 °F) . The generator shall be in electrical and mechanical balance at all speeds up to 125 percent of rated speed. The generator shall withstand operation at 125 percent of rated speed.

3.5.6 Temperature rise. Allowable temperature rise of generator coils, windings and mechanical parts, when the generator and auxiliary items are installed on the APU, shall not exceed the following:

Coils, windings and connections:

- 105 °C (221 °F) (measured by rise in resistance method)

Generator Bearings:

- 50 °C (122 °F)

Poles, cores, and all other mechanical parts:

- 105 °C (221 °F)

3.5.7 Insulation resistance. Insulation resistance of generator windings shall not be less than 1 megohm in an ambient temperature of 25 °C (77 °F).

3.5.8 Dielectric strength. Generator windings shall withstand the following 60 Hz voltages applied for 1 minute:

a. Generator field and exciter windings - 10 times the ceiling voltage, but neither less than 1,500 nor more than 3,500 volts (applied between windings and ground)

b. Windings energized by the 24-volt DC control, cranking and battery charging systems - 500 volts (applied between windings and ground)

c. All others - twice the rated voltage plus 1,000 volts (applied between winding and ground and between windings where applicable).

3.5.9 Short circuit. The generator, voltage regulator and excitation system operating as a unit shall withstand two consecutive line-to-line and line-to-neutral short-circuits at 5-minute intervals at the generator output terminals when operating at rated load and frequency without reduction in dielectric strength to a point where it does not meet the requirements in 3.5.8. Short circuits shall be for 5 seconds.

3.5.10 Winding resistance. Generator winding resistances of production APUs shall not differ by more than 10 percent from the average resistance of the corresponding winding of the first article preproduction APUs. All resistance values shall be corrected to a temperature of 25 °C (77 °F).

3.5.11 Saturation curves. The curves listed herein shall be plotted with the generator armature terminal volts on the vertical axis versus the exciter field current on the horizontal axis:

a. Open circuit saturation curve
b. Synchronous impedance curve (short circuit saturation curve)
c. Zero power factor saturation curve
d. Rated load current saturation curve

The exciter field current of production APUs shall not differ by more than 10 percent from the average field current of the first article preproduction APUs.

3.5.12 Transient reactance, rated voltage. The generator's direct axis transient reactance shall not be more 25 percent for the 120-volt connection.

3.5.13 Flexural vibrations and critical speeds. The APU shall be free from dangerous flexural vibration (see 6.4.4) and dangerous torsional critical speeds (see 6.4.7) between the minimum low idle speed and 115 percent of rated speed.

3.5.14 Overspeed. The APU shall operate at 115 percent of rated speed for 5 minutes without damage.

3.5.15 Instruments, controls, and other devices. Instruments, controls, and devices shall meet all requirements herein when mounted on the APU with the APU operating under all conditions, including starage, as specified herein.

3.5.15.1 DC control power. All DC control devices shall be suitable for operation at 20 to 32 volts. DC voltage transients resulting from operation of the AC circuit interrupter or any other APU mounted device shall not exceed 150 volts measured across any DC component. When the APU is operating, total operating DC current at any one time for all devices shall not exceed 5 amperes (amps). When the APU master switch is in the “off” position, no current drain shall be imposed on the host batteries, except the following:

a. Panel lights, when associated switch is in the “on” position.

b. Malfunction indicator lamps, which require manual reset.

3.5.16 Protective system. The APU shall be equipped with the protective devices specified herein.

3.5.16.1 Overspeed device. This device shall activate at 4,086 ±54 rpm and shut down the engine.

3.5.16.2 High temperature device. This device shall activate when the engine coolant reaches the engine manufacturer’s recommended maximum value, and shut down the engine before damage.

3.5.16.3 Low oil pressure device. The low oil pressure protective device shall activate when oil pressure drops to the engine manufacturer's recommended minimum value.

3.5.16.4 Low fuel level device. This device shall activate when the fuel level in the APU day tank falls to a point at which operation of the APU at rated load is four minutes or more and shut down the APU.

3.5.16.5 Overvoltage device.

3.5.16.5.1 120-volt operation. This device shall activate in less than 1.25 seconds after the voltage in a 120-volt generator coil winding has risen to and remained at any value greater than 150 ±3 V for more than 200 milliseconds (ins), and shall shut down the APU.

3.5.16.5.2 240-volt operation. This device shall activate in less than 1.25 seconds after the voltage in a 240-volt generator coil winding has risen to and remained at any value greater than 300 ±6 V for more than 200 ms, and shall shut down the APU.

3.5.17 Instrument accuracy. The maximum error (see 6.4.12) range of each metering system shall be as follows:

INSTRUMENT	Maximum Allowable Error Range
Voltmeter	
115-125 volt range	± 9v
200-250 volt range	± 9v
Ammeter (AC)	
25 percent Load Current	15-35 percent Rated Current
50 percent Load Current	40-60 percent Rated Current
75 percent Load Current	65-85 percent Rated Current
100 percent Load Current	90-110 percent Rated Current
Frequency meter	
55-65 Hz range	± 1.5 Hz

3.5.18 Malfunction indicator. The malfunction indicator system shall cause the appropriate indicating lamp to energize under activation of the protective devices (see 3.5.16).

3.5.19 Interchangeability. All APUs shall use an interchangeable engine, governing system, skid base, wiring harnesses, schematic diagrams, mounts, battery charging system, fuel system, air filter, oil filter, fuel filter and muffler.

3.6 Transportability. The APU shall not be damaged by rough handling (see 6.4.3.2) which could be encountered during rail, truck, trailer, aircraft, or helicopter transportation (see 6.4.8, 6.4.9, and 6.4.10).

3.7 Performance. The APU performance shall be as specified herein.

3.7.1 Starting, operating and stopping.

3.7.1.1 Starting. The APU shall start (see 6.4.1) within 5 minutes under the following conditions:

a. Any individual or combination of the environmental conditions specified in 3.9.

b. With the base of the APU in planes from level up to 15 degrees from level.

c. With fuels, lubricants, and coolants as specified herein.

3.7.1.2 Operating. Immediately after starting and with a maximum warm-up period of 5 minutes, the APU shall operate without damage or failure (see 6.4.11) under the following conditions:

a. Conditions specified in 3.7.1.1.

b. All loads, continuous and intermittent, up to and including rated load as specified herein.

c. Servicing and maintenance shall be in accordance with Appendix A, Maintenance Schedule.

3.7.1.3 Stopping. The APU shall stop (see 6.4.2) within 10 seconds or within the time interval specified herein after activation of any device intended to stop the APU.

3.7.2 Maximum power. The minimum acceptable maximum power shall be 11 kW at unity power factor under all operating conditions.

3.7.3 Fuels. The APU, while operating or referee grade fuels conforming to MIL-F-46162; grade low sulfur No. 1-D or No. 2-D diesel fuel conforming to A-A-52557; JP-5 turbine fuel conforming to MIL-T-5624; or JP-8 turbine fuel conforming to MIL-T-83133, shall meet all requirements specified herein. The APU, while operating on JP-4 turbine fuel conforming to MIL-T-5624 (with a cetane rating of 30 to 35), shall meet all requirements specified herein, except rated load may be reduced 15 percent and a maximum of 300 hours of operation on JP-4 per 3,000 hours of APU operation shall be required. Operation on JP-4 shall only be required at temperatures from -18 to 38 °C (0 to 100 °F) and at altitudes up to 914 meters (m) (3,000 feet [ft]).

3.7.4 Lubricants. The engine shall operate on lubricating oil conforming to MIL-L-2104 when temperatures are above -26 °C (-15 °F). The engine shall operate on lubricating oil conforming to MIL-L-46167 when temperatures are at or below 4 °C (40 °F).

3.7.5 Coolant. The APU shall operate with the following coolants:

a. MIL-A-11755 antifreeze from -32 to 49 °C (-25 to 120 °F) ambient.

b. Water with MIL-A-46153 inhibited antifreeze from -32 to 49 °C (-25 to 120 °F) ambient.

c. Water with MIL-A-53009 additive from 4 to 49 °C (40 to 120 °F) ambient.

3.8 Audio noise. When tested as specified in 4.7.2.1, audio noise sound-pressure levels (SPLs) emanating from the APU shall not exceed 75 dBA at 7 m, (22.9 ft) from the perimeter of the APU, when measured at 1.2 m (3.9 ft) above the ground. In addition, audio noise emanating from the APU shall not exceed 85 dBA at the operator's station, defined to be 0.7 m (2.3 ft) from the control panel. These requirements apply under all operating conditions specified herein with the APU operating at all loads from no load to rated load.

3.9 Environmental requirements.

3.9.1 Starting and operating. The APU shall start and operate under each and any combination of the following operating conditions:

a. All possible relative humidities, with ambient temperatures ranging from -32 to 49 °C (-25 to 120 °F) at sea level; and from -32 to 35 °C at 1,219 m (-25 to 95 °F at 4,000 ft). The high temperature requirement remains at 35 °C (95 °F) at altitudes above 1,219 m (4,000 ft).

b. Altitudes up to and including 2,438 m (8,000 ft). Rated load may be reduced by 3.5 percent for each 305 m (1,000 ft) above 1,219 m (4,000 ft) (e.g., at 8,000 ft rated load may be reduced by 14 percent). Exhaust smoke conditions shall be measured during all altitudes. Exhaust smoke testing shall be in accordance with 4.7.2.20.

c. When mounted in the host system with 127 millimeters (mm) (5 inches) of rain per hour impinging on the host system at angles from the vertical up to 45 degrees.

d. When mounted in the host system, with 355 British thermal units (BTUs) per square foot per hour of solar radiation on the host system.

e. When mounted in the host system, with sand and dust particle concentration of up to 1,400 milligrams per cubic meter (mg/m³). Particle sizes shall range from less than 74 micrometers in diameter to 1,000 micrometers with the bulk of the particles ranging in size from 74 to 350 micrometers.

f. When mounted in the host system, with a steady windspeed of 22 meters per second (m/s) (73 ft per second [ft/s]) and gusts up to 29 m/s (95 ft per second[ft/s]) at a height of 3 m (10 ft) above ground level.

g. When mounted in the host system, with accumulations on the host system of ice glaze, freezing rain and hoarfrost of up to 13 mm (0.5 inch) and up to a specific gravity of 0.9.

h. When mounted in the host system, in a salt fog or sea spray environment.

3.9.2 Storage. The APU without packaging shall not be damaged (see 6.4.3.1) by exposure to:

a. Storage -51 to 71 °C (-60 to 160 °F).
b. Salt fog environment.
c. All possible relative humidities.

3.10 High altitude electromagnetic pulse (HAEMP). The APU shall withstand the HAEMP nuclear environment as specified in the US Army Nuclear and Chemical Agency Memorandum, dated 17 April 1987. The APU shall meet the operational requirements specified herein within 5 minutes after being subjected to the specified HAEMP nuclear environment. The recovery may not include the replacement of piece parts or components.

3.11 Electromagnetic interference. When tested in accordance with Appendix B, TM 101.1, the electromagnetic interference emission and susceptibility characteristics of the APU shall not exceed the UM04 limits of class C2 equipment of MIL-STD-461, Part 9.

3.12 Treatment and painting. Treatement and painting shall be in accordance with the drawings.

3.13 Maintainability. The maintenance ratio (see 6.4.14) shall not exceed 0.05.

3.14 Endurance. The APU shall operate for 1,500 hours without critical failure (see 6.4.11d) at all loads, continuous and intermittent, up to and including rated load, under all conditions specified in 3.9. The APU shall have a minimum life of 3,000 hours.

3.15 Safety and health. The APU shall conform to the provisions of MIL-STD-882, 5.13 of MIL-STD-1472 (as specified in 3.16) and shall use Requirement 1 of MIL-HDBK-454 for guidance. Ex posed parts of such nature as to be a hazard to personnel shall be insulated, enclosed or gaurded without impairing the function of those parts.

3.16 Human factors engineering. The APU shall conform with the criteria of design for human factors engineering as described in MIL-STD-1472. The APU shall be transportable, operable and maintainable during day and night by 5th percentile through 95th percentile soldiers when wearing clothing which is appropriate to the environments described in 3.6 and 3.8.1, including Arctic and MOPF IV mittens and clothing. Particular design attention shall be given, but not limited to the following paragraphs of MIL-STD-1472: general requirements, control/display integration, visual display, audio display controls, labeling, anthropometry, design for maintainability, hazards and safety.

3.17 Government-furnished property. When specified, the APU shall be mounted in the Government-furnished SICPS or JTACS host system (see 6.6) .

3.18 Workmanship. Workmanship shall be of a quality to assure delivery of APUs that are free from defects (see 6.4.15) resulting from defective material and incorrect manufacturing or assembly practices.

4. VERIFICATION

4.1 Classification of inspection. Inspection shall be classified as follows:

a. First article preproduction inspection (see 4.3).
b. First article production inspection (see 4.4).
c. Conformance inspection (see 4.5).

4.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the applicable test method document or applicable paragraphs in the specification.

4.2.1 Fuel, lubrications, and coolant for inspection. Grade low sulfur No. 2D fuel conforming to A-A-52557 shall be used for all tests unless otherwise specified herein. Grade low sulfer No. 1D fuel (A-A-52557) shall be used for all testing with ambient temperatures between -32 to -18 °C (-26 to 0 °F). Lubricating oil shall be as follows:

LUBRICATING OIL SPECIFICATION	**GRADE**	DAILY LOW AMBIENT TEMPERATURE (°C/°F)
MIL-L-2104	OE/HDO-15/40	-18 to 49 °C (0 to 120 °F)
MIL-L-2104	OE/HDO-10	-26 to 4 °C (-15 to 40 °F)
MIL-L-2104	OE/HDO-30	-9 to 49 °C (15 to 120 °F)
MIL-L-2104	OE/HDO-40	-4 to 49 °C (25 to 120 °F)
MIL-L-46167	OEA	-32 to 4 °C (-25 to 40 °F)

Coolant shall conform to either MIL-A-11755, water with MIL-A-46153 inhibited antifreeze, or water with MIL-A-53009 additive for all testing conducted at temperatures from 4 to 49 °C (40 to 120 °F). Below 4 °C (40 °F), either MIL-A-11755 or water with MIL-A-46153 inhibited antifreeze shall be used for testing.

4.3 First article preproduction inspection. The separate generator, with excitation system, and complete APUs shall be examined and tested as specified herein to determine compliance with this specification.

4.3.1 Examination of components and subassemblies. Examination of components and subassemblies shall be made prior to assembly of the APU. Evidence that any components or subassemblies do not comply with the requirements of this specification shall be cause for rejection of that component or subassembly.

4.3.1.1 Examination of generator with excitation system and APUs. Examination of the separate generator with excitation system and the five APUs shall be made without disassembly. Evidence that the generator, excitation system, or APUs do not comply with the drawings shall be cause for rejection of the generator, excitation system, or APUs.

4.3.2 Preproduction tests. Two preproduction APUs shall be subjected to the applicable tests marked “X” under column 1 of table I except for the reliability test. Three preproduction APUs shall be subjected only to the reliability test of table I. All generators shall be subjected to the generator only tests marked “X” in column 1 of table I. The separate generator with excitation system shall be subjected to the generator with excitation system tests marked “X” under column 1 of table I. In addition to

any test specified as part of the preproduction tests, the Government reserves the right to conduct any and all other tests contained in this specifications as part of the preproduction tests. Failure of such additional tests shall have the same effect as failure of those tests specified as preproduction

TABLE I. Test schedule.

1	2	3	4	5	6	7
First Article		Quality Control				
P P T SEE 4.3.2	P T SEE 4.4	I N D I SEE 4.5.1	S A M P SEE 4.5.2.1	TEST	TEST METHOD (MIL-STD-705) AND TEST PARAGRAPH (SEE NOTE 1)	BASIC REQUIREMENT PARAGRAPH
				GENERATOR ONLY:		
X		X		High Potential	TM 302.1 (Isolate diodes)	3.5.8
X		X		Insulation Resistance	TM 301.1 (Isolate diodes)	3.5.7
X		X		Winding Resistance	TM 401.1	3.5.10
				GENERATOR WITH EXCITATION SYSTEM:		
X	X			Direct-axis Transient Reactance	TM 425.1	3.5.12
X			X	Generator Power Input	TM 415.1	3.1
X	X			Open Circuit Saturation Curve	TM 410.1 (See Note 2)	3.5.11
X	X			Overspeed (Generator only)	TM 505.3	3.5.14
X		X		Rated load Current Saturation Curve	TM 413.1 (See Note 2; One point at rated voltage only for individual tests)	3.5.11
X			X	Short Circuit (Mechanical strength)	TM 625.1 (Apply short circuits at each line-to-line and each line-to-neutral connection. Short circuits are for 5 seconds. Power input to the voltage regulator to sustain the required short circuits may be obtained from a separate source.)	3.5.9
X	X			Synchronous Impedance Curve (Short-circuit Saturation Curve)	TM 411.1 (See Note 2)	3.5.11
X	X			Zero Power Factor Saturation Curve	TM 412.1 (See Note 2)	3.5.11
				APU:		
X	X		X	Noise level	4.7.2.1	3.8
X		X		Circuit Interrupter (Overvoltage)	TM 512.3	3.5.16.5
X		X		DC Control	TM 655.1 (Perform at minimum and maximum settings of the battery charging voltage adjustment control.)	3.5.15.1
			X	Sample Endurance	TM 690.1, 4.7.2.6	3.14
X		X		Frequency Adjustment Range	TM 511.2 (At no load and rated load; See Note 2)	3.1, 3.5.3.5
X		X		Frequency & Voltage Regulation, Stability and Transient Response (Short Term)	TM 608.1 (See Note 2)	3.1, 3.5.3.1, 3.5.3.2, 3.5.3.4, 3.5.4.1.1, 3.5.4.1.2
X	X			Frequency & Voltage Stability (Long Term)	TM 608.2 (See Note 2)	3.1, 3.5.3.3, 3.5.4.1.9

TABLE I. Test schedule. Continued.

1	2	3	4	5	6	7
First Article		Quality Control				
PPT SEE 4.3.2	PT SEE 4.4	IND SEE 4.5.1	SAMP SEE 4.5.2.1	TEST	TEST METHOD (MIL-STD-705) AND TEST PARAGRAPH (SEE NOTE 1)	BASIC REQUIREMENT PARAGRAPH
X	X		X	High Temperature at 49 °C (120 °F)	TM 710.1 at 49 °C (120 °F) (Take temperature rise measurements on the stator windings and exciter field under the following conditions: (See Note 3) All voltage connections at the maximum and minimum voltage adjustment range. (Also perform TM 619.1 and 619.2 at rated frequency.)	3.1, 3.5.6
X		X		High Temperature Protective Device	TM 515.2	3.5.16.2
X	X			Humidity	TM 711.1, 4.7.2.19	3.9
X		X		Indicating Instrument (Electrical)	TM 513.1 (At all rated voltage connections.)	3.5.17
X		X		Low Fuel Protective Device	TM 515.5 (See Note 4)	3.5.16.4
X		X		Low Oil Pressure Protective Device	TM 515.1	3.5.16.3
X		X		Malfunction Indicator Exam	4.7.2.10	3.5.18
X	X			Maximum Power	TM 640.1	3.7.2, 3.7.3
		X		Maximum Power	TM 640.4	3.7.2, 3.7.3
X		X		Overspeed (APU)	TM 505.1 (At 115 percent rated speed for 5 minutes)	3.5.14
X		X		Overspeed Protective Device	TM 505.2	3.5.16.1
X	X			Railroad Impact	4.7.2.2	3.6
X	X			Reliability	TM 695.1, 4.7.2.17.1	3.1.3
X		X		Start and Stop	TM 503.1	3.7.1, 3.9.1
X	X			Voltage Dip and Rise for Rated load	TM 619.2 (See Note 2)	3.1, 3.5.4.1.4
X	X		X	Voltage Dip for Low Power Factor Load	TM 619.1 (See Note 2)	3.1
X	X		X	Voltage Modulation	TM 602.1 (At all rated voltage connections.)	3.1, 3.5.4.1.8
X	X			Voltage Unbalance with Unbalanced Load	TM 620.2	3.1, 3.5.4.1.7
X	X		X	Voltage Waveform (Oscillographic, Harmonic Analysis)	TM 601.1 and 601.4 (See Notes 2 & 5; At all rated voltage connections and the following loading conditions: a. No load b. Rated kW at 0.8 pf lagging c. Rated kW at 1.0 pf)	3.1, 3..5.4.1.6

NOTES:

1. Tests shall be conducted with the 120/240-volt connection, unless otherwise indicated. The Government reserves the right to reject the APU for not meeting any requirement of this specificatio even through not performing a test directly related to the specific requirement.

2. Test shall be conducted at 60 Hz at all voltage connections.

TABLE I. Test schedule. Continued.

3. For sample tests, only make the runs which gave highest stator and excitor field temperature rises during the first article inspection.

4. For the low fuel protective device test, the requirements of fuel system shall be verified as applicable.

5. View waveform with an oscilloscope having a bandwidth of DC to 1.5 MHz and a usable viewing screen of 8 by 10 cm. The oscilloscope gain shall be adjusted such that one cycle of voltage covers approximately the entire viewing screen. For sample tests, only TM 601.4 need to be used for the voltage waveform test.

4.3.3 Inspection failure. Failure of a preproduction APU to meet any requirement specified herein, during, and as a result of the examination and tests specified in 4.4 shall be cause for rejection of the first article APUs.

4.4 First article production inspection. Two production APUs shall be subjected to the applicable tests marked "X" under column 2 of table I except for the reliability test. Three production APUs shall be subjected only to the reliability test of table I. All generators shall be subjected to the generator only tests marked "X" in column 2 of table I. The separate generator with excitation system shall be subjected to the generator with excitation system tests marked "X" under column 2 of table I. In addition to any test specified as part of the first article production inspections, the Government reserves the right to conduct any and all other test contained in this specification as part of the first article production inspection. Failure of such additional tests shall have the same effect as failure of those tests specified as first article production inspections.

4.4.1 Inspection failure. Failure of a production APU to meet any requirement specified herein, during, and as a result of the examination and tests specified in 4.4 shall be cause for rejection of the production APUs and shall be cause for refusal by the Government to continue acceptance of production APUs until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies. Correction of such deficiencies shall be accomplished by the contractor at no cost to the Government on APUs previously accepted and produced under the contract. Any deficiencies found as a result of the production inspection will be considered prima facie evidence that all APUs accepted prior to the completion of production inspection are similarly deficient unless evidence to the contrary is furnished by the contractor and such evidence is acceptable to the contracting officer.

4.5 Conformance inspection.

4.5.1 Individual APU inspection. Each production APU shall be examined and tested as specified herein, without disassembly. Nonconformance with the requirements of this specification shall be cause for rejection.

4.5.1.1 Tests. Each APU shall be subjected to the tests marked "X" under column 3 of table I. For generator only tests, the tests shall be conducted prior to assembly into the APU. Failure of any test shall be cause for rejection.

4.5.2 Sample inspection. Sampling shall be in accordance with ANSI/ASQC 21.4 after all APUs comprising a lot have passed the inspection specified in

4.5.1 Unless otherwise specified (see 6.2), lot sizes shall consist of not more than 50 APUs except that the first lot shall contain not less than 25 APUs. For a lot size of 50 or less, a minimum sample size of 2 shall be used. A lot shall be accepted when zero defects are found and rejected when one or more defects are found. No adjustment or substitution of components shall be made on the APUs selected for sample inspection.

4.5.2.1 Tests. APUs selected in accordance with 4.5.2 shall be subjected to the tests marked "X" u nder column 4 of table I in the order listed with the exception that the sample endurance test shall be conducted on 50 percent of the samples from each lot or on 2 samples per lot, whichever is greater When this 50 percent results in fraction of APUs, the next highest number representing complete APUs shall be used. A sample APU which fails to meet a requirement during any test shall be considered a defective APU. Failure of any sample APU to meet any requirement herein shall be cause for rejection of the lot. Rejection shall be cause for the Government to refuse further acceptance of production APUs until Government-approved correction of deficiencies has been implemented. The Government may choose that the rejected lot, after correction of deficiencies, undergo any or all of the table I, column 4 tests, prior to acceptance of the lot or acceptance of further production APUs. Correction of deficiencies and re-testing of rejected APUs or lots shall be accomplished by the contractor under Government supervision at no cost to the Government.

4.6 Test schedules. The test schedules shall be as shown in table I. Nonconformance to the applicable requirement paragraph shown in column 7 shall constitute failure of the test and shall be cause for rejection of the generator, the generator with excitation system, or the APU, as applicable. The Government reserves the right to reject the equipment for not meeting any requirement herein, even though not performing a test directly related to the specific requirement. The requirements in section 3 shall apply to all tests performed as a part of another test. If maintenance shutdown, as permitted in Appendix A, Maintenance Schedule, would be due to occur, because of hours accrued during previous testing, after the beginning of any test, the shutdown shall be postponed until completion of the test or until completion of 100 hours of operation, whichever is the lesser.

4.6.1 Table I. Unless otherwise specified (see 6.2), the test schedule shall be as shown in table I.

4.6.2 Table II. When changes to components or materials specified on the drawings are proposed (see 6.3) by the contractor, the contracting officer shall determine which, if any, additional tests listed in table II shall be conducted by the contractor to determine APU compliance with the requirements specified herein. All quality assurance provisions of section 4 shall apply.

TABLE II. Additional test schedule.

1	2	3
TEST	TEST METHOD (MIL-STD-705) And TEST PARAGRAPH	BASIC REQUIREMENT PARAGRAPH
	APU:	
Altitude Operation	Before and after REM[1] test. TM 720.1 at 1219 m, 35 °C; and 2438 m,	3.7.3, 3.9.1.b

[1] Reliability, Endurance and Maintainability

TABLE II. Additional test schedule. Continued.

1 TEST	2 TEST METHOD (MIL-STD-705) And TEST PARAGRAPH	3 BASIC REQUIREMENT PARAGRAPH
	35 °C (4,000 ft, 95 °F; and 8,000 ft, 95 °F)	
Drop (Ends)	TM 740.3, 4.7.2.3	3.6
Electromagnetic Interference	4.7.2.4 (At all rated voltage connections at the following load conditions: a. No load b. Rated kW load at 1.0 pf c. Rated kW load at 0.8 pf lagging	3.11
Extreme Cold Storage	TM 731.1, 4.7.2.15	3.9.2
Fuel Consumption	TM 670.1 (At 25, 50, 75, and 100 percent rated load)	3.1
HAEMP	4.7.2.7	3.10
Ice Glaze and Wind	4.7.2.14	3.9.1.f , 3.9.1.g
Inclined Operation	TM 660.1 (Perform at maximum fuel levels. Perform at full and add positions on the oil dipstick)	3.7.1.1.b
JP-4 and JP-5 Fuel	4.7.2.11	3.7.3
Maintainability Demonstration	4.7.2.21	3.13
Motor Starting	4.7.2.5	3.1
Rain	4.7.2.16	3.9.1.c
Reliability, Endurance, Maintainability	4.7.2.17.2	3.1.3, 3.13, 3.14
Road	4.7.2.8	3.6
Salt Fog	4.7.2.9	3.9.1.h
Sand and Dust	4.7.2.13	3.9.1.e
Size and Weight	4.7.2.24	3.1.2
Solar Radiation	4.7.2.22	3.9.1.d
Starting and Operating (Moderate Cold Battery Start)	TM 701.2 at -32 °C (-25 °F)	3.9.1.a
Voltage and Frequency Drift	4.7.2.12	3.1, 3.5.3.6, 3.5.4.1.3
Hot Storage Test	TM 732.1, 4.7.2.18	3.9.2
Torsiographing	TM 504.2 (At no load and rated load. Also perform search for dangerous flexural vibration and dangerous torsional critical speeds between low idle speed and 115 percent of rated speed.)	3.5.13
Safety & Health Test	4.7.2.25	3.15
Human Factors Engineering Test	4.7.2.26	3.16

4.7 Test procedures.Tests shall be conducted in accordance with MIL-STD-705, MIL-HDBK-705, and as specified herein. Test instruments shall be of the laboratory type and shall have been calibrated within 30 days of the start of testing and at six-month intervals thereafter. Instruments used in calibration should be at least five times the accuracy of the instrument being calibrated. Direct-reading instruments shall have at least 0.5 percent accuracy and shall be connected to indicate the most accurate portion of their range. On DC instruments, the readings shall not be made on the lower 15 percent of the scale. On AC instruments, the readings shall not be made on the lower one-third of the scale. Oscillograph galvanometers frequency response shall be flat (±5 percent) from DC to not less than 3,000 Hz. The voltage and frequency recording-type meters, other than oscillographs, shall have the following specifications:

a. Rise time for the frequency to be 250 ms.

b. Rise time for the voltage to be 60 ms.

c. Input to be up to 500 volts RMS.

d. Output to be ±5 volts DC maximum.

e. The signal input(s) and output(s) shall be ungrounded.

In addition, if an analog signal is digitized for the purpose of automation. the sampling frequency shall be at least 25 percent higher than twice the highest frequency component of the analog signal; (i.e., The sampling frequency for voltage waveforms acquired using the above oscillograph is 7.5 kHz; 3.75 MHz for the oscilloscope aforementioned.) The sampl ing frequency for any waveforms acquired using the above voltage and frequency recording-type meter shall be at least 100 Hz. The data shall be saved on 3-1/2-inch or 5-1/4-inch floppy disks and in ASCII text file. Exhaust smoke testing shall be in accordance with the method specified in 4.7.2.20. Exhaust smoke conditions shall be measured during all altitude testing.

4.7.1 Government performed tests. If desired and proposed by the contractor (prior to the contract), the railroad impact, maintainability demonstration, railroad impact, road, and HAEMP tests can be accomplished by the Government at Government expense at a Government installation (see 6.2).

4.7.2 Tests.

4.7.2.1 Audio noise test. Instrumentation and procedures for the audio noise test shall conform to Appendix B, TM 100.1. Measure audio noise sound pressure levels at no load and rated load. The microphone(s) shall be located at 7 m (22.9 ft) from the perimeter of the APU and 1.2 m (3.9 ft) above the ground. Measure audio noise sound pressure levels at 0.7 m (2.3 ft) from the control panel, at a height equal to the control panel, with the APU on the ground.

4.7.2.2 Railroad impact test. The railroad impact test shall be performed in accordance with Appendix B, TM 107.1, with the following conditions:

a. One APU shall be used.
b. The APU shall be mounted in a SICPS or JTACS system.
c. The system shall be mounted in accordance with the system rail tiedown procedures.

d. The system shall not require any type of packaging for the test.
e. The APU day tank shall be at least half full of fuel.

4.7.2.3 Drop test. The drop test shall be performed in accordance with TM 740.3 of MIL-STD-705 at a height of 9 inches.

4.7.2.4 Electromagnetic interference test. The electromagnetic interference test shall be performed in accordance with Appendix B, Test Method 101.1.

4.7.2.5 Motor starting test. The motor starting test shall be performed by use of a motor rated NEMA Code F, in accordance with MG-1. The motor shall be loaded with a flywheel or equivalent having an inertia equal to that of the motor rotor. Satisfactory starting is defined as acceleration of the motor to rated speed without tripping any APU protective devices.

4.7.2.6 Sample endurance test. Sample APUs shall be operated for 50 hours per APU, in accordance with MIL-STD-705, TM 690.1. The disassembly portion contained in TM 690.1 is not required. The number of operating hours at each load shall be proportional to the hours specified in the TM 690.1 cyclic load schedule. JP-8 fuel per MIL-T-83133 shall be used for this test. The sample APUs shall complete the test with zero defects.

4.7.2.7 HAEMP tests and analyses. This test will be conducted in accordance with the Detailed Test Plan for First Article Preproduction Test (FAPT) of Tactical Quiet (TQ) Generator Sets and Towed Assemblages, Nuclear Effects Directorate, US Army Test and Evaluation Command, dated December 1989.

4.7.2.8 Road test. The APU will be installed in a SICPS or JTACS system and tested in accordance with Appendix B, TM 106.1.

4.7.2.9 Salt fog test. The salt fog tests shall be conducted on two APUs and shall be performed in accordance with Appendix B, TM 104.1. Each APU shall be installed in a SICPS or JTACS system. Each APU/host system shall be subjected to two 48-hour cycles as follows:

24 hours - salt fog exposure
24 hours - standard ambient (drying)

Salt concentration shall be a 5 ±1 percent solution. The APUs shall be tested in a simulated normal operating mode. TM 608.1 of MIL-STD-705 shall be performed within 4 hours before the start of the salt fog cycling. After performing TM 608.1, but prior to the start of the salt fog cycling, isolate the exciter field and measure their insulation resistances in accordance with TM 301.1 of MIL-STD-705, except that the values need not be corrected for temperature. After completion of the salt fog cycling, but prior to the post-cycling TM 608.1 test, measure the insulation resistance of all circuits initially measured in accordance with TM 301.1, except that the APU shall not be operated prior to this test and measured values shall not be corrected for temperature. Upon completion. of the post-cycling TM 301.1 test, reconnect all circuits and perform TM 608.1 within 4 hours after removal of the APU from the test chamber. The APU shall be examined for corrosion *or* other physical damage resulting from this test.

4.7.2.10 Malfunction indicator exam. Indicator operation shall be noted throughout all testing.

4.7.2.11 JP-4 and JF-5 fuel test. The fuel test shall be performed using JP-4 fuel as follows:

a. Perform a high temperature test at 38 °C (100 °F) in accordance wth TM 710.1 of MIL-STD-705, except that 710.1.3.2 shall be modified as follows: Perform only paragraphs a. and g. (608.1 only).

b. Perform a moderate cold test at 18 °C (0 °C) in accordance with TM 701.2 of MIL-STD-705, except that 701.2.3.2k shall be modified as follows: Perform 608.1 only.

c. Operate each test APU for a total of 300 hours in accordance with TM 690.1 of MIL-STD-705.

The above procedures shall be repeated using JP-5 fuel except that the high temperature test shall be performed at 49 °C (120 °F). Acceptance criteria for the 300-hour operation run shall be zero relevant or critical failures. JP-4 shall conform to MIL-T-5624 with a cetane rating of 30-35, and JP-5 shall conform to MIL-T-5624.

4.7.2.12 Voltage and frequency drift test. Follow the same procedure in TM 608.2 of MIL-STD-705, except that the APU is initially stabilized at an ambient temperature which differs by 33 °C (60 °F) from the final stabilization temperature and the test is conducted for 8 hours. This test may be accomplished as the environmental chamber is being warmed from a cold temperature test. Temperature change shall be less than 5.5 °C per hour (10 °F per hour).

4.7.2.13 Sand and dust test. The sand and dust test shall be conducted in accordance with Appendix B, TM 103.1 with the following conditions:

a. Perform TM 608.1 of MIL-STD-705.

b. Test shall be performed at prevailing ambient temperatures and relative humidities.

c. Air velocity shall be maintained at a minimum of 32.2 km/h (20 mph).

d. Sand concentration shall be 1.4 g/m^3.

e. The test shall consist of four 90-minute intervals. The APU shall be mounted in a SICPS or JTACS system which shall be oriented with each side exposed to the blowing sand for one 90-minute interval. The APU shall be operated at no load for a minimum of 10 minutes during the last half of each 90-minute interval.

f. Following completion of the four 90-minute intervals, TM 608.1 of MIL-STD-705 shall be performed.

4.7.2.14 Ice glaze and wind test. The APU shall be mounted in a SICPS or JTACS system and subjected to the combined action of wind and ice as follows:

a. Perform TM 608.1 of MIL-STD-705.

b. With the ambient temperature between -23 and 0 °C (-10 and 32 °F), and with a steady windspeed of at least 22.25 m/s (73 ft/s), deliver a uniform rainspray on the non-operating system until 12.7 mm (0.5 inch) of ice glaze has accumulated on the top of the shelter.

c. After accumulation of 12.7 mm (0.5 inch) on the top of the shelter, the APU shall be started and operated at no load for a minimum of 1 hour.

d. After 1 hour of operation at no load, TM 608.1 of MIL-STD-705 shall be performed.

4.7.2.15 Extreme cold storage test. The extreme cold storage test shall be conducted in accordance with TM 731.1 of MIL-STD-705 except at an extreme cold temperature of -51 °C (-60 °F) instead of -62 °C (-80 °F).

4.7.2.16 Rain test. Mount the APU in a SICPS or JTACS system. Conduct the rain test in accordance with Appendix B, TM 102.1, at 5 inches of rain per hour.

4.7.2.17 Reliability, endurance, maintainability test. The reliability test shall be conducted on 3 APUs in accordance with MIL-STD-705, TM 695.1. The disassembly portion contained in TM 695.1 is not required. The number of operating hours at each load shall be proportional to the hours specified in the TM 695.1 cyclic load schedule. The APUs shall be fueled utilizing the normal fuel system on the APU. The APU fuel system shall be inspected for leaks during the test.

4.7.2.17.1 Reliability test. The duration of the reliability test shall be 7,260 hours total (1,210 hours per APU). Fourteen relevant failures shall be allowed during the test. All failures shall be in accordance with 6.4.11. Unless otherwise specified (see 6.2), a failure report shall be provided. JP-8 fuel per MIL-T-83133 shall be used for this test. One critical failure shall constitute failure of the reliability test.

4.7.2.17.2 Reliability, endurance, and maintainability test. When specified, a reliability, endurance, and maintainability test shall be conducted in accordance with MIL-STD-705, TM 690.1. The duration of the test shall be 9,000 hours minimum (minimum of 1,500 hours on each of 6 APUs). Seventeen relevant failures shall be allowed during the test. All failures shall be in accordance with 6.4.11. One critical failure shall constitute failure of the endurance test. JP-8 fuel per MIL-T-83133 shall be used for one-half of the test and grade low sulfur No. 1-D or 2-D diesel fuel per A-A-52557 shall be used for the other half of the test. Each APU shall run an additional amount of hours to accumulate 3,000 hours per APU. The maintenance ratio shall be determined during the reliability portion of the test.

4.7.2.18 Hot storage test. Perform the hot storage test in accordance with MIL-STD-705, test method 732.1 at 71 °C (160 °F).

4.7.2.19 Humidity test. The humidity test shall consist of 5 consecutive 48-hour cycles as specified in MIL-STD-705, test method 711.1.

4.7.2.20 Exhaust smoke. Exhaust smoke conditions for diesel engines during performance and altitude testing shall be measured by the use of a Robert Bosch EFAW 65 sampling pump and analyzed on an EFAW 68 analyzing instrument at room temperature (65 to 80 °F). The smoke sampling tuve shall be located in the exhaust pipe, positioned midway of and parallel to the pipe walls and between 12 and 60 inches of the exhaust manifold. Tubing between the sampling pump and exhaust probe shall not exceed 24 inches in length and shall have an inside diameter of not more than 1/4 inch. At that location, the exhaust pipe inside area shall not be larger than 125 percent of the exhaust manifold outlet area. Alternate smoke analyzers (see 6.2), may be

utilized provided comparative data is obtained during initial portion of the test program, and the engine manufacturer and contracting officer mutually establish an official table indicating comparative readings.

4.7.2.21 Maintainability demonstration. The maintainability demonstration shall consist of the performance of all scheduled maintenance per Appendix A. Arctic mittens and MOPP IV gear shall be used. Any item of service that cannot be performed with arctic mittens or MOPP IV gear shall constitute a failure. Item 21, tighten hardware, shall be excluded.

4.7.2.22 Solar radiation test. Mount the APU in a SICPS or JTACS system. Conduct the solar radiation test in accordance with Appendix B, TM 105.1.

4.7.2.23 Referee grade diesel fuel test. The referee grade diesel fuel test shall be conducted on 2 APUs. Each APU shall be operated for 500 hours using diesel fuel conforming to MIL-F-46162. The test shall be performed in accordance with TM 695.1 of MIL-STD-705.

4.7.2.24 Size and weight. The overall size of the APU shall be determined using standard measuring equipment. The APU shall be weighed to determine the operational weight, using a calibrated scale. For information only, a dry weight defined as no fluids shall be determined.

4.7.2.25 Safety and health test. The safety and health test shall be in accordance with Appendix B, TM 108.1.

4.7.2.26 Human factors engineering test. The human factors engineering test shall be in accordance with Appendix B, TM 109.1.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's 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 APUs are intended to supply power for multipurpose use in military applications.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this Specification

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1, 2.2.2, and 2.3).

c. When first article preproduction inspection is required, and time frame required for submission of preproduction model(s) (see 3.2).

d. When the Government will conduct any or all of the preproduction model examination and tests. When the Government will conduct some but not all of the preproduction examination and tests, the contracting officer should specify which examination and tests, will be conducted by the Government and which examination and tests shall be conducted by the contractor (see 3.2) .

e. When first article production inspection is required and number of APUs to be furnished, when applicable (see 3.3).

f. Government-furnished property (see 3.17).

g. Size of lots for production APUs (see 4.5.2).

h. When table I test schedule is other than as shown (see 4.6.1).

i. Delivery and test schedule of Government performed tests (see 4.7.1).

j. Whether failure reports are required for reliability testing (see 4.7.2.17.1).

k. When specified, utilization of alternate smoke analyzers (see 4.7.2.20).

l. Packaging requirements (see 5.1).

6.3 Configuration management. The APUs covered by this specification are under the configuration management authority of the DoD Project Manager for Mobile Electric Power. All engineering change proposals (ECPs), request for waivers (RFWs), and request for deviations (RFDs) must be processed in accordance with DLAR 4120.7, AR700-101, AFR 400-50, NAVMATINST 4120.100A, MC011310.8C, Joint Operating Procedures Management and Standardization of Mobile Electric Power Generating Sources.

6.4 Definitions.

6.4.1 Start. An APU is considered to have started when it is operating at rated voltage and speed without the further use of starting aids.

6.4.2 Stop. An APU is considered to have stopped when all rotating members are at zero rpm, with the exception of a turbo charger if used.

6.4.3 Damage. Damage is defined as any failure (see 6.4.11), temperature or humidity related (see 6.4.3.1), rough handling damage (see 6.4.3.2) or degradation in life. The blowing (opening) of a replaceable fuse is not considered damage, provided it is performing its intended function.

6.4.3.1 Temperature and humidity damage. Temperature and humidity damage is defined as conditions causing malfunction of any component or part, corrosion, breakage, deformation, or reduction of insulation resistance below 50,000 ohms.

6.4.3.2 Rough handling damage. Rough handling damage is defined as any condition resulting in malfunctioning of the APU, liquid leakage, deformation, loosenign, breakage, or change of fit of any component or part.

6.4.4 Dangerous flexural vibration. Dangerous flexural vibration is defined as a vibration that occurs at a speed at which maximum stress in the shaft from flexural vibration exceeds 9,000 psi.

6.4.5 Stable (engine) operating conditions. Stable (engine) operating conditions are the conditions specified for short-term, steady-state performance.

6.4.6 Rated load. Rated load is rated kilowatt at rated power factor, rated frequency and rated voltage.

6.4.7 Dangerous torsional critical speed. Dangerous torsional critical speed is defined as the speed at which maximum vibrating stress in the shaft from torsional vibration exceed 5,000 psi.

6.4.8 Railroad transportation. Railroad transportation shall be interpreted to mean impact speeds up to and including 12.88 km/h (8 mph) under test conditions specified in 4.7.2.2.

6.4.9 Truck and trailer transportation. Truck and trailer transportation is defined as the conditions encountered during four cycles of a read test, each cycle consisting of the following, with the APU mounted on an Army truck or trailer:

ROAD CONDITION	DISTANCE km (MI)	SPEED km/h (MPH)
Paved Highway	161 (100)	up to 80.5 (50)
Level Cross-country	161 (100)	up to 32.2 (20)
Hilly Cross-country	80.5 (50)	up to 32.2 (20)
Belgian Block	9.7 (6)	up to 32.2 (20)

6.4.10 Aircraft and helicopter transportation. Aircraft and helicopter transportation shall be interpreted to mean a 22.86 cm (9 inch) end drop under test conditions specified in MIL-STD-705, method 740.3.

6.4.11 Failure. A failure is defined as the inability of an item to perform within specified limits. The contracting officer will classify failures into the categories described below. The following definitions are applicable for section 3 requirements.

a. Relevant failure. Any failure of an item which prevents the APU from starting, stopping, meeting the power output requirements, meeting audio noise requirements, any failure which renders any device of the protection system (see 3.5.16) inoperative, or any failure which causes a critical or catastrophic hazard to personnel or equipment. Relevant failure shall be used to calculate the MTBF requirement.

b. Nonrelevant failure. Any failure of an item which is not used to compute reliability. Examples of nonrelevant failures are as follows:

. Secondary failures caused by failures in the powered equipment or other occurrences in the APU environment when integral APU protection is not provided against such equipment failures of occurrence, e.g., explosion

or fire

. Failures due to characteristics of the load, e.g., waveform distortion caused by saturated inductors.

· Failures resulting from operating items beyond requirement.

. A failure of an item which does not prevent the APU from meeting the power output requirements specified herein, e.g., a panel light burms out.

. Failures due to operator error where procedures are documented in technical manuals, instruction plates mounted on the APU, or both, e.g., use of improper lubricant.

. Failures due to design deficiencies when subsequent testing demonstrates that the design deficiency has been corrected may be assessed and restored as nonrelevant if the Government determines testing has proved the design deficiency has been corrected.

d. Critical failure. A critical failure is defined as a relevant failure requiring removal of the engine, cylinder head, oil pan, gear cover, or ac generator to repair.

6.4.12 Accuracy/error. Accuracy is a ratio which defines the limit of error expressed as a percentage of full scale value. Error is the difference between the indication and the true value of the quantity measured. It is the quantity which, when algebraically subtracted from the indication, gives the true value. A positive error denotes that the indication of the meter is greater than the true value.

6.4.13 Operational weight. The operational weight is the total wet weight of the APU including fuel in the day tank, and lubricating oil and coolant at full capacities.

6.4.14 Maintenance ratio. The maintenance ratio is defined as the total maintenance manhours per total operating hours for all scheduled and unscheduled maintenance (excluding preventive maintenance checks and services by the operator) of the APU. Mainenance manhours include any and all manhours expended for scheduled and unscheduled manhours (excluding preventive maintenance checks and services by the operator) before, during and after operation, including time expended for inspection, diagnosis, and adjustments of the APU and repair of failed components and assemblies.

6.4.15 Defect. A defect is any nonconformance of the APU with either the specification or drawings.

6.4.16 Low idle speed. The low idle speed is defined as the slowest speed attainable by the frequency adjust control.

6.4.17 Frequency and voltage regulation. Frequency and voltage requlation is defined as the difference between the no-load value and the rated-load value divided by the rated-load value. To express requlation as a percentage, multiply the value found by 100.

6.5 Government-furnished property. The contracting officer should arrange to furnish the Government-furnished property listed in 3.17.

6.6 Subject term (key word) listing.

Diesel engine
Generator set
JTACS
Power supply
SICPS

Custodian:
Army - ME

Review activities:
Army - CR, GL, MI

Preparing activity:
Army - ME

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APPENDIX A

MAINTENANCE SCHEDULE

A1. SCOPE

A.1.1 Scope. The appendix is a mandatory part of the specification. The information contained herein is intended for compliance only.

A.2 APPLICABLE DOCUMENTS. This sectio nis not applicable to the appendix.

A.3 MAINTENANCE SCHEDULE.

#	Interval (minimum time)	Item to be Inspected	Procedures Check for and have repair or adjust as necessary
1	Daily	Housing (if applicable)	Check doors, panels, hinges, and latches for damaged, loose or corroded items. Inspect air intake and exhaust grills for debris.
2	Daily	Identification plates	Check to ensure identification plates are secure.
3	Daily	Skid Base	Inspect skid base for cracks or corrosion.
4	Daily 500	Engine Assembly	Check for loose, damaged or missing hardware. Tighten head bolts.
5	Daily	Fuel System	Inspect fuel system for leaks, damaged, loose or missing parts.
6	Daily 500	Fuel Filter/ Water Separator	Inspect fuel filter/water separator for leaks, proper mounting, cracks damage, or missing parts. Replace fuel water separator element.
7	Daily	Lubrication System	Inspect lubrication system for leaks, damaged, loose or missing parts. Check engine oil level. Check engine oil for contamination.
8	Daily	Hoses	Check hoses for leaks or cracks.
9	Daily	Exhaust System	Check muffler for leaks and exhaust system for corrosion, damaged, or missing parts
10	Daily	Air Cleaner Assembly	Inspect air cleaner assembly and piping for loose or damaged connections
11	Daily	Output Connection	Check for loose or damaged wiring or cables.
12	Daily	Indicators and Controls	Check all indicators and controls for damaged or missing parts. Ensure all indicators are operating properly.
13	Daily	Control Box Harness	Check for loose or damaged wiring.
14	75	Engine Lube Oil	Drain lube oil and add proper lube oil.

MAINTENANCE SCHEDULE - Continued.

#	Interval (minimum time)	Item to be Inspected	Procedures Check for and have repair or adjust as necessary
15	100	Lube Oil Strainer	Clean engine lube oil strainer (replace if necessary).
16	300	Governor Linkage	Clean and lubricate governor actuator linkage rod ends.
17	1,000	Engine Fuel Injectors	Replace engine fuel injectors.
18	800	Engine Valve Tappets	Adjust engine valve tappets.
19	500	Air Filter	Replace air filter element.
20	300	Crankca Breather	Replace crankcase breather.
21	250	Hardware	Tighten hardware
22	1,500	Interior of set	Clean engine compartment.
23	1,500	Magnetic Pick-up	Remove, clean, and reinstall magnetic pick-up.
24	1,500	Governor Actuator	Replace governor actuator.
25	3,000	Governor Systems	Examine all interior and exterior components and renew as necessary.
26	3,000	Muffler	Check for leaks, restriction, accumulation of carbon and replace as necessary.
27	2,000	Fuel injection Pump	Replace fuel injection pump.
28	1,500	DC Generator Brushes	Replace brushes.
29	2,000	Flexible Coupling	Replace flexible coupling.

APPENDIX B

GENERAL REQUIREMENTS

B.1 SCOPE

B.1.1 Scope. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance only. This document clarifies the test methods to be used for testing the APU.

B.2 APPLICABLE DOCUMENTS

B.2.1 Government documents.

B.2.2 Standards. The following standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-462	-	Measurement of Electromagnetic Interference Characteristics.

B.2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ISO 10012-1	-	Quality Assurance For Measuring Equipment, Part I, Meteorological Confirmation System for Measuring Equipment.
NCSL Z 540.1	-	General Requirements for Calibration Laboratories, Measuring and Test Equipment.

(Application for copies should be addressed to: AMERCN NATL STANDS INST, 1430 BROADWAY, NEW YORK NY 10016.)

B.3 GENERAL REQUIREMENTS

B.3.1 Test conditions. Unless otherwise specified herein, measurements and tests shall be made at the following conditions:

a. Standard ambient. Ambient measurements and checks (e.g., pre- and post-test) are conducted at room ambient conditions as follows:

Temperature:	25 ±10 °C (77 ±18 °F)
Relative humidity:	Uncontrolled room ambient
Atmospheric pressure:	Site pressure

b. Controlled ambient. When the ambient conditions must be closely controlled, the following shall be maintained:

Temperature:	23 ±2 °C (73 ±3.6 °F)
Relative humidity:	50 percent ±5 percent
Atmospheric pressure:	86.45 to 103.05 kPa (655 to 775 millimeters Mercury [mmHg]) (25.5 to 30.5 inches Mercury [inHg])

B.3.1.1 Tolerance for test conditions. Unless otherwise specified, tolerances for test conditions shall be as follows:

a. The test item shall be totally surrounded by an envelope of air (except at necessary support points). The temperature of the test section measurement system. and the temperature gradient throughout this envelope, which is measured close to the test item, shall be within ±2 °C (±3.6 °F) of the test temperature and shall not exceed 1 °C per meter or a maximum of 2.2 °C total (equipment non-operating).

b. ±5 percent (±200 Pa).

c. Relative humidity at the chamber control sensor shall be ±5 percent RH of the measured value.

d. Elapsed time shall be measured with an accuracy of ±1 percent.

e. Air velocity shall be within 10 percent of the specified value.

B.3.1.2 Accuracy of the test instrumentation calibration. The accuracy of instruments and test equipment used to control or monitor the test parameters shall be verified prior to and following each test and then calibrated in predetermined intervals and shall meet the requirements of ISO 10012-1 and ANSI/NCSL Z 540-1 to the satisfaction of the procuring activity. All instruments and test equipment used in conducting the tests specified herein shall:

a. Be calibrated to laboratory standards whose calibration is traceable to the National Standards via primary standards.

b. Have an accuracy of at least one-third the tolerance for the variable to be measured. In the event of conflict between this accuracy and a requirement for accuracy in any one of the test methods of this appendix, the latter shall govern.

B.3.2 General test performance guidance.

B.3.2.1 Pretest performance record. Before testing, the test item should be operated at standard ambient conditions to obtain and record data determining compliance with the requirements document(s) and for comparison with data obtained before, during, and after the environmental test(s). The identification and environmental test history of the specific test item(s) should be documented for failure analysis purposes. The pre-test record shall include (as applicable):

a. The functional parameters to be monitored during and after the test if not specified herein. This shall include acceptable functional limited (with permissible degradation) when operation of the test item is required.

b. Additional evaluation criteria.

B.3.2.2 Installation of test item in test facility. Unless otherwise specified, the test item shall be installed in the test facility in a manner that will simulate service usage, with connections made and instrumentation attached as necessary.

a. Plugs, covers, and inspection plates not used in operation, but used in servicing, shall remain in place.

b. Electrical connections normally used in service but not in test shall be provided with electrical connectors having dummy cables with protected terminations. Such mechanical connections shall also be protected.

c. For tests where temperature values are controlled, the test chamber shall be at standard ambient conditions when the test item is installed or as specified in the individual methods.

d. The test item shall be operated according to the applicable technical order or technical manual, when available, to determine that no malfunction or damage has resulted from faulty installation or handling. The requirement to operate the test item after its installation in the test facility applies only when the item is required to operate during the test.

e. Test items shall be positioned at least 15 cm (6 inches) from each other or from walls, floors, ceilings, etc. to allow for adequate circulation.

f. If the item to be tested consists of several separate units, these units may be tested separately provided the functional aspects are maintained as defined herein.

B.3.2.3 Interruped tests. Unless otherwise specified in the individual methods, the following procedures shall be followed when a test is interrupted. Any deviation from this guidance shall be explained in the test report .

B.3.2.3.1 In-tolerance interruptions. Interruptions during which the prescribed test tolerances are not exceeded shall be considered as part of the total test duration. (No allowance is necessary if exposure to the proper test levels was maintained.)

B.3.2.3.2 Methods 103.1, 105.1 (See figure 1).

a. Undertest. If test tolerances have been exceeded resulting in an undertest condition, the test may be resumed from the point at which tolerances were exceeded following re-establishment of prescribed conditions (except as noted in the individual methods), and extended to ensure that the prescribed test cycle is achieved.

b. Overtest. If an overtest condition occurs, the preferable course of action is to stop the test and start over with a new test item. However, if

any damage is a direct result of the overtest conditions and will not affect other test item characteristics, or if the item can be repaired, the test may be resumed and extended as in the undertest condition. If an item failure occurs during the remainder of the test, the test results shall be considered invalid.

B.3.2.3.3 Methods 104.1. Each of these methods contains guidance for handling out-of-tolerance-test interruptions. Any such interruption must be carefully analyzed. If the decision is made to continue testing from the point interruption, to restart th elast successfully completed test cycle, or to restart the entire test with the same test item, and a failure occurs, it is essential to consider the possible effect of the interruption or of the extended length of the test.

B.3.2.4 Post-test data. At the completion of each environmental test, the test item shall be inspected as specified herein, and the results shall be compared with the pretest data obtained in accordance with B.3.2.1. Post-test data shall include:

a. Complete identification of all test equipment and accessories.

b. The actual test sequence (program) used.

c. Deviation from the planned test program.

d. The room ambient test conditions recorded periodically during the test period.

e. A signature and data block for certification of the test data by the test engineer.

f. Other data as specified in the individual methods or as specified herein.

B.3.2.5 Failure criteria. Failure of the test item to meet any one of the following conditions shall constitute a test item failure.

a. Deviation of monitored functional parameter levels beyond acceptable limits established in B.3.2.1 and specified herein.

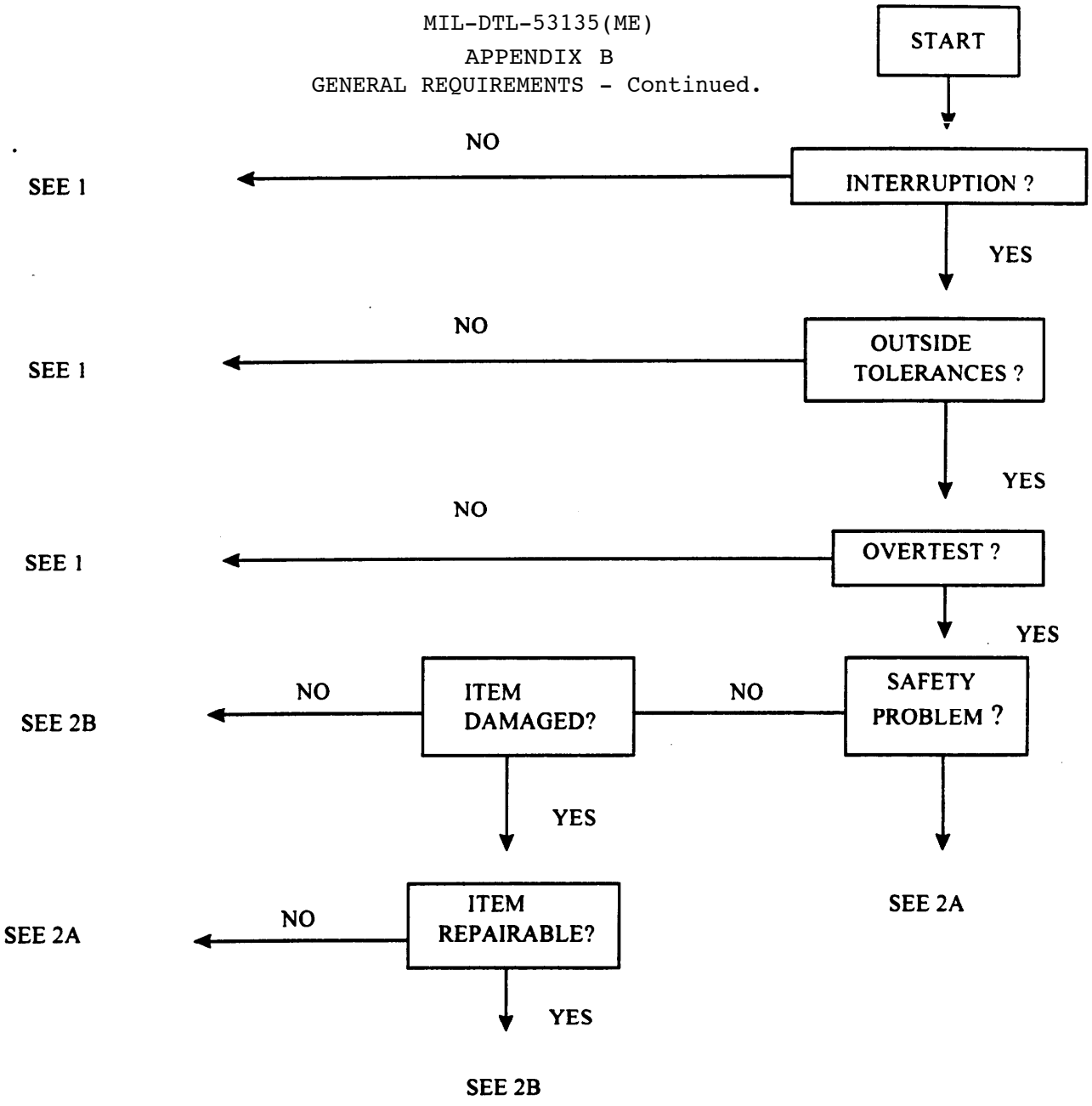
NOTE: Certain types of equipment (e.g., propellants and electrically driven devices) are often expected to demonstrate lesser performance at an environmental extreme, particularly low temperature. A failure would occur only if degradation is more than permissible.

b. Nonfulfillment of safety requirements or the development of safety hazards.

c. Nonfulfillment of specific test item requirements.

d. Changes to the test item which could prevent the equipment from meeting its intended service life or maintenance requirements. (For example: Corroded oil drain plug cannot be removed with specified tools.)

e. Deviation from established environmental requirements.



NOTES:

1. CONTINUE TEST (SEE INDIVIDUAL METHODS); EXTEND TEST TIME IF NECESSARY.

2. ALTERNATIVES:

   A. RESTART AT THE BEGINNING.

   B. COMPLETE THE TEST WITH UNDAMAGED OR REPAIRED TEST ITEM.
   (NOTE: TEST RESULTS WILL BE INVALID IF AN ITEM FAILURE OCCURS.)

FIGURE 1. Interrupted test cycle logic.

TEST METHOD 100.1

AUDIO NOISE TEST

100.1.1 General. The APU must satisfy audio noise requirements.

100.1.2 Apparatus. Instrumentation for measuring load conditions and noise shall be as described and illustrated in MIL-HDBK-705.

100.1.3 Procedure.

100.1.3.1 Preparation for test. The test site shall be a uniform flat grass surface, free of ice, snow, or vegetation over 0.15 meter (5.9 inches) tall it shall be free of reflecting surfaces such as buildings, trees, hillsieds, or load bank(s) within a 50-meter (164-foot) radius. The APU shall be positioned in the center of the test site. An anechoic or hemi-anechoic chamber may be substituted for outdoor measurements. Audio noise sound pressure level (SPL) readings shall be taken with the APU not operating (ambient), at no load and rated load. The ambient noise level must be at least 10 dB below the APU for a valid test.

100.1.3.2 Steady-State noise. Start and operate the APU ad allow it to stabilize at rated load, rated voltage and rated frequency. Stabilization shall be considered to have occurred after the APU is operated at rated load, rated voltage and rated frequency for 10 minutes. The APU shall be operated at rated load, 75 percent, 50 percent, 25 percent and no load. Measurements shall be taken at each load condition. The dB(a) SPL shall be determined by positioning microphones at an elevation above the ground and distance away from the perimeter of the APU as specified herein. The sensing element of the microphones shall be positioned parallel to the ground. The microphone(s) shall be placed or moved in 30-degree increments around the APU with the 0-degree location being the center of the operator’s control panel.

100.1.3.3 Hearing protection assessment. The control panel door (if applicable) shall be opened and secured. Position the microphone at the distance from the operator’s panel specified herein. The height of the microphone will be equal to the vertical center of the control panel. The APU shall be operated at rated load, 75 percent, SO percent, 25 percent and no load. Noise level measurements shall be taken at each load condition.

100.1.3.4 Data required. The following data will be included on the test data sheets for each test condition:

a. Ambient temperature, °C (°F).

b. Wind speed, km/hr (mph).

c. Barometric pressure, mmHg.

d. Relative humidity, percent.

e. Ambient noise levels versus octave band center frequency (dB and dB(A))

f. A tabulation of the audio noise SPL versus octave band center frequency for rated load and no load operation for each measurement (dB).

TEST METHOD 100.1 - Continued.

g. tabulation of the SPL at each measurement (dB(A)).

h. A measurement of the SPL at the operator's station (dB(A)).

100.1.3.5 Results. Compare the operator’s control panel noise level with the 85 dB(A) criteria for personnel hearing protection.

TEST METHOD 101.1

ELECTROMAGNETIC INTERFERENCE TEST

101.1.1. General. The APU must satisfy the electromagnetic interference requirements.

101.1.2 Apparatus. Instrumentation for measuring load conditions shall be as described and illustrated in MIL-HDBK-705. Measurement instrumentation shall include electromagnetic interference meter, current probes, head set and intermediate frequency (IF) monitoring device, test antennas, and signal source as described and illustrated in MIL-STD-462. In addition, a 50-foot load cable, resistive/reactive load bank having sufficient capacity to load the APU to rated capacity at both unity and 0.8 power factor, and a recording voltage and frequency meter in accordance with MIL-HDBK-705 shall be needed.

101.1.3 Procedure.

101.1.3.1 Procedure 1. (Conducted emission - 0.015 to 50 MHz, power leads) .

101.1.3.1.1 Test setup. The test setup shall be as shown in figure CE02 of MIL-STD-462.

101.1.3.1.2 Test. With the 50-foot cable connected to the APU output and energized during the no-load test, determine the broadband conducted emissions (0.015 - 50 MHz) on each conductor at the end of the cable at no-load, rated kW load at 1.0 pf, and rated kW load at 0.8 pf at all voltage and frequency connections.

101.1.3.2 Procedure 2. (Radiated emission, 14 kHz t o1 GHz, electric field).

101.1.3.2.1 Test setup.

a. The basic test setups shall be as shown in figures RE02-1 and RE02-2 of MIL-STD-462. Test sample antenna terminals if any shall be connected to shield dummy loads.

(1) Non-portable equipment which is permanently connected either physically or electrically to a vehicle, system or installation shall be tested in accordance with the setup shown in figure RE02-1.

(2) Portable equipment including manpack operable equipment and test equipment shall be tested in accordance with the setup shown in figure RE02-2.

(3) Equipment falling into both of the categories indicated in 101.1.3.2.1a(1) and 101.1.3.2.1a(2) shall be tested both ways.

b. Probe the test sample as indicated in Section 4 of MIL-STD-462 to locate the points of maximum radiation from the test sample.

c. Select and position the test antennas as indicated in Section 4 at a test distance indicated in table VIII of MIL-STD-461. In the frequency range of 0.030 to 12.4 GHz, position linearly polarized antennas so as to make both vertical and horizontal measurements.

TEST METHOD 101.1 - Continued.

d. Bond counterpoise of 41-inch rod antenna using bonding straps.

101.1.3.2.2 Test. With the 50-foot cable connected to the APU output and energized during the no-load test, determine the radiated emissions (14 kHz - 1 GHz) at no-load, rated kW load at 1.0 pf, and rated kW load at 0.8 pf at all voltage and frequency connections. For each antenna, scan the applicable frequency range of this test with the EMI meter and take measurements as required.

NOTE: Errors due to reflections within the shielded enclosure can be reduced by use of absorptive materials lining the walls or by portable panels of such materials placed around the test setup.

101.1.3.3 Procedure 3. (Radiated susceptibility, 2 MHz to 10 GHz, electric field).

101.1.3.3.1 Test setup.

a. The test setup shall be as required by the general testing requirements of MIL-STD-462 for placement of antennas.

b. Test signals shall be selected in accordance with the rules of 101.1.3.3.3 below.

c. Fields shall be generated, as required, with the antenna specified in table I of MIL-STD-462. Care shall be taken so that the test equipment is not affected by the test signals.

d. The specified field strength shall be established prior to the actual testing by placing a field measuring antenna at the same distance and in the same relative location as where the test sample will be placed and adjusting the signal level applied to the transmitting antenna until the required field intensity is indicated. The voltage or power at the input terminals of the transmitting antenna, required to establish the specified field shall be monitored and recorded. When performing this calibration in a shielded enclosure, the measurement antenna shall be placed in either the exact location that the test sample will occupy or shall be in a position which simulates exactly the geometry of the test sample location as regards distances to reflective surfaces. (This calibration may be used for all subsequent testing provided that the data was taken in a reflective free area or the exact same shielded enclosure test sample location is used).

e. When a large test sample is to be immersed in a field, the transmitting antenna shall be placed at a distance sufficient to allow the entire test sample to fall within the 3 dB bandwidth of the transmitted field. If this is not feasible because of difficulty in generating the required field at the greater distance or because of the nature of the antenna radiation characteristics, the sample may be tested in segments, each segment being equal in dimension to the 6 dB bandwidth of the antenna radiation characteristic. For a whip transmitting antenna the horizontal segments shall have length no greater than given by the following equation:

$$L = 2 \times [\, rd - (d-2)^2 \,]^{1/2}$$

TEST METHOD 101.1 - Continued.

Where R is the test distance and d is the test sample width measured along a line forming a right angle with the face of the test sample which is directed toward the transmitting antenna.

101.1.3.3.2 Test.

a. Determine those frequencies at which the test sample is susceptible. At these frequencies, determine the threshold of susceptibility. Record all pertinent data.

b. With the 50-foot cable connected to the APU and energized during the no-load test, subject the APU to electric fields of 10 V/m (2 - 400 MHz) and 5 V/m (400 MHz to 10 GHz) while operating at no-load, rated kW load at 1.0 pf, and rated kW load at 0.8 pf at all voltage and frequency connections.

c. The APU's output voltage shall be monitored throughout the test with the recording voltage and frequency meter operating at 6 inches per hour until voltage or frequency variations as a function of field strength or frequency are noted. Upon ovserving such variation, the chart speed shall be increased to 6 inches per minute and the frequency spectrum in question shall be re-scanned for acceptance/rejection analysis.

101.1.3.3.3 Susceptibility signal modulation rules. Test signals shall be modulated according to the following rules.

a. Test samples with audio channels/receivers.

(1) AM Receivers: Modulate 50 percent 1000 Hz tone.

(2) FM Receivers: When monitoring signal to noise ratio modulate with 1000 Hz signal using 10 kHz deviation. When monitoring receiver quieting, use no modulation.

(3) SSB Receivers: Use no modulation.

(4) Other Equipment: Same as for AM receivers.

b. Test samples with video channels other than receivers. Modulate 90 to 100 percent with pulse of duration 2/BW and repetition rate equal to BW/1000 where BW is the video bandwidth.

c. Digital equipment. Use pulse modulation with pulse duration and repetition rates equal to that used in the equipment.

d. Non-tuned equipment. Amplitude modulate 50 percent with 1000 Hz tone.

101.1.3.4 Results.

a. For prodedure 1, compare the test results with the limit of figure 9.1 of MIL-STD-461. Conduct emissions exceeding the limit of figure 9.1 of MIL-STD-461 shall be cause for rejection.

b. For procedure 2, compare the test results with the limit of figure 9.2 of MIL-STD-461. Radiated emissions exceeding the limit of figure 9.2 of MIL-STD-461 shall be cause for rejection.

TEST METHOD 101.1 - Continued.

c. For procedure 3, compare the short-term stability of the test results with the short-term stability of the requirement for both voltage and frequency. Failure of the output voltage or frequency to remain within the 30-second short-term stability bandwidth (which is established prior to the application of the various electrical fields) when subjected to the specified electrical fields shall be cause for rejection.

TEST METHOD 102.1

RAIN TEST

102.1.1 General. This test is performed to assure proper operation of the APU during a heavy rain storm while the APU is mounted in a SICPS or JTACS system. For this test method, “test item” indicates the APU mounted in the SICPS or JTACS system.

102.1.2 Apparatus. Instrumentation for measuring load conditions and rain shall be as described and illustrated in MIL-HDBK-705. In addition, a test area capable of providing the required rainfall and wind conditions shall be provided.

102.1.3 Procedure.

102.1.3.1 Preparation for test.

a. Perform test method 608.1 of MIL-STD-705 within 4 hours before the start of the rain test.

b. Place the mounted APU in the rain environmental location with external connections made to simulate field installation conditions as closely as possible.

c. Connect the load instrumentation in accordance with the applicable figure of MIL-HDBK-705, method 205.1, 205.1.10 for the voltage connection and frequency specified herein.

d. The test area shall be at normal ambient temperature (68 to 86 °F or 20 to 30 °C) at the beginning of the test and no further regulation of temperature is required.

102.1.3.2 Test.

a. A simulated rainfall of 8 ±1 inches per hour or as otherwise specified herein, shall be produced by water spray nozzles of such design that the water is emitted in the form of small droplets, rather than a fine mist. The temperature of the water shall be above 40 °F (4.44 °C). The spray nozzles shall be located so that the water drops impinge on the test item at angles between 15 and 45 degrees from the vertical. The water shall be dispersed as uniformly as possible over the entire area by means of a wind source producing wind velocities up and including 40 mph (18 m/s). The wind velocity shall be measured at the position of the set prior to placement of the set in the facility.

b. Subject the test item to the water spray for 3 consecutive hours. Each side of the test item shall be exposed to simulated blowing rain for 30 minutes beginning with the APU side of the test item. At the beginning of the last hour of the test, and with the simulated blowing rain on the APU side of the test item, perform TM 608.1 of MIL-STD-705. Continue operating the APU during the simulated blowing rain until completion of TM 608.1 or after completion of the third hour, whichever condition is the longer of the two.

c. Immediately after exposure to the simulated blowing rain and at the rain test site, examine the APU for evidence of water penetration and damage. After completion of the examination of the APU, start the APU and perform TM 608.1.

102.1.4 Results. The data sheet shall indicate the length of test, quantity and incident angle of the water, wind velocity, any malfunction, water penetration, and water damage (see figure 2).

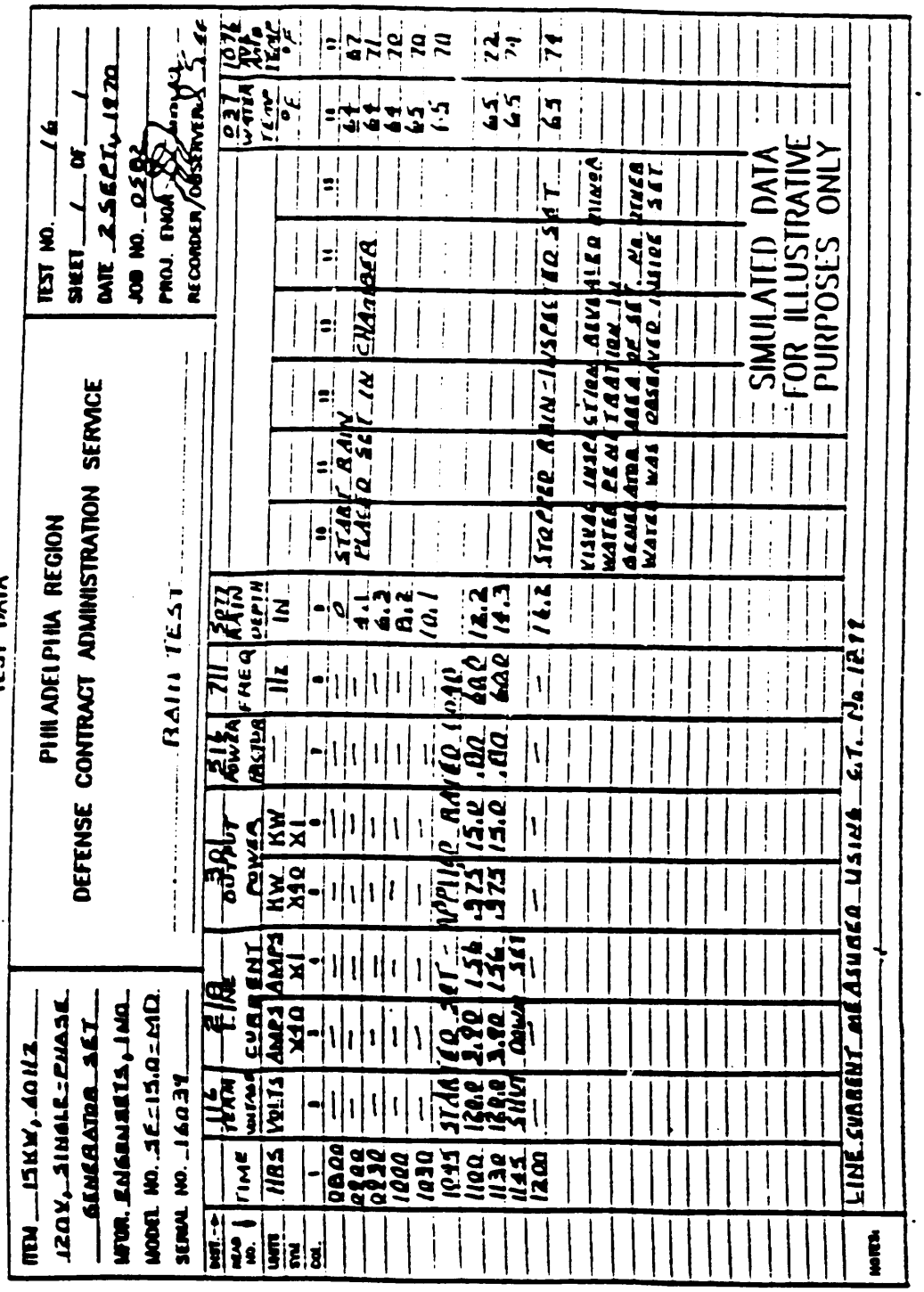


FIGURE 2. Typical test record for ruin test.

TEST METHOD 103.1

SAND AND DUST TEST

103.1.1 General. This test is performed to assure proper operation of the APU in an airborne sand and dust environment while the APU is mounted in a SICPS or JTACS system. For this test method, “test item” indicates the APU mounted in the SICPS or JTACS system.

103.1.2 Apparatus.

103.1.2.1 Test facility.

a. The required apparatus consists of a chamber or cabinet, together with necessary air conditioning and circulation equipment with its auxiliary control instrumentation, sand storage and moving equipment, and sand concentration measuring equipment, capable of maintaining and continuously monitoring the required conditions throughout an envelope of air surrounding the test item(s). (see B.1.1) Figures 3 and 4 are schematic diagrams of typical facilities for this test.

b. A data collection system, separate from the chamber controllers, shall be employed to measure test space conditions. Readout charts shall be readable to within at least 0.6 °C (1 °F) .

c. Dehumidification, heating, and cooling of chamber test volume air for control of test conditions shall be achieved by methods that do not alter the chemical composition of the air, sand, or water vapor within the chamber test volume air.

d. Test facility design considerations.

(1) The vibratory or screw type sand feeder shall be controlled to emit the sand at the specified concentrations. The feeder shall be located in such a manner as to ensure that the sand is uniformly in suspension in the air stream when it strikes the test item, to simulate the same effects as in the field.

NOTE: Uniform sand distribution is usually easier to obtain when the sand-air mixture is directed downward, as in figure 3.

(2) Because of the extremely abrasive characteristics of blowing sand at high velocity, it is not recommended that the sand be re-circulated through the fan or air conditioning equipment. Instead, it should be separated from the air downstream from the test chamber in a sand separator, collected in a separate receiver, and reintroduced into the sand tank or hopper. The fan should re-circulate only the sand-free conditioning air.

NOTE: The sand collected in the separator may be reused for other tests if, after analysis, it still conforms to 103.1.2.2d of this method.

103.1.2.2 Controls.

a. Unless otherwise specified herein, temperature and relative humidity measrements made during testing shall be continuous if measurements are in

alalog form, or at intervals of one every 15 minutes or less if measurements are in digital form. All instrumentation used with the test chamber shall be capable of meeting the accuracies, tolerances, etc. of B.1.1 and B.1.2. Any significant change of the test item temperature or chamber conditions shall result in the test item being re-established at the required environmental conditions before continuation.

b. Relative humidity in the test section shall be less than 30 percent throughout the conduct of the test.

c. The test variables (temperature, air velocity, and dust concentration) shall be continuously monitored during the test. Humidity shall be verified just before or during each test.

d. Unless otherwise specified, the sand suggested to be used in the large-particle test is silica sand (at least 95 percent by weight SiO_2). The amount 1.0 percent ±O.5 percent of the sand shall be retained by a 20-mesh screen (850 mm), 1.7 percent ±0.5 percent by a 30-mesh screen (590 mm), 14.8 percent ±1 percent by a 40-mesh screen (420 mm), 37.0 percent ±1 percent by a 50-mesh screen (297 mm), 28.6 percent ±1 percent by a 70-mesh screen (210 mm), 12.7 percent ±1 percent by a 100-mesh screen (149 mm), and 5.2 percent ±1 percent shall pass a 100-mesh screen. The sand shall be of subangular structure with a mean Krumbein number (roundness factor) equal to 0.2 and a hardness factor of 7 mobs.

e. The sand concentrations shall be 1.4 grams per cubic meter.

f. An air velocity shall be maintained at a minimum of 20 mph.

103.1.2.3 Test interruption. (see B.2.3).

a. Undertest. The abrasion, penetration, and collection of dust are cumulative effects that are not affected by interruption. The test item shall be re-established at the prescribed temperature and the test continued from the point of interruption.

b. Overtest. Any interruption that results in more extreme exposure of the test item than required herein should be followed by a complete physical examination and operational check (where possible) before continuation of testing. If a problem is encountered, the test should be re-initiated with a new test item.

103.1.3 Criteria. The failure of an APU to meet the requirements specified herein must be analyzed, and related information must be considered, such as:

a. Degradation allowed in operating characteristics while at the extreme conditions.

b. Necessity for use of special operating procedures or special kits during extreme conditions.

c. The APU shall be considered to have failed the large-particle test when:

(1) Abrasion of the APU exceeds the amount described herein.

(2) The APU does not perform safely or operate adequately as described herein.

NOTE: The test plan shall contain procedures for determining the APU's degradation due to abrasion. These procedures shall describe parameters (such as amount of wear or loss of weight) or observable attributes (such as change of shape) which, if not within specified limits, are indications that the APU has failed because of abrasion effects. The permissible tolerances of the parameters and attributes shall be provided.

103.1.4 Procedure.

103.1.4.1 Preparation for test. Conduct the pretest checkout as follows:

Step 1. Position the test item in the test chamber as near the center of the test sections as practicable. The test item shall have a minimum clearance of 15 cm (6 inches) from any wall of the test chamber and from any other test item (if more than one item is being tested). Orient the test item so as to expose the most critical or vulnerable parts to the sand or dust stream.

NOTE: The orientation of the test item may be changed during the test if required by the test plan.

Step 2. Prepare the test item in its operational configuration in accordance with B.2.2.

Step 3. Stabilize the test item at standard ambient conditions (see B.1a).

Step 4. Conduct a complete visual examination of the APU with special attention to sealed areas and minute of openings.

Step 5. Document the results.

Step 6. Conduct an operational checkout of the APU in accordance with the approved test plan. Perform TM 608.1 of MIL-STD-705 within 4 hours before the start of the sand and dust test.

Step 7. Record results for compliance with B.2.1.

Step 8. If the APU operates satisfactorily, proceed to step 1 of the test procedure. If not, resolve the problem and restart at step 1 of pretest checkout.

103.1.4.2 Test.

Step 1. Adjust the chamber temperature to the high operating temperature of the APU and maintain until temperature stabilization of the APU is achieved.

Step 2. Adjust the air velocity to that required by the test plan.

Step 3. Adjust the sand feeder to obtain the sand concentration specified in the test plan, depending upon the application of the APU.

Step 4. Maintain the conditions of steps 1 through 3 for the duration specified in the test plan.

Step 5. If operation of the APU during the test is required, perform an operational test of the APU during the last hour of the test and document the results. If not, proceed to step 6.

Step 6. Turn off all chamber controls and allow the test item to return to standard ambient conditions. Remove accumulated sand from the APU by brushing, wiping, or shaking, taking care to avoid introduction of additional sand into the APU.

Step 7. Conduct an operational checkout of the APU in accordance with the approved test plan. Within 4 hours after the completion of the test, perform TM 608.1 of MIL-STD-705.

Step 8. Document the results.

Step 9. Visually inspect the APU looking for abrasion and clogging effects and any evidence of sand penetration.

Step 10. Compare these data with the pretest data.

103.1.4.3 Data to be recorded.

a. APU identification (manufacture, serial numbers, etc.).

b. Previous test methods to which the specified APU has been subjected.

c. Orientation and any change in orientation during test.

d. Results of each performance check (pretest, during test, and post-test).

e. Values of the test variables for each section of the test.

f. Results of each visual inspection.

g. Duration of each section of test.

103.1.5 Results. The results will be reviewed and compared to the criteria (see 103.1.3) for compliance. Inability to meet the voltage and frequency specified herein will constitute failure of the test.

TEST METHOD 103.1 - Continued.

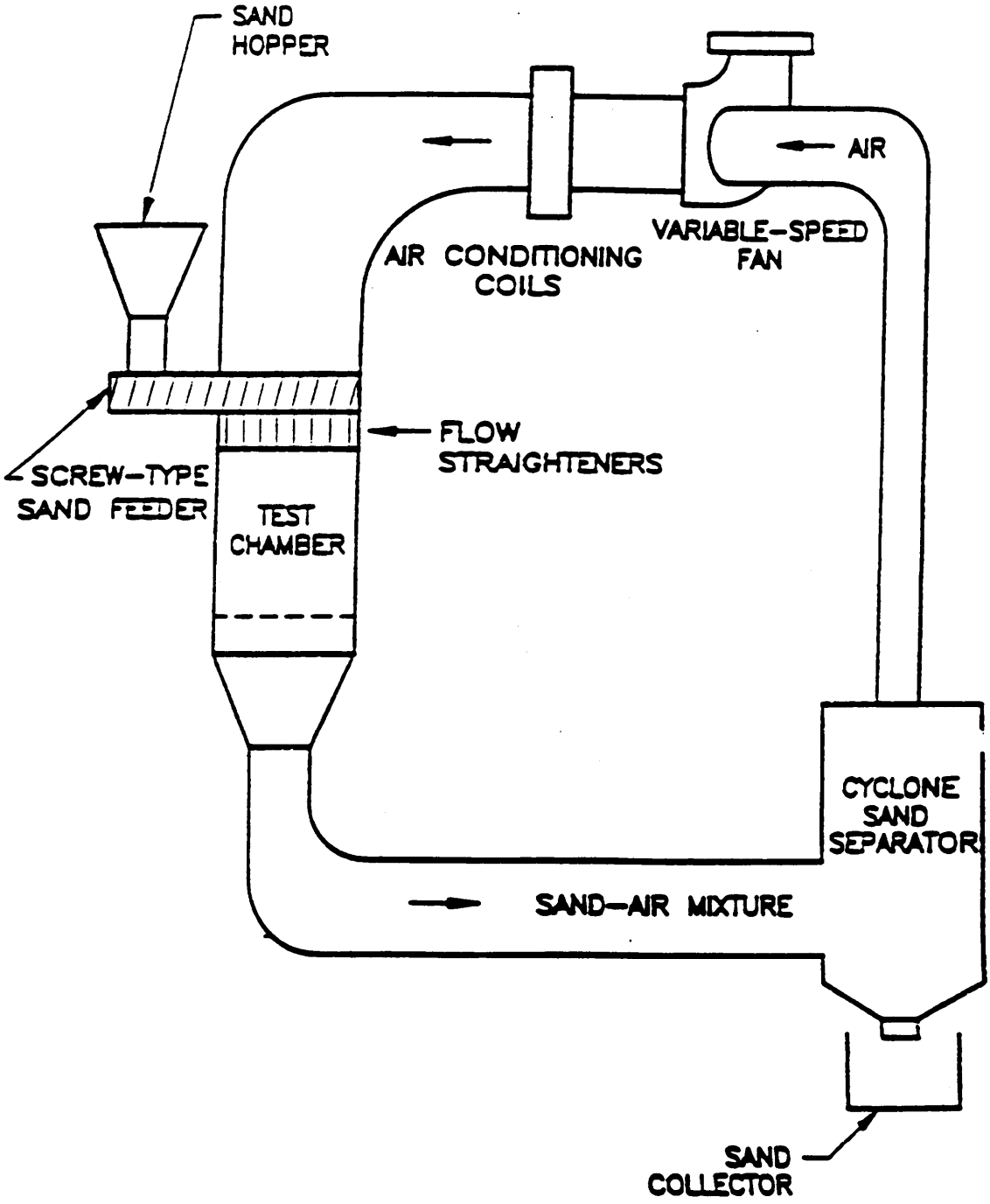
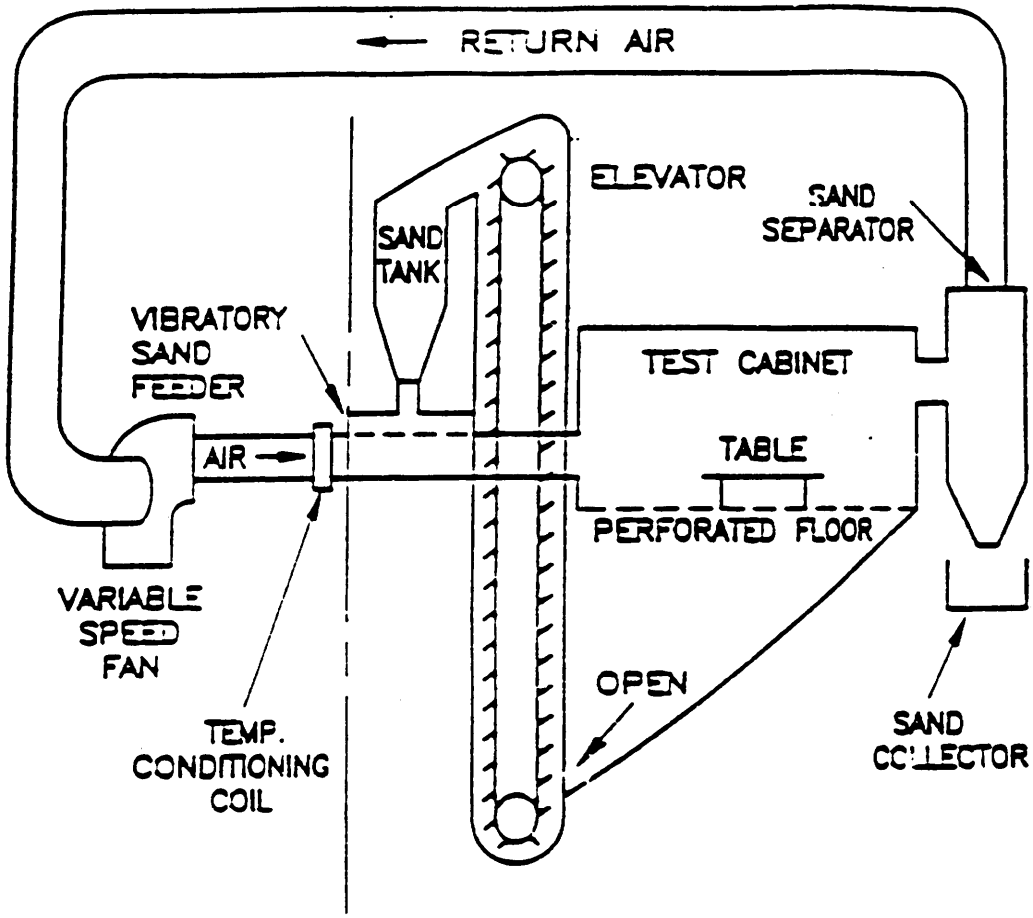


FIGURE 3.

Blowing sand test facility (vertical flow).



NOTE: THE LAYOUT OF THIS SYSTEM IS NOT DRAWN TO SCALE IT IS INTENDED TO ILLUSTRATE THE ARRANGEMENT OF THE COMPONENTS. THE SPECIFICATIONS OF ALL COMPONENTS ARE NOT PROVIDED IN THIS TEST DESCRITPION. THEY MUST BE CALCULATED BY THE ORGANIZATION SUPPLYING THE COMPONENTS. INDUSTRIAL VENTILATION, A MANUAL OF RECOMMENDED PRACTICE WILL PROVIDE DATA AND GUIDANCE FOR DESIGNING THE REQUIRED EQUIPMENT.

FIGURE 4.
Blowing sand test facility (horizontal flow).

TEST METHOD 104.1

SALT FOG TEST

104.1.1 General. This test is performed to determine the resistance of the APU to the effects of an aqueous salt atmosphere while the APU is mounted in a SICPS or JTACS system. For this test method, “test item” indicates the APU mounted in the SICPS or JTACS system.

104.1.2 Apparatus.

104.1.2.1 Test facility. The apparatus used in ferforming the saslt fog test in this method shall include:

a. A test chamber with:

(1) Supporting racks designed and constructed so that they will not affect the characteristics of the salt fog mist. All parts of the test chamber and the supporting racks that come into contact with the test item shall be constructed of material or will be buffered with material that will not cause electrolytic corrosion. Condensation shall not be allowed to drip on the test item. No liquid that comes in contact with either the exposure chamber or the test item shall return to the salt solution reservoir. The exposure chamber shall be properly vented to prevent pressure buildup.

(2) The capability to maintain temperatures in the exposure zone at 35 °C (95 °F). Satisfactory methods for controlling the temperature accurately are by housing the apparatus in a properly controlled constant-temperataur room, by thoroughly insulating the apparatus and preheating the air to the proper temperature before the atomization, or by jacketing the apparatus and controlling the temperature of the water or the air used in the jacket. The use of immersion heaters within the chamber exposure area for the purpose of maintaining the temperature within the exposure zone is prohibited.

b. A salt solution reservoir made of material that is non-reactive with the salt solution, e.g., glass, hard rubber, or plastic.

c. A means for injecting the salt solution into the test chamber. Caution must be exercised to prevent clogging of the nozzles from salt buildup. Atomizers used shall be of such design and construction as to produce a finely divided, wet, dense fog. Atomizing nozzles and the piping system shall be made of material that is non-reactive to the salt solution. Suitable atomization has been obtained in chambers having a volume of less than 0.34 m^3 (12 ft^3) under the following conditions:

(1) Nozzle pressure as low as practical to produce fog at the required rate.

(2) Orifices between 0.5 and 0.76 mm (0.02 and 0.03 inches) in diameter.

(3) Atomization of approximately 2.8 liters of salt solution per 0.28 m^3 (10 ft^3) of chamber volume per 24 hours. When chambers with a volume considerably in excess of 0.34 m^3 (12 ft^3) are used, the conditions specified may require modification.

NOTE: A filter fabricated of noncorrosive materials similar to that shown in figure 5 shall be provided in the supply line and immersed in the salt solution reservoir as illustrated in figure 6.

d. Salt fog collection receptacles placed so that a clean receptacle at any point in the exposure zone will collect from 0.5 to 3 milliliters of solution per hour for each 80 square centimeters of horizontal collecting area (10 cm diameter) in an average test of at least 16 hours. A minimum of 2 receptacles shall be used, one placed nearest to any nozzle and one farthest from all nozzles. Receptacles shall be placed so that they are not sheilded by the test item and will collect no drops of solution from the test item or other sources.

104.1.2.2 Controls.

a. Before injection into the test section, the salt solution shall be heated to within ±6 °C (±10 °F) of the test section temperature at the time of injection.

b. All water used during the salt fog tests shall be from steam or distilled, demineralized, or de-ionized water, and have a pH between 6.5 and 7.5 at 25 °C, or have a resistivity of not less than 250,000 ohms/cm at 25 °C.

c. Test section air circulation: Air velocity in test chambers shall be minimal (essentially zero).

104.1.2.3 Test interruptions. (See B.2.3.)

a. Undertest. If an unscheduled test interruption occurs that causes the test conditions to exceed allowable tolerances toward standard ambient conditions, the test item should be given a complete visual examination, and a technical evaluation should be made of the impact of the interruption on the test results. The test must be restarted at the point of interruption and the test item re-stabilized at the test conditions.

b. Overtest. If an unscheduled test interruption occurs that causes the test conditions to exceed allowable tolerances away from standard ambient conditions, the test conditions should be stabilized to within tolerances and held at that level until a complete visual examination and technical evaluation can be made to determine the impact of the interruption on test results. If the visual examination or technical evaluation results in a conclusion that the test interruption did not adversely affect the final test results, or if the effects of the interruption can be nullified with confidence, pre-interruption conditions should be reestablished and the test continued from the point where the test tolerances were exceeded.

104.1.3 Criteria. In addition to the failure criteria of B.2.5, the following must be considered. Any corrosion must be analyzed for its immediate or potential effect on the proper functioning of the APU. Satisfactory operation following this test is not the sole criterion for pass/fail.

104.1.4 Procedure.

104.1.4.1 Preparation for test.

104.1.4.1.1 Preparation of salt solution. The salt used for this test shall be sodium chloride containing (on a dry basis) not more than 0.1 percent sodium iodide and not more than 0.5 percent total impurities. Unless otherwise specified, a 5 ±1 percent solution shall be prepared by dissolving 5 parts by weight of salt in 95 parts by weight of water. The solution shall be adjusted to, and maintained at, a specific gravity (see figure 7) by using the measured temperature and density of the salt solution. Sodium tetraborate (borax) may be added to the salt solution as a pH stabilization agent in a ratio not to exceed 0.7g sodium tetraborate to 75 liters of salt solution. The pH of the salt solution, as collected as fallout in the exposure chamber, shall be maintained between 6.5 and 7.2 with the solution temperature at +35 °C (+95 °F). Only diluted chemically pure hydrochloric acid or chemically pure sodium hydroxide shall be used to adjust the pH. The pH measurement shall be made electrometically or colorimetrically.

104.1.4.1.2 Chamber operation verification. Unless the chamber has been used within five days, immediately before the test, and with the wxposure chamber empty, adjust all test parameters to those required for the test. Maintain these conditions for one 24-hour period. Continuously monitor all test parameters to verify that the test chamber is operating properly.

104.1.4.1.3 Pretest standard ambient checkout. All items require a pretest checkout at room ambient conditions to provide baseline data. Conduct the checkout as follows:

Step 1. Prepare the test item in its required configuration in accordance with B.2.2.

Step 2. Record the room ambient conditions.

Step 3. Conduct a complete visual examination of the APU with attention to:

a. High-stress areas.

b. Areas where dissimilar metals are in contact.

c. Electrical and electronic components - especially those having closely spaced, unpainted, or exposed circuitry.

d. Metallic surfaces.

e. Enclosed volumes where condensation has occurred or may occur.

f. Components or surfaces provided with coatings or surface treatments for corrosion protection.

g. Cathodic protection systems; mechanical systems subject to malfunction if clogged or coated with salt deposits.

h. Electrical and thermal insulators.

NOTE: Partial or complete disassembly of the APU should be considered if a complete visual examination is required. Care must be taken not to damage any protective coatings, etc.

Step 4. Document the results. (Use photographs, if necessary.)

Step 5. Conduct an operational checkout in accordance with the approved test plan. Perform TM 608.1 of MIL-STD-705 within 4 hours before the start of the test.

Step 6. Record the results for compliance with B.2.1.

Step 7. If the APU meets General Requirements, the approved test plan, or other applicable documents, proceed to step 1 of the test procedure below. If not, resolve any problems and restart the pretest standard ambient checkout at the most reasonable step above.

104.1.4.1.4 Preparation of the test item.

a. The APU shall be given a minimum of handling, particularly on the significant surfaces, and will be prepared for test immediately before exposure. Unless otherwise specified, APUs shall be free of contamination such as oil, grease, or dirt, which could cause a water bread. The cleaning methods shall not include the use of corrosive solvents, solvents which deposit either corrosive or protective films, or abrasive other than a paste of pure magnesium oxide.

b. Arrange the test item configurations as specified in the test plan.

c. Insert the test item into the test chamber (see B.2.2).

104.1.4.2 Test.

Step 1. Adjust the test chamber temperature to 35 °C (95 °F) and condition the test item for at least two hours before introducing the salt fog.

Step 2. Continuously atomize a salt solution of a composition as given in 104.1.4.1.1 into the test chamber for a period of 48 hours or as specified in the test plan. (Cycling periods of 24 hours each (wet and dry) may be required instead of constant wetting for 48 hours or longer.) During the entire exposure period, the salf fog fallout rate and pH of the fallout solution shall be measured at least at 24-hour intervals. (More frequent intervals are recommended. If fallout quantity requirements are not met, that internal must be repeated.) Fallout shall be between 0.5 and 3 ml/80 cm^2/hr.

Step 3. Store the test item in a standard ambient atmosphere for 48 hours, or as specified in the equipment specification, for drying.

Step 4. At the end of the drying period, unless otherwise specified, the APU shall be operated and the results documented for comparison with the pretest data. Within 4 hours after the completion of the test, perform TM 608.1 of MIL-STD-705.

Step 5. The APU shall be visually inspected in accordance with the guidelines given in 104.1.4.1.3. If necessary to aid in examination, a gentle wash in running water not warmer than 38 °C (100 °F) may be used.

104.1.4.3 Data to be recorded.

a. APU identification (manufacturer, serial number, etc.).

b. Previous test methods to which the APU was subjected.

c. Results of each visual examination and performance checkout performed on the APU.

d. Areas of the APU visually and functionally examined and an explanation of their inclusion.

e. Areas of the APU not visually and functionally examined and an explanation of their exclusion.

f. Test chamber operational information (interruptions, time schedule. etc.).

g. Test variables:

(1) Salt solution pH.

(2) Salt solution fallout rate (ml/cm²/hr).

(3) Resistance of initial water and type of water.

h. Preliminary failure analysis.

104.1.5 Results. The results will be reviewed and compared to the criteria (see 104.1.3) for compliance. Inability to meet the voltage and frequency specified herein will constitute failure of this test.

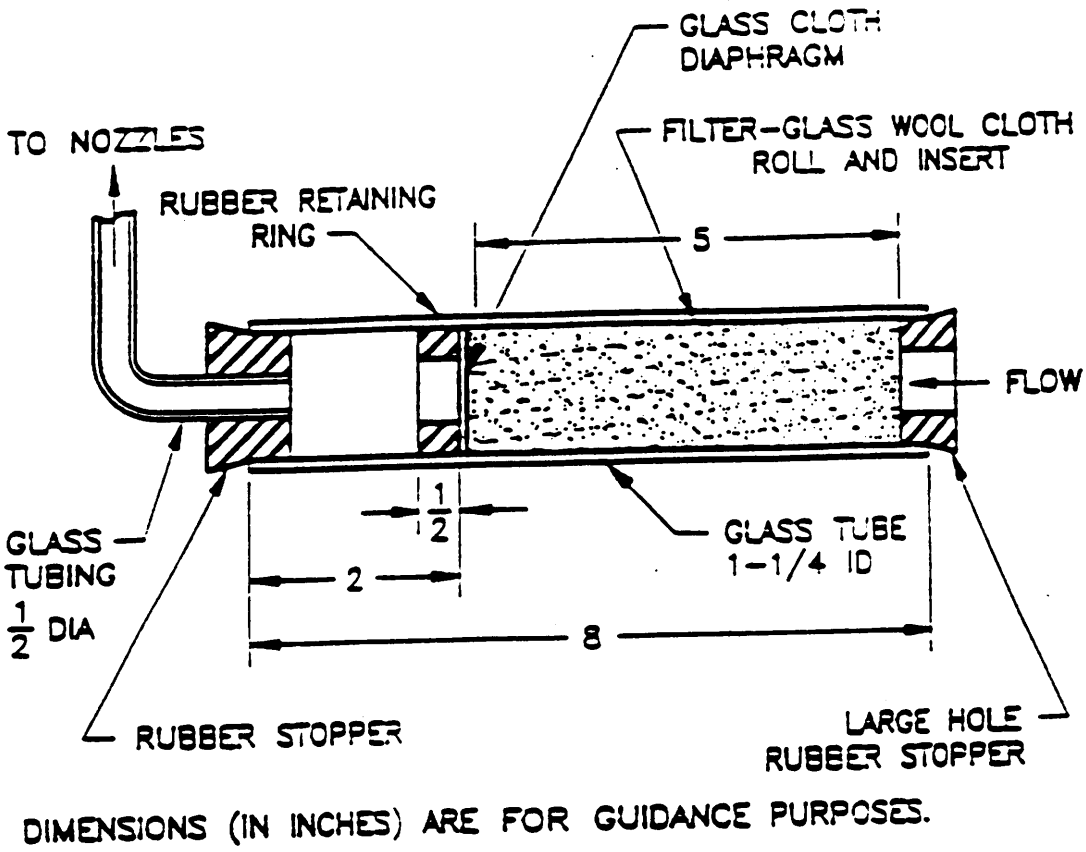


FIGURE 5. Salt solution filter.

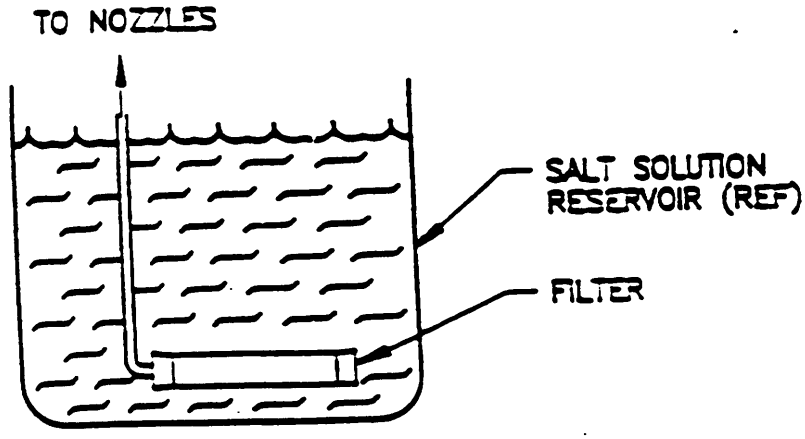


FIGURE 6. Location of salt solution filter.

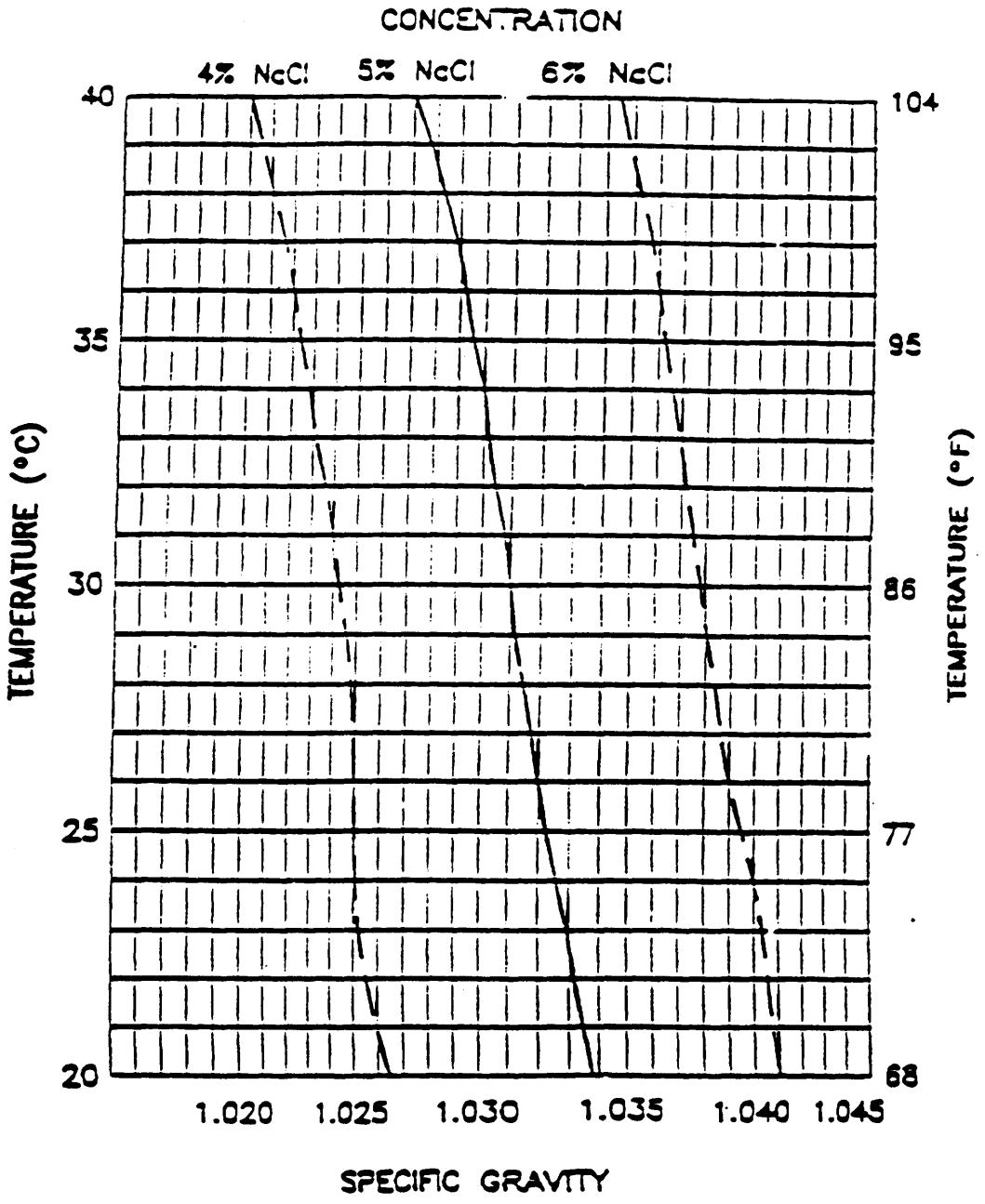


FIGURE 7.

Variation of specific gravity of salt (NaCl) solution with temperature.

SOLAR RADIATION TEST

105.1.1 General. The APU must be capable of withstanding the effect of solar loading without physical damage or compromises in operational ability while mounted in a SICPS or JTACS system. For this test method, "test item" indicates the APU mounted in the SICPS and JTACS system.

105.1.2 Apparatus.

105.1.2.1 Test facility.

a. The required facility consists of a chamber or cabinet, auxiliary instrumentation, and a solar lamp bank. This apparatus must be capable of maintaining and monitoring required conditions of temperature, airflow, and irradiation.

b. The possible cooling effects of airflow over the test specimens must be considered. An airflow of as little as 1 m/s can cause a reduction in temperature rise of over 20 percent. It is essential, therefore, to control and measure the rate of airflow, which should be as low as possible consistent with achieving satisfactory control of temperature. Adjustments of the temperature within the enclosure and control of chamber gradients by suitable heating and cooling of the walls of the enclosure eliminate the need for high air velocities. The air velocity shall be maintained between 0.25 and 1.5 m/s (50 to 300 ft/min).

c. The volume of the test chamber shall be a minimum of 10 times that of the envelope volume of the test item.

d. The solar radiation source area shall be such that the length and width of the test item shall be no more than one-half the same dimensions of the lamp bank and may be composed of either radiant heat-producing lamps or lamps that simulate the solar spectrum.

e. The irradiance shall have a maximum intensity of 1120 W/m² (±10 percent), and the radiation on the test item shall be uniform to within ±10 percent of the desired value, with the spectral distribution given in table III. Where thermal effects only are to be assessed, deviation from this spectral distribution is permitted, but the irradiance must be adjusted to give an equivalent heating effect. In order to calculate this adjustment, it is necessary to know:

(1) The spectral reflectance or transmittance of the irradiated surfaces, and

(2) The spectral energy distribution of the particular lamps being used (and also the effect of any associated reflectors *or* glasses). The radiation shall be directed onto the test item and shall irradiate the entire surface of the test item facing the solar radiatio source. The value of 1120 W/m² shall include any radiation reflected from the test chamber walls and received by the test item, but it should not include long-wave infrared radiation emitted by the chamber walls. The radiation-measuring device shall be calibrated in the wavelength range of the test source radiation.

TEST METHOD 105.1 - Continued.

TABLE III. Spectral energy distribution and permitted tolerance.

CHARACTERISTIC	SPECTRAL REGION			
	ULTRAVIOLET		VISIBLE	INFRARED
Bandwidth	0.28 to 0.32 mm	0.32 to 0.40 mm	0.40 to 0.78 mm	0.78 to 3.00 mm
Irradiance Tolerance	5 W/m^2 ±35%	63 W/m^2 ±25%	517 to 604 W/m^2 ±10%	492 W/m^2 ±20%

NOTE: The amount of radiation wavelength shorter than 0.30 mm reaching the Earth's surface is insignificant.

f. The radiation source shall be located at least 76 cm, (30 inches) away from any other surface of the test item.

g. Light source.

(1) Tests conducted for degradation and deterioration of materials due to actinic effects, as weall as heat buildup within the APUs, must satisfy the full spectrum of table III and may use one of the following acceptable radiation sources:

(a) Xenon arc or mercury xenon arc (used singularly) with suitable reflector.

(b) Combination of high-pressure sodium vapor and improved mercury vapor with suitable reflectors.

(c) High-intensity multi-vapor, mercury vapor (with suitable reflectors), and incandescent spot lamp.

(d) Carbon arc lamp with suitable reflectors.

NOTE: Other combinations of the lamps listed above and in 105.1.2.1a(2) below may be used if it is proven that the combination produces the spectrum of table III.

(2) Tests in which it is not sought to reproduce the sun's spectrum may use the appropriate lamps from

(a) Mercury vapor lamps (internal reflector type only).

(b) Combination of incandescent spot lamps and tubular-type mercury vapor lamps with external reflectors.

(c) Combination of incandescent spot lamps and mercury vapor lamps with internal reflectors.

(d) Metal halide.

(e) Mercury xenon arc lamps with suitable reflectors.

TEST METHOD 105.1 - Continued.

(f) Multi-vapor (clear or coated bulb) with suitable reflectors.

(g) Tungsten filament lamps.

This list is not intended to exclude new lamps made available by advanced technology.

105.1.2.2 Controls.

a. The chamber air temperature shall be within ±2 °C (±3.6 °F) of the test temperature and shall not exceed 1 °C per meter or a maximum of 2.2 °C total (equipment non-operating) and measured (with adequate shielding from radiated heat) at a point or points in a horizontal plane 0 to 50 mm below the prescribed irradiation plane, at half the distance between the test item and the wall of the chamber or at 1m from the test item, whichever is smaller. This is one way to ensure reasonable control of the envelope of air surrounding the test item.

b. Dust and other surface contamination may significantly change the absorption characteristics of irradiated surfaces. Unless otherwise required, specimens should be clean when they are tested.

c. Instrumentation.

ITEM	TOLERANCE
Pyranometer or pyrheliometer	Total irradiation (direct and scattered) to +47 W/m² (+14 Btu/ft /h)
Spectroradiometer or filtered pyranometer	+5% of reading

NOTE: Values may be assumed to represent plus or minus two standard deviations; thus, the stated tolerances should not be exceeded in more than 1 measurement out of 20. Solar radiation intensity shall be measured with a pyranometer or pyrheliometer. Spectral distribution of irradiance as a function of wavelength shall be measured with a spectral radiometer or filtered pyranometer.

d. Because of the variety of permissible lamps and chamber designs, it is particularly important that the chamber be calibrated to assure that the proper levels of radiant infrared energy are impacting the test area when heat alone is of concern and that the proper intensity and spectral distribution of solar radiation are impacting the test area when actinic effects are of concern. Over the area covered by the test item, the radiation intensity must be within +10 percent. As the lamps age, their spectral output changes. A check on spectral distribution, intensity, and uniformity shall be performed at intervals not exceeding 500 hours of operation to ensure that the facilities continue to meet established specifications. This value is based on the manufacturer's guarantee for minimum bulb life.

105.1.2.3 Test interruptions.

TEST METHOD 105.1 - Continued.

a. Undertest.

(1) The test rationale is based on the total cumulative effect of the solar environment. Any undertest interruptio nshould be followed by re-stabilization at the specified conditioning and continuation of the test from the point of the interruption.

(2) If an interruption occurs after 18 hours 20 minutes of the last cycle, the test shall be considered complete. (At least 92 percent of the test would have been completed, and the probability of a failure is low during the remaining reduced levels of temperature and solar radiation.)

b. Overtest. Any overtest conditions must be followed by a thorough examination and checkout of the test item to verify the effect of the overtest. Since any failure following continuation of testing will be difficult to defend as unrelated to the overtest, a new test item should be used.

105.1.3 Criteria.

a. The APU shall not be damaged (see below) or show degradation in operational performance by the effects of solar radiation with up to 355 British Thermal Units (BTUs) per square foot per hour of solar radiation.

b. The damage is defined as:

(1) Change in strength, stress, or loss of structural integrity due to differential expansion and contraction of dissimilar materials.

(2) Jamming or loosening of moving parts or linkages.

(3) Loss of seal or gasket integrity.

(4) Deteriorated electronic or electrical components or wiring.

(5) Blistering, fading, cracking, or peeling of paints.

(6) Softening or weakening of glued parts.

105.1.4 Procedure.

105.1.4.1 Preparation for test. Before the APU is placed in the solar radiation test chamber the following preparation will be made:

a. Perform test method 608.1a of MIL-STD-705.

b. Fill the APU's day tank and all other liquids to rated capacity.

c. Install thermocouples at the following locations:

(1) Engine compartment.

(2) Control cubicle, if applicable.

TEST METHOD 105.1 - Continued.

(3) Fuel tank.

(4) Top, front, rear, and side surfaces of housing, if applicable.

(5) Ambient (in accordance with 202.1.4 of MIL-HDBK-705).

d. Conduct the checkout as follows:

Step 1. Install the test item in the chamber and stabilize it at standard ambient conditions (see B.1.1a) and in a manner that will simulate service usage, unless the storage configuration is specified. Position the test item in accordance with the following:

(a) As near the center of the test chamber as practical and so that the surface of the item is not closer than 0.3m (1 foot) to any wall or 0.76m (30-inch) to the radiation source when the source is adjusted to the closest position it will assume during the test.

(b) Oriented, within realistic limits, to expose its most vulnerable parts to the solar radiation, unless a prescribed orientation sequence is to be followed.

(c) Separated from other items that are being tested simultaneously, to ensure that there is no mutual shading or blocking of airflow.

Step 2. Conduct a visual examination of the test item with special attention to stress areas, such as corners of molded cases.

Step 3. Document the results.

Step 4. Prepare the test item in accordance with B.2.2, with the temperature sensors necessary to determine test item response.

Step 5. Conduct an operational checkout in accordance with the approved test plan.

Step 6. Record results for compliance with B.2.4.

Step 7. If the test item operates satisfactorily, place it in its test configuration (if other than operational). If not, resolve the problem and restart at step 1. Position the test item in accordance with the following and proceed to the first test as specified in the test plan.

(a) As near the center of the test chamber as practical. (See 105.1.2.1c and d.)

(b) Oriented, within realistic limits, to expose its most vulnerable parts to the solar radiation, unless a prescrived orientation sequence is to be followed.

(c) Separated from other items that are being tested to ensure that there is no mutual shading or blocking of airflow.

105.1.4.2 Test.

TEST METHOD 105.1 - Continued.

a. Each side will singularly be exposed to four 24-hour, hot-dry test cycles described in table IV. The APU will be placed in the chamber and positioned so that one vertical side and top of the APU receives the greatest amount of radiation during the first 24-hour cycle so that the equal exposure to the radiation is accomplished to the entire APU by the end of the test.

Step 1. Raise the chamber air temperature to the 0000-hour temperature of table IV.

Step 2. Expose the test item to continuous 24-hour cycles of controlled simulated solar radiation and dry-bulb temperature as indicated in table IV or as specified in the equipment specification. The number of cycles performed shall be whichever of the following is longer:

(a) The minimum necessary to ensure that the peak response temperature of the most critical area of the test item achieved during a cycle is within ±2 °C (±3.6 °F) of the peak response temperature achieved during the previous 24-hour cycle, or

(b) Three continuous cycles.

Increase and decrease the solar radiation intensity in a minimum of four steps up and four steps down to approximate the curve of figure 9. The test item may or may not be operated throughout the test. When an evaluation of the heating effects is important, operation at least at peak temperature should be specified. For certain one-shot items (e.g., rockets), thermocouples affixed to critical portions of the test item should be used to determine the time and value of peak temperature. The time of operation shall coincide with peak temperature.

TABLE IV. Temperature/solar radiation diurnal cycles.

Time	Hot-Dry		Basic Hot		Solar Radiation (see figure 8)	
	°C	°F	°C	°F	W/m^2	$Btu/ft^2/hr$
0000	37	98	33	91	0	0
0300	34	93	32	90	0	0
0600	32	90	30	86	55	18
0900	38	101	37	99	730	231
1200	44	112	42	107	1120	355
1500	48	119	43	110	915	291
1600	49	120	43	110	730	231
1800	48	118	42	107	270	85
2100	41	105	36	97	0	0
2400	37	98	33	91	0	0
Max	49	120	43	110	1120	355
Min	32	90	30	86	0	0

Step 3. Continue cycling until the peak response temperature (measured at representative locations) achieved during a cycle is within ±2 °C (±3.6 °F) of

TEST METHOD 105.1 - Continued.

the peak response temperature achieved during the previous 24-hour cycle, or during 7 cycles, whichever comes first.

Step 4. Conduct an operational checkout of the APU as in 105. 1.4.1d, step 5.

Step 5. Adjust the chamber air temperature to standard ambient conditions and maintain until temperature stabilization of the test item has been achieved.

Step 6. Conduct a complete visual examination of the APU.

Step 7. Document the results.

Step 8. Conduct an operational checkout of the APU as in 105.1.4.1d, step 5.

Step 9. Document the results.

Step 10. Compare these data with the pretest data.

b. After completion of the four cycles, thoroughly examine the APU for physical damage.

c. Remove the APU from the chamber and perform TM 608.1a, of MIL-STD-705.

105.1.5 Results. The results of the solar radiation test will be reviewed and compared to the criteria for compliance. Inability to meet the voltage and frequency criteria specified in the specification and applicable specification sheets, or evidence of physical damage as described above in 105.1.3, will constitute failure of this test.

TEST METHOD 105.1- Continued.

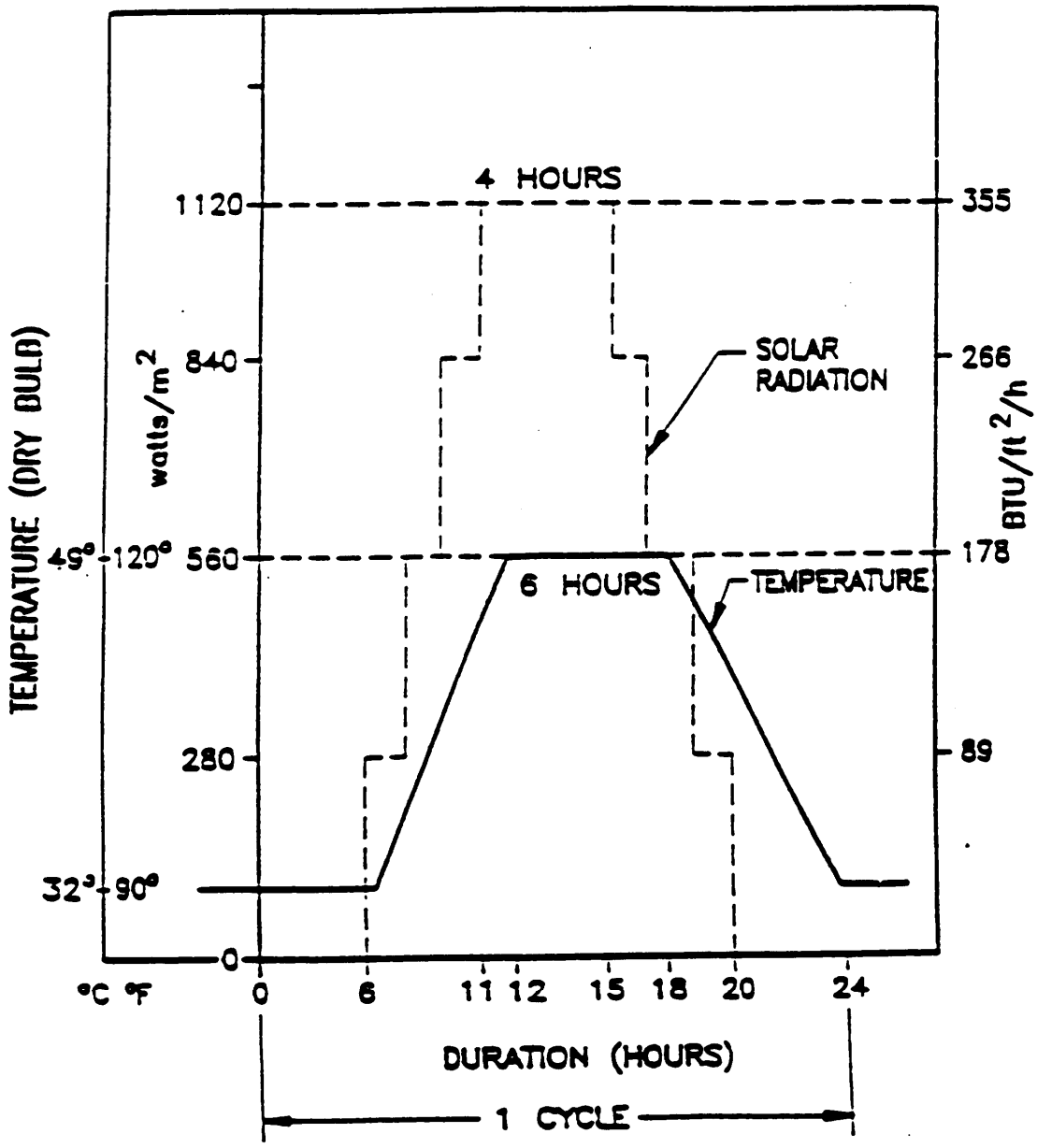


FIGURE 8.

Simulated solar radiation cycle.

TEST METHOD 105.1- Continued.

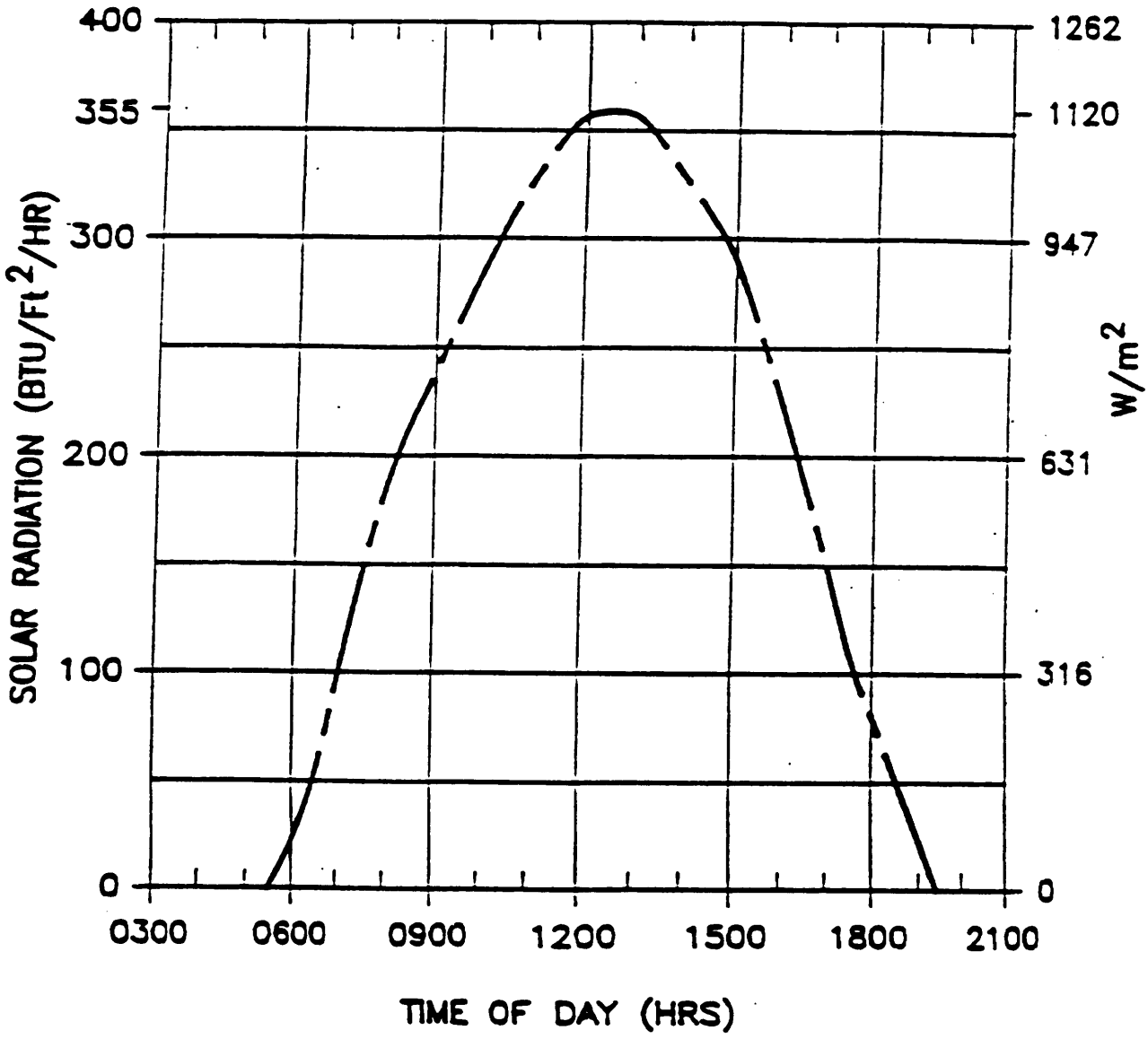


FIGURE 9. Daily solar radiation cycle

TEST METHOD 106.1

ROAD TRANSPORTABILITY TEST

106.1.1 General. The APU must be capable of withstanding the vibration and shock encountered during road transport while mounted in a SICPS or JTACS system. APUs not mounted in a SICPS or JTACS system are normally transported in the bed of wheeled vehicle cargo trucks.

106.1.2 Apparatus. Instrumentation for measuring load conditions, field voltage and current, and ambient temperature shall be as described and illustrated in MIL-HDBK-705. Recording meter(s) for recording voltage and frequency shall be required. A military cargo truck of size applicable to the APU under test will be required for skid APU testing. Instrumentation for measuring and recording the truck speed and road mileage shall be required.

106.1.3 Procedure.

106.1.3.1 Preparation for test.

a. The APU shall be serviced to verify that all fluids are at normal operating levels with the exception of the fuel in the day tank. Unless otherwise stated, the fuel in the day tank will be at least half full.

b. The positive securement of the APU and associated equipment to the SICPS or JTACS system shall be verified.

c. The SICPS or JTACS system shall be inspected and serviced in accordance with its technical manual including the brake system, suspension, lighting, tire pressure and lubrication.

106.1.3.2 Slope operation.

a. The theoretical tipping angles (critical angles) should be calculated for both ends and sides of the SICPS or JTACS system before traversing the slopes to establish a rough approximation of the maximum slopes on which the system can safely negotiate.

b. The APU shall be transported in a sine wave pattern along the horizontal length of the required side slope(s). The APU will be transported in both directions on the slope. During the traversal of a slope, the system shall be stopped for inspection purposes. The APU shall be inspected for any shifting of on-board equipment, and the overflow of any fluid reservoirs. The results of the inspection shall be recorded.

c. The APU shall be transported up and down the required longitudinal slope(s). During traversal of the slope, the system shall be stopped for inspection purposes. The APU shall be inspected for any shifting of on-board equipment, and the overflow of any fluid reservoirs. The results of the inspection shall be recorded.

106.1.3.3 Road test.

a. Prior to and at the end of the last cycle of road testing, a Method 608.1, Frequency and Voltage Regulation, Stability and Transient Response Test (Short Term) of MIL-STD-705, shall be conducted. At the end of each

TEST METHOD 106.1 - Continued.

roadability cycle of table V, a Method 608.1 test (rated load only; will be repeated to verify operability of the APU.

b. The APU shall be exposed to four cycles of the road schedule presented in table V. At the beginning and end of each driving period (shift or day), the APU shall be started and run at no load until stabilized to verify operability including rated voltage, rated frequency, and adequate oil pressure. The APU and system shall be visually inspected several times each driving period for any evidence of structural damage, deformation or degradation that may occur during travel. The results of the inspections shall be recorded.

106.1.3.4 Skid-mounted APUs as loose cargo.

106.1.3.4.1 Preparation for test. Service the skid-mounted APU as indicated in 106.1.3.1.a. Unless specified herein, the skid-mounted APU shall be tied down on a military cargo truck using the APU lifting eyes and cargo straps.

106.1.3.4.2 Road test.

a. Prior to and at the end of the last cycle of road testing, a Method 608.1, Frequency and Voltage Regulation, Stability and Transient Response Test (Short Term), shall be conducted. At the end of each roadability cycle of table V, a Method 608.1 test (rated load only) will be repeated to verify operability of the APU.

b. The skid-mounted APU shall be exposed to four cycles of the road schedule presented in table V. At the beginning and end of each driving period (shift or day) the APU shall be started and run at no load until stabilized to verify operability including rated voltage, rated frequency, and adequate oil pressure. The APU shall be visually inspected several times each driving period for any evidence of structural damage, deformation or degradation that may occur during travel. The results of the inspections shall be recorded.

TABLE V. Road transportability test schedule.

Road Course (Aberdeen Proving Ground, Maryland)	Distance		Maximum Speed	
	mi	km	mph	km/hr
Paved highway	250	402	50	80
Level cross-country (Perryman 1)	250	402	20	32
Hilly cross-country (Churchville B)	125	201	20	32
Belgian Block	15	24	20	32
Totals	640	1029		

TEST METHOD 107.1

RAILROAD IMPACT TEST

107.1.1 General. The APU must be capable of withstanding the vibration and shock encountered in all forms of transportation and movement while mounted in the SICPS or JTACS system. The mechanical integrity of the APU is tested by means of the shock loading encountered during the railroad impact test. The test also evaluates the method of tie-down on the rail car.

107.1.2 Apparatus. Instrumentation for measuring load conditions, field voltage and current, and ambient temperature shall be as described and illustrated in MIL-HDBK-705. Meter(s) for recording voltage and frequency shall be required. Unless otherwise specified herein, the recording meters shall be as described and illustrated in MIL-HDBK-705, Methods 101.1 and 104.1. In addition, two railroad cars with a total standing weight of not less than 250,000 pounds, divided approximately equally between the two cars, and one standard flat railroad car (test car) all with standard draft gear couplings and conventional underframes, a means of moving the test car, an electrical or electronic device to determine the test car speed at impact, and shock measuring equipment as applicable, shall be required.

107.1.3 Procedure.

107.1.3.1 Preparation for test.

a. Unless otherwise specified, the equipment shall be mounted on the impact end of the test car in accordance with the standard loading and bracing method as shown in section 6 of the Association of American Railroads (AAR) “Rules Governing the Loading of Department of Defense Material on Open Top Cars”. No exotic or unusual tiedown methods shall be used. Unless otherwise specified the longitudinal axis of the system shall be mounted parallel to the length of the test car.

b. Unless otherwise specified, the system fuel tank and the APU day tank shall be half full of fuel. Used batteries filled with water may be installed to prevent acid damage should the system batteries fail. All liquids (except fuel) shall be at normal operating level.

c. Any load in the stationary (buffer) cars shall be secured to prevent sliding or shifting; any movement greater than two inches resulting from the test shall be justification for re-test.

107.1.3.2 Test.

a. Within four hours of the test and at the test site, perform Method 608.1, Frequency and Voltage Regulation, Stability and Transient Response Test (Short Term).

b. The couplers between the stationary cars shall be compressed to remove the slack and all of the air and hand brakes shall be set.

c. Locate the test car between the stationary cars and the locomotive. A minimum of 200 feet of reasonably level track between the test car and stationary cars is required to achieve the required locomotive speeds unless an inclined ramp and tug is used. A practice test run without impacting the

TEST METHOD 107.1 - Continued.

test car may have to be conducted to assure the required speed of impact can be achieved.

d. Position the draft gear knuckles of the stationary and test cars for coupling.

e. Install the timing device to measure the test car speed (±0.05 mph) within six feet of impact with the stationary cars.

f. Push the test car towards the stationary cars and release the test car when the desired test speed of 4 mph (+0.5, -0.0 mph) is reached as observed by using the locomotive's speedometer or other means, thus allowing the test car to freely impact the stationary cars. If an inlined ramp and tug is used, move the test car to the incline position for the desired speed and release the test car allowing it to freely impact the stationary cars.

g. Record the speed of impact.

h. Visually inspect the equipment for liquid leaks, deformation, loosening, breakage or change of fit of any component or part including the method of tiedown, tiedown anchors and fittings, and observations of blocking and lading. Record results of inspection and observations.

NOTE: If adjectment of the lading, reconditioning of the bracing or items of securement is required during the impact tests, testing will stop. A complete, new impact test shall then be required.

i. Repeat 107.1.3.2b through h at a speed of 6 mph (+0.5, -0.0 mph).

j. Repeat 107.1.3.2b through h at a speed of 8 mph (+0.5, -0.0 mph).

k. Repeat 107.1.3.2b through h at any other speeds specified herein.

l. Reverse the test car and repeat 107.1.3.2b through h at 8 mph (+0.5, -0.0 mph). No adjustment of the lading, reconditioning of the bracing or items of securement shall be made.

m. Within four hours after completion of the four impacts and final inspection, perform Method 608.1 Frequency and Voltage Regulation, Stability and Transient Response Test (Short Term) at the test site.

107.1.4 Results.

a. Compare the results of the test with the requirements specified herein.

b. Compare the result of the tests specified in 107.1.3.2a and 107.1.3.2m with the requirements specified herein.

TEST METHOD 108.1

SAFETY AND HEALTH TEST

108.1.1 General. The APU must not pose an unsafe or hazardous condition to personnel.

108.1.2 Apparatus. No specific equipment is required.

108.1.3 Procedure.

108.1.3.1 Preliminary safety and health assessment. A preliminary safety and health assessment will be accomplished upon receipt of the APU. This will establish the safety of the APUs so that hazards to test participants can be minimized. As a minimum this preliminary assessment will include the following essentials:

a. A thorough examination will be conducted during the initial inspection and service test to identify all obvious safety problems. Based on a visual examination of the APU, the Safety Checklist (table VI) will be completed by the test director and, if available, a qualified safety engineer. At this point, based on the limited visual inspection, it is realized that only safety problems that are reasonably obvious will be determined since a more thorough evaluation of safety and health will be conducted during the remaining scope of testing. A cursory review of the safety and health warnings and other information will be made of the equipment manuals provided. This is to assure that sufficient information has been provided in these manuals related to safety and health, specifically in the area of data plates, information, warning plates (including noise hazard warnings if required), proper grounding procedures, lifting and tie-down information, electrical shock hazard warnings, and other essential safety and health information that would ordinarily appear in a manual for an APU. Some limited safety-related tasks will be performed, if necessary, to ensure that the APUs are safe for further testing.

b. During the initial inspection, an initial safety review will be made using the safety checklist contained in table VI. The appropriate questions will be answered insofar as possible without further testing. Detailed comments and answers will be indicated for each applicable question of the safety checklists for electrical and mechanical hazards. Responses will not be limited to only the items appearing on the checklist; any other safety and health hazards found will be recorded and incorporated into this subtest.

108.1.3.2 Comprehensive safety and health assessment. A comprehensive safety and health assessment will be conducted throughout the entire test program. This assessment will include:

a. Systematic observations and analysis of the APU throughout all phases of the entire test to identify and investigate any actual or potential hazards to personnel and equipment that may result from operation and maintenance. A detailed description of all safety hazards identified during operation, maintenance, and all other phases of operation will be documented.

b. To ensure that the checklist of table VI has been completed and that all hazards have been identified, the APU will be continuously monitored for hazards during all phases of testing and maintenance. It is expected that by the end of testing, all items on the safety checklist will have been answered.

c. Limitations or compromises on operating performance and maintenance because fo safety considerations.

d. Examination of safety instructions and warning plates for adequacy and appropriate location.

e. Examination of operation and service manuals for adequate safety guidance concerning operation and maintenance.

f. Classification of all safety hazards in accordance with MIL-STD-882 with recommendations for appropriate corrective measures and ways to either reduce or eliminate the hazard severity and hazard probability.

108.1.4 Results.

a. List all mechanical and electrical hazards. Identify all hazards that require warning labels/placards.

b. Each NO answer reported in the checklist of table VI and any other hazards identified will be reviewed and assessed to determine the degree of noncompliance with the criteria. The hazard classification (including hazard severity and hazard probability) outlined in MIL-STD-882 will be used to classify all identified safety hazards into hazard level categories. The hazards will be categorized as a deficiency, shortcoming, or suggested improvement using table VII.

c. All problems recorded that have an effect on safety will be thoroughly analyzed to determine the extent of the problems and their impact on the operators, maintainers, and other personnel associated with the APU. Noncompliance with specific elements of the criteria will be evaluated and suggested corrective actions will be proposed. Appropriate recommendations regarding methods to control, downgrade, or eliminate actual or potential hazards will be made so that the necessary changes can be incorporated before field deployment.

TABLE VI. Safety checklist.

No.	Item	Yes	No	NA	Remarks
1	Are all external parts, surfaces, shields, and all other electrically neutral parts at ground potential at all times during normal operation?				
2	Is the ground connection for all external parts mechanically secured?				
3	Is there a suitable terminal lug or other ground connection located on the chassis or frame to provide a continuous and permanent path to ground?				
4	Are grounding rods furnished?				
5	Are output terminals or other high potentials, in excess of 70 V rms, sufficiently shielded or guarded to prevent accidental contact by personnel?				
6	Are energized components located or enclosed so that suitable protection is provided against contact with uninsulated items?				
7	Are components, conductors, and shielding appropriately located such that overheating, arching, shorting, and contact with moving parts is avoided?				
8	Are wires and cables adequately supported and terminated to prevent shock and fire hazard?				
9	Are wires and cables properly protected against rubbing at access ports by insulated bushings?				
10	Is the set provided with warning placards or caution plates mounted conspicuously adjacent to any condition presenting a potential hazard to personnel (such as high voltage, rotating parts, sharp corners, etc.)?				
11	Are electrical connectors designed to ensure that only the correct plug can be inserted into its receptacle and not into a wrong receptacle?				
12	Where design considerations require plugs and receptacles of similar configuration, are mating plugs and receptacle suitably coded or marked to indicate the correct mating connection?				
13	Are exposed connector pins energized after being disconnected?				
14	Are controls located away from high voltage areas?				

TABLE VI. Safety checklist. - Continued.

No.	Item	Yes	No	NA	Remarks
15	Are emergency controls placed in readily accessible positions?				
16	Is the main circuit breaker in an easily accessible location?				
17	Does a battle short switch (to bypass the safety interlocks) exist on the main control panel?				
18	Is the battle short switch designed with a readily visible indicator light to show that it is on?				
19	Are the following protective devices present with suitable indicators to safeguard against operator injury and/or equipment failure?: Low oil pressure High coolant temperature Overspeed Low fuel Short circuit Overload Under voltage Under frequency Reverse power Overvoltage				
20	Are DC power connections clearly marked for polarity?				
21	Does a DC circuit breaker exist that can cut off all power to the entire system?				
22	Are potential electrical hazards adequately treated in the instruction manual?				
23	Are operator means of detecting hazardous conditions adequate?				
24	Are circuit breakers and all control panel instruments and controls properly labeled?				
25	Does the convenience outlet have provisions for automatic grounding?				
26	Are adjustment screws or other commonly worked-on parts located away from unprotected high voltages?				
27	Are tools to be used near high voltages, such as the load terminal wrench, adequately insulated?				
28	Is the grounding conductor of the equipment electrically insulated from the AC power return (neutral)?				
29	Are internal controls located at safe distances from dangerous voltages?				

TABLE VI. Safety checklist. - Continued.

No.	Item	Yes	No	NA	Remarks
30	Is protective guards sufficiently separated from exposed conductors to prevent shorting or arcing?				
31	Are components that sustain high operating temperatures during normal operation (such as exhaust pipes, turbochargers, radiators, etc.) sufficiently protected to prevent accidental contact by personnel?				
32	Are these components adequately identified by warning plates?				
33	Are the materials used in the engine and generator housing including noise attenuating material inherently nonflammable and non-explosive?				
34	Do exposed gears, cams, levers, fans, belts, or other reciprocating, rotating, or moving mechanical parts have adequate safety covers?				
35	Are doors, hinged covers, panels, and any other exposed sharp projections or overhanging edges presenting a potential safety hazard rounded to prevent injury to personnel?				
36	Are fasteners and methods of securing doors and peripheral ancillary components sufficiently strong to prevent breakaway during normal use?				
37	Is the method of opening doors or covers evident from the construction of the cover? If not, is an instruction plate permanently attached to the outside of the cover?				
38	Is it evident when a cover is in place but not secured?				
39	Are tasks of operation and maintenance such that they do not require excessive physical strength?				
40	Can maintenance be accomplished with shielding in place?				
41	Do external or internal surfaces that expand during maintenance have sharp edges?				
42	Is the center of gravity and weight of the APU distinctly marked?				
43	Are weight capacities indicated on tie-downs, lifting points, etc.?				
44	Is the APU provided with sufficient caution plates to warn maintenance personnel of potential safety hazards?				

TABLE VI. Safety checklist. - Continued.

No.	Item	Yes	No	NA	Remarks
45	Is the control panel adequately illuminated for safe and efficient operation?				
46	Have fire-extinguishing methods been included in the technical publications?				
47	Are potential mechanical hazards adequately treated in the draft instruction manual?				
48	Do floor surfaces provide adequate non-slip characteristics?				
49	Are lifting rings or slings provided?				
50	Are climbing rings, handholds, rails, etc., provided where needed?				
51	Do doors and hinged covers have positive-action hold-open devices?				
52	Are handles recessed rather than extended where they might be hazardous?				
53	Are doors and other openings free of hazards from improperly designed catches, hinges, supports, fasteners, and stops?				
54	Are the tasks of operation and maintenance such that they do not require excessive physical strength?				
55	When glass is used is it glare proof and shatter proof?				
56	Does the ventilating system provide for operator safety by ducting excess heat liberated by the radiator cooling air or other hot air outlets to the exterior of the set?				
57	Are adequate precautions made to prevent exposure of operators and maintainers to exhaust gases or other toxic fumes?				
58	Is the air intake isolated or at a sufficient distance from the exhaust?				
59	Does the instruction and maintenance manual specify type of cleaning fluid and precautions to be taken when cleaning the equipment?				

	HAZARD PROBABILITY				
	FREQUENT	**PROBABLE**	**OCCASIONAL**	**REMOTE**	**IMPROBABLE**
SPECIFIC INDIVIDUAL ITEM	Likely to occur frequently	Will occur several times in life of item	Likely to occur sometime in the life of item	Unlikely but possible to occur in the life of an item	So unlikely it can be assumed the occurrence may not be experienced
FLEET OR INVENTORY	Continuously experienced	Will occur frequently	Will occur several times	Unlikely but can reasonably be expected to occur	Unlikely to occur but possible
HAZARD SEVERITY	A	B	C	D	E
I - CATASTROPHIC May cause death or system loss	Deficiency	Deficiency	Deficiency	Deficiency	Shortcoming
II - CRITICAL May cause severe injury occupational illness, or major system damage	Deficiency	Deficiency	Deficiency	Shortcoming	Suggested improvement
III - MARGINAL May cause minor injury, minor occupational illness or minor system damage	Deficiency	Shortcoming	Shortcoming	Suggested improvement	Suggested improvement or Acceptable
IV - NEGLIGIBLE May cause less than minor injury occupational illness or system damage	Shortcoming	Suggested improvement	Acceptable	Acceptable	Acceptable

TEST METHOD 109.1

HUMAN FACTORS ENGINEERING (HFE) TEST

109.1.1 General. The APU must satisfy general human engineering design criteria and practices.

109.1.2 Apparatus. The following equipment shall be required: photographic and video equipment, tape measure, ruler, illumination meter (lighted displays).

109.1.3 Procedure.

109.1.3.1 Control, display, labeling. Observations will be made of all controls, displays, and labeling with respect to HFE design practices (based on paragraphs 5.1, 5.2, 5.4, and 5.5 of MIL-STD-1472). Control separation and control dimensional measurements will be taken to determine if any design problems exist. The ability of the operator to successfully operate the APU while wearing regular, artic, and Nuclear Biological Chemical (NBC) gloves will be observed as well as the operator's ability to operate the APU at night.

109.1.3.2 Workspace and maintenance access. Maintenance access openings and workspaces will be observed with respect to th eability of the crew to perform maintenance and to determine compatibility with anthropometric dimensions for the 5th through 95th percentile personnel while outfitted in battle dress uniform (BDU), arctic, and NBC protective ensembles.

109.1.3.3 Subjective assessment.

a. Human factors questionnaires will be administered to personnel assigned to the testing program. Questionnaires will primarily pertain to operating and maintaining the equipment. A section of each questionnaire will be devoted to task performance while wearing NBC and arctic gear. Questionnaires, (table VIII), will be administered near the end of the test cycle to assure that all personnel are thoroughly experienced with system operations before completing the forms. Interviews will be conducted to determine the test participants opinions on the overall operation, maintenance, and performance of the APU.

b. Checklists (table IX) will be prepared by an HFE engineer on the following elements of system design:

1. HFe design - controls, displays, and markings.

2. Maintainability.

c. Observations will be made throughout all testing to gain additional information on any HFE-related problems. Comments and informal interviews, in addition to HFE observations, will be documented throughout to provide subjective input to assess the APUs. These interviews, comments, and observations will be used to augment data from other HFE subtests supplements and will be integrated into the analysis of the APU.

109.1.3.4 Anthropometric and demographic data.

TEST METHOD 109.1 - Continued.

a. Anthropometric measurements (standard distribution presented in table X) will be taken of test personnel who participate in daily operation, maintenance, and performance exercises.

b. Demographic data will be compiled of the same test participants and will include the following:

(1) Sex.

(2) Job position (for this test).

(3) Length of experience (in job position).

(4) Age.

109.1.3.5 Operator/maintainer performance tasks. The ability of the test participants to perform critical maintenance tasks while outfitted in MOPP IV and NBC protective ensembles (arctic mittens, and NBC gloves with liners) will be determined by comparing performance times required to complete the following tasks:

a. Checking, filling, and draining engine oil.

b. Replacing engine oil filter(s).

c. Replacing air filter element.

d. Connecting load cable.

e. Replacing fuel filter(s).

f. Checking, filling, and draining hydraulic fluid (if equipped).

g. Replacing hydraulic fluid filter(s) (if equipped).

h. Other common field maintenance actions such as filling fuel tank and radiator, and adjusting belts, etc.

Excessive maintenance times or inability to perform any critical maintenance tasks will be recorded.

109.1.3.6 Manual readability. The reading grade level (RGL) of the operation and maintenance manual will be determined by conducting a readability test as referenced in TOP 1-2-609, Instructional Material Adequacy Guide and Evaluation Standard (Images), January 1981. An adequate number of text samples will be used to determine the overall grade level (OGL).

109.1.3.7 Data required. The following data will be obtained.

a. Control separation and dimensional measurements.

b. Ability of operators to operate the APU while wearing regular, arctic, and NBC gear.

c. Anthropometric and demographic data of test participants.

TEST METHOD 109.1 - Continued

d. Results of interviews and questionnaires administered to test personnel.

e. Results of completed checklists.

f. An assessment of controls and displays.

g. The adequacy of New Equipment Training (NET).

h. RGL of the operation and maintenance manuals.

i. Photographs and videotapes of HFE problems associated with the setup, operation, or maintenance of the APU.

j. Performance times of critical maintenance tasks while maintainers are outfitted in arctic and NBC ensembles.

109.1.4 Results.

a. Qualitative results of observations, checklists and questionnaires will be summarized and presented in narrative and tabular form.

b. The degree to which the APU conforms or does not conform to HFE standards and requirements will be presented. Instances of nonconformance will be supported by measurements and photographic illustrations. The causes and consequences of nonconformance will be assessed with regard to the effect on mission performance. Any degradation of the systems man-item relationship with regard to safety will be assessed and corrective action recommended. Human performance reliability will be assessed in terms of frequency and consequence of human error committed during preparation, operation, and maintenance of the APU. Subjective data analysis will include a structured interview follow-up of all unfavorable/negative comments to arrive at a description of the cause and possible corrective action.

c. The following will constitute failure of this test:

(1) Controls, displays, or labeling that do not conform to MIL-STD-1472, 5.2., 5.4 and 5.5 in relation to appearance, spacing, size, or location.

(2) Inability to successfully operate or maintain the APU when personnel are weaing regular, NBC, or MOPP IV gear.

(3) Workspace and maintenance access openings that do not allow personnel, with anthropometric dimensions between the 5th through the 95th percentile, to perform maintenance.

TEST METHOD 109.1 - Continued.

TABLE VII. HFE questionnaires and checklists.

How would you rate the adequacy of the following?

Rating Scale

6 Excellent
5 Very Good
4 Adequate
3 Not Quite Adequate
2 Poor
1 Extremely Poor

Human Factors Engineering - Adequacy	6	5	4	3	2	1
1. Before, during, and after operation checklist.						
2. Display panels.						
3. Space provided to service APU.						
4. Accessibility of hand controls.						
5. Illumination of instruments during night operation.						
6. Protection of operator from moving parts by guards and warning panels.						
7. Lifting provisions.						
8. Access for using test equipment.						
9. Standard tools and test equipment.						
10. Technical manuals for operation and maintenance.						
11. Based upon the previous questions, rate the OVERALL ADEQUACY of the APU.						

TABLE VIII. HFE questionnaires and checklists. - Continued.

How would you rate the adequacy of the following? Rating Scale 6 Excellent 5 Very Good 4 Adequate 3 Not Quite Adequate 2 Poor 1 Extremely Poor						
Human Factors Engineering - Tasks	**6**	**5**	**4**	**3**	**2**	**1**
1. Reading warnings or instruction labels.						
2. Connecting and disconnecting power cables.						
3. Operation and maintenance while wearing arctic clothing.						
4. Operation and maintenance while wearing NBC clothing.						
5. Reading and understanding the material presented in the technical manuals.						
6. Set up for operation.						
7. Operation during hours of darkness.						
8. Based upon the previous questions, rate the OVERALL EASE OF OPERATION.						

TABLE VIII. HFE questionnaires and checklists. - Continued.

Please rate how often the following occur?

Rating Scale

6 Almost Never
5 Very Seldom
4 Seldom
3 Often
2 Very Often
1 Almost Always

Human Factors Engineering - Intensity	**1**	**2**	**3**	**4**	**5**	**6**
1. The vibration level during operation.						
2. The noise level during operation.						
3. Exhaust fumes during operation.						
Human Factors Engineering - Frequency	**1**	**2**	**3**	**4**	**5**	**6**
1. Requirement for special tools and test equipment.						
2. Glare on operating instruments and gauges.						

TEST METHOD 109.1

TABLE IX. HFE checklists.

Yes - Adequate No - Inadequate NA - Not Applicable

NO.	ITEMS	YES	NO	REMARKS
	HFE DESIGN - CONTROLS, DISPLAYS, AND MARKING			
1	***Controls***			
a	Are all adjustments located on single panel?			
b	Are controls placed on the panel in the order they will normally be used?			
c	When controls are used in a fixed procedure, are they numbered to indicate?			
d	Are controls labeled with functional statements?			
e	Are control-position markings descriptive rather than coded or numbered?			
f	Are control scales fine enough to permit accurate setting?			
g	Except for detents or selector switches, do the controls have smooth, even resistance to movements?			
h	Are concentric knobs adequately coded to avoid confusion?			
i	Are adjustment controls easy to set and lock?			
j	Do all physical adjustment procedures provide visual, auditory, or tactical feedback?			
k	Are controls free of excessive backlash that could require needless readjustment?			
l	Are primary and emergency controls easily identifiable both visually and non-visually?			
m	Can controls be operated by personnel wearing arctic and NBC clothing?			
n	The method used to prevent accidental activation of the control, if any does not increase the time required to operate the control to such an extent that it is unacceptable.			
2	***Displays***			
a	When this equipment is placed in ways that it will typically be used, can the display be easily read?			
b	The information presented is necessary for the decisions or actions required of the operator.			
c	The information is presented in the most immediately meaningful form, i.e., no interpretation or decoding is required.			

TEST METHOD 109.1
TABLE IX. HFE checklists. - Continued.

Yes - Adequate No - Inadequate NA - Not Applicable

NO.	ITEMS	YES	NO	REMARKS
d	The information is displayed to the accuracy required by the decisions or actions of the operator.			
e	Are display scales limited to only that information needed to make decisions or to take some action?			
f	Information is current, that is, lag is minimized.			
g	Failure is clearly shown or the operator is otherwise warned.			
h	The contrast ratio and illumination of controls and/or displays are sufficient under all expected light conditions.			
i	A warning device is provided to indicate significant deviations from normal operating conditions.			
3	***Miscellaneous***			
a	Vibration and noise are kept below levels that might impair the efficiency of personnel.			
b	Visibility provides the maximum field of view possible in consonance with station, task requirement, and body conformation.			
c	Illumination of controls and displays is sufficient for the operators to carry out necessary tasks.			
d	Vibrations do not affect operator performance in reading dials and manipulating controls.			
e	No material within the operator's vision is capable of reflecting glare sufficiently to impair vision during day or night operation.			
	MAINTAINABILITY			
1	***Handles***			
a	When possible, handles are provided on covers, drawers, and components to facilitate handling.			
b	When handles cannot be provided, hoist and lift points are clearly marked.			
2	***Covers***			
a	Method of opening a cover is evident from the construction of the cover itself. If not, an instruction plate is permanently attached to the outside of the cover.			
b	Hinges are used where possible to reduce the number of fasteners required.			
c	When a hinged cover is used, a space equal to the swept volume of the cover is provided (e.g., opening of the cover is not obstructed by bulkheads, brackets, etc.).			

TEST METHOD 109.1
TABLE IX. HFE checklists. - Continued.

Yes - Adequate No - Inadequate NA - Not Applicable

NO.	ITEMS	YES	NO	REMARKS
d	Structural members, other components, etc. Do not interfere with removal of a cover.			
e	Is it evident when the cover is in place but not secured?			
f	If instructions applying to a covered APU are lettered on a hinged door, the lettering is properly oriented for reading when the door is open.			
g	A minimum number and type of fasteners are used, commensurate with requirements for stress, bonding, etc.			
h	When possible, the same size and type of fasteners are used for all covers, cases, and access doors.			
i	Captive nuts and bolts are used where feasible.			
3	***Location of Replaceable Components***			
a	Large components which are difficult to remove are mounted so that they do not prevent access to other components.			
b	Components are placed to allow sufficient space for use of test equipment and other required tools without difficulty or hazard.			
c	All throwaway components are accessible without removal of other components.			
d	Structural members of the frame do not prevent access to components.			
e	Delicate components are so located or guarded that they will not be damaged while the APU is being handled or worked on.			
f	Sensitive adjustments are so located or guarded that they cannot be accidentally disturbed.			
g	Internal controls are located at a safe distance from dangerous voltages or access to dangerous voltages is prevented by suitable barriers.			
4	***Conductors and Cables***			
a	Conductors are bound into cables and held by means of lacing twine or other acceptable means.			
b	Long conductors or cables, internal to equipment, are secured to the chassis by cable clamp.			
c	Cables are long enough so that each functioning component can be checked in a convenient place or, if this is not feasible, extension cables/devices are provided.			

TEST METHOD 109.1
TABLE IX. HFE checklists. - Continued.

Yes - Adequate **No - Inadequate** **NA - Not Applicable**

NO.	ITEMS	YES	NO	REMARKS
d	Cables are long enough to permit jockeying or movement of components when it is difficult to connect or disconnect other cables.			
e	Electrical cables are not routed below fluid lines.			
f	Cables are routed so they cannot be walked on or used for handholds.			
g	Cables are easily accessible for inspection and repair.			
h	Cables are so routed that they need not be bent or twisted sharply or repeatedly.			
i	Input and output cables, with the exception of test cables, do not terminate on a control-display panel.			
j	If test cables terminate on control-display panels test receptacles are located so that their associated cables do not interfere with controls and displays.			
5	***Connectors***			
a	One-turn or other quick-disconnect plugs are used.			
b	When dirt and moisture are a problem, plugs have an attached cover.			
c	Connectors are located far enough apart so that they can be grasped firmly for connection and disconnection.			
d	Plugs are designed so that it is impossible to insert the wrong plug in a receptacle.			
e	Socket rather than plug contacts are "hot".			
f	Test points to determine that a unit is malfunctioning are provided.			
g	Appropriate test provided when a component is not completely self-checking.			
6	***Fuses and Circuit Breakers***			
a	Fuses and circuit breakers are so located that they can be easily seen and quickly replaced or reactivated by personnel wearing clothing appropriate to environment of interest.			
b	No special tools are required for fuse replacement.			
7	***Tools***			
a	Variety of tools is held to a minimum.			
b	As few special tools as possible are required.			
c	Tools to be used near high voltage are adequately insulated.			
d	Metal handles are avoided on tools likely to be used in extreme cold or heat.			

TEST METHOD 109.1
TABLE IX. HFE checklists. - Continued.

Yes - Adequate No - Inadequate NA - Not Applicable

NO.	ITEMS	YES	NO	REMARKS
8	***Lubrication***			
a	Equipment containing mechanical components either has provision for lubrication without disassembly or does not require lubrication.			
b	When lubrication is required, the type of lubricant to be used and the frequency of lubrication is specified by a label at or near the lubrication point.			

TEST METHOD 109.1 - Continued.

TABLE X. Distribution of anthropometric measurement data by uniform type.

MEASUREMENT	5th Percentile				95th Percentile			
	Regular		Arctic		Regular		Arctic	
	cm	in.	cm	in.	cm	in.	cm	in.
Stature (nude)	163.8	64.5			186.0	73.2		
Functional reach	72.6	28.6	77.7	30.6	90.9	35.8	95.5	37.6
Sitting height, erect	85.1	33.5	87.9	34.6	97.0	38.2	101.5	40.0
Eye height, sitting	72.6	28.6	74.7	29.4	84.6	33.3	85.9	33.8
Knee height	49.8	19.6	56.4	22.2	58.7	23.1	64.0	25.2
Buttock-knee length	54.9	21.6	60.0	23.6	64.3	25.3	67.3	26.5
Shoulder breadth, sitting	41.4	16.3	47.5	18.7	49.8	19.6	55.9	22.0
Hip breadth, standing	30.7	12.1	41.1	16.2	38.4	15.1	48.8	19.2
Buttock-popliteal length	46.0	18.1	43.7	17.2	54.6	21.5	52.0	20.5
Hand length	17.5	66.9	20.8	8.2	20.6	8.1	23.9	9.4
Hand breadth	8.0	3.1	12.7	5.0	9.7	3.8	12.2	4.8
Palm length	9.5	3.7	10.4	4.1	11.7	4.6	12.4	4.9
Weight (kg)	57.3	---	---	---	91.6	---	---	---

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter must be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-DTL-53135(ME)	2. DOCUMENT DATE (YYMMDD) 960909

3. DOCUMENT TITLE
Auxiliary Power Unit, 10 KW, 120/240 VAC, 60 Hz

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7.DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME BELVOIR CECOM SOUTH	b. TELEPHONE (Include Area Code) (1) Commercial (703) 704-3468 (2) AUTOVON DSN 654-3468
c. ADDRESS (Include Zip Code) BELVOIR CECOM SOUTH 10115 GRIDLEY ROAD STE 228 ATTN: AMSEL-LC-IEW-D-ED Fort Belvoir VA 22060-5849	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340