

MIL-G-52732B
 27 September 1985
 SUPERSEDING
 MIL-G-52732A
 16 July 1979

MILITARY SPECIFICATION

GENERATOR SETS, GASOLINE ENGINE DRIVEN, 0.5KW THRU 10KW,
 60 HERTZ, 400 HERTZ AND 28 VOLT DIRECT CURRENT,
 TYPE I (TACTICAL), CLASS 2 (UTILITY)

GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for military design, gasoline-engine-driven (GED), tactical utility, generator sets (herein after referred to as "sets" or "set") from 0.5 kilowatt (kW) through 10 kW, 60 Hertz (Hz), 400 Hz, and 28 volt direct current (VDC). The general characteristics of the sets are described in MIL-STD-633 (see 6.3).

1.2 Classification. The sets shall be type I (tactical), class 2 (utility) and of the following modes and sizes in accordance with MIL-STD-1332, as specified (see 3.1 and 6.2):

Mode II	-	400 Hz
Mode III	-	60 Hz
Mode IV	-	Direct current (28 VDC)
Size 0.5	-	0.5kW
Size 1.5	-	1.5kW
Size 3	-	3kW
Size 5	-	5kW
Size 10	-	10kW

1.3 Voltage connections. Mode II and III sets shall provide output voltage connections as specified (see 3.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: USA Belvoir Research and Development Center, ATTN: STRBE-DS, Fort Belvoir, VA 22060-5606 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 6115

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

VV-G-1690 - Gasoline, Automotive, Leaded or Unleaded.

MILITARY

MIL-L-2104 - Lubrication Oil, Internal Combustion Engine, Tactical Service.
 MIL-L-21260 - Lubricating Oil, Internal Combustion Engine, Preservative and Break-In.
 MIL-G-28554 - Generator Sets, Mobile Electric Power, Packaging of.
 MIL-L-46167 - Lubricating Oil, Internal Combustion Engine, Arctic.

(See supplement 1 for list of applicable detail specifications.)

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
 MIL-STD-454 - Standard General Requirements for Electronic Equipment.
 MIL-STD-461 - Electromagnetic Interference Characteristics Requirements for Equipment.
 MIL-STD-462 - Electromagnetic Interference Characteristics, Measurement of.
 MIL-STD-705 - Generator Sets, Engine-Driven, Method of Tests and Instructions.
 MIL-STD-810 - Environmental Test Methods.
 MIL-STD-831 - Test Reports, Preparation of.

HANDBOOKS

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

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

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, (except for associated detail specifications, specifications sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3 REQUIREMENTS

3.1 Detail requirements for individual set modes and sizes. The individual set requirements shall be as specified herein and in accordance with the applicable detail specifications. In the event of any conflict between the requirements of this specification and the detail specifications, the latter shall govern.

3.1.1 Drawings. The drawings forming a part of this specification are end product drawings. No deviation from the prescribed dimensions or tolerances is permissible without prior approval of the contracting officer. Any data (e.g., shop drawings, layouts, flow sheets, processing procedures, etc.) prepared by the contractor or obtained from a vendor to support fabrication and manufacture of the production item shall be made available upon request, for inspection by the contracting officer or his designated representative.

3.2 First article. When specified (see 6.2), samples shall be subjected to the first article inspections. Sample size shall be as specified (see 6.6). Examinations and tests shall be conducted by the contractor subject to surveillance and approval by the Government.

3.3 Government performed first article tests. When specified (see 6.2), the Government will conduct any or all of the first article examination and tests.

3.4 Starting, operating, handling, and storage.

3.4.1 Starting and operating. The set shall start (see 6.4.1) and operate as follows.

3.4.1.1 Without winterization. The set shall start within five minutes:

- a. At ambient temperatures from +125° F (51.7° C) to -25° F (-31.7° C) at all possible relative humidity.
- b. With the base of the set in planes from level to 15 degrees from level.

3.4.1.2 With winterization. Operation of the set with winterization shall be as specified (see 3.1).

3.4.1.3 Operating. Immediately after starting, the set shall run for 15 minutes at no load (warmup period). At the end of this warmup period, the set shall operate as required herein for the duration of the tests without overhaul, replacement of parts, maintenance or servicing other than servicing, adjustment, and replacement of parts as specified (see 3.1).

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3.4.2 Operating speeds. Operating (rated) speed for the sets shall be 3,600 revolutions per minute (rpm) for the mode III and IV sets and 3,428 rpm for the mode II set. Sets shall be capable of operating at 110 percent of rated speed for a period of 10 minutes without damage at rated voltage.

3.4.3 Rough handling. The set shall not be damaged (see 6.4.2) by rough handling which could be encountered during rail, truck, aircraft, and helicopter transportation (see 4.8.4, 4.8.5, 4.8.6 and 4.8.7).

3.4.4 Storage temperature and humidity. The set shall not be damaged (see 6.4.3) by storage in temperatures from +160° F (+71.1° C) to -70° F (-56.7° C) at all possible relative humidity within that temperature range and shall not be damaged by exposure to five consecutive 48-hour cycles as specified in MIL-STD-705, method 711.1

3.5 Maximum power. The maximum power (corrected) in kW of the set shall be not less than the specified values (see 3.1), when operated at rated speed, rated voltage, and at unity power factor.

3.6 Engine.

3.6.1 Engine design. A military design engine will be furnished by the Government for each set (see 6.5), as specified (see 3.1).

3.6.2 Engine temperature. Engine stabilized operating temperatures, at rated load and normal ambient conditions (see 6.4.7) shall not exceed the values specified (see 3.1).

3.6.3 Lubricants. Lubricants in accordance with the following specifications and conditions shall be used:

<u>Specification</u>	<u>Grade</u>	<u>Temperature</u>
MIL-L-2104	30	above 32° F
MIL-L-2104	10	-10° F to +32° F
MIL-L-46167	-	below -10° F

3.6.4 Governing system. After the set has been stabilized in accordance with the applicable test method, the governing system shall perform as specified herein.

3.6.4.1 Frequency or speed regulation. The frequency or speed regulation (see 6.4.4) shall not exceed 3 percent with the frequency or speed adjustment constant.

3.6.4.2 Short-term steady-state stability (30 seconds), mode II and III sets. The governing system shall automatically maintain the short-term, steady-state frequency of the set within the specified bandwidth percentages (see 3.1), at constant loads from no load to rated load (see 6.4.5) during any 30-second period of operation, when measured with the recording instrument specified in 4.8.1 and analyzed as specified in MIL-STD-705, method 608.1.

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3.6.4.3 Long-term, steady-state stability (4 hours), mode II and III sets. The governing system shall automatically maintain the long-term, steady-state frequency within the specified bandwidth percentages (see 3.1), at constant loads from no load to rated load during any 4 hour period of continuous operation at constant barometric pressure and temperature, when measured with the recording instrument specified in 4.8.1 and analyzed as specified in MIL-STD-705, method 608.2

3.6.4.4 Transient performance, mode II and III sets. Following any sudden increase in load, including from no load to rated load, the governing system shall reestablish stable engine operating conditions (see 6.4.6) within 4 seconds, and the maximum transient frequency change below the new steady-state frequency (undershoot) shall be not 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 operation conditions within 6 seconds, and the maximum transient frequency change above the new steady-state frequency (overshoot) shall be not more than 5 percent of rated frequency. The set shall meet these requirements when measured with the recording instrument specified in 4.8.1 and analyzed as specified in MIL-STD-705, method 608.1.

3.7 Generator.

3.7.1 Generator rotor. The rotor shall be in electrical and mechanical balance at all speeds up to 125 percent of rated speed and shall withstand operation at 125 percent of rated speed, without damage, for not less than 15 minutes.

3.7.2 Temperature rise. The maximum temperature rise with the set delivering rated load continuously shall be not more than 75° C (135° F) for the stator windings when measured by the rise in resistance method.

3.7.3 Dielectric strength. Electric windings shall withstand the following 60 Hz voltage applied for 1 minute:

- a. Generator armature: 1480 V between phase windings, and 1240 V between phase windings and ground.
- b. Generator field and exciter windings: Ten times ceiling voltage but not less than 1500 V nor more than 3500 V applied between the winding and ground.
- c. Windings energized by the 28 V dc control, cranking and battery charging system: 500 V (applied between the winding and ground).
- d. All others: Twice rated voltage plus 1000 V (applied between the windings and ground or between windings, as applicable).

3.7.4 Short circuit. The generator, exciter and voltage regulator, operating as a unit, shall withstand 10 consecutive and instantaneous 10-second line-to-line short circuits at the generator output terminals when operating at rated load and frequency without reduction of dielectric strength to a point where it will not meet the requirements of 3.7.3. Mode II and III sets shall be connected for single phase, 120 volt output. All sets shall be operating at rated load when the short circuits are applied. Sixty seconds of operation at rated load is necessary between short circuit applications.

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3.7.5 Winding resistance. The winding resistance of each winding shall not differ by more than 10 percent from the resistance specified on the applicable drawing. All resistance values shall be corrected to a temperature of 77° F (25° C).

3.7.6 Voltage unbalance, mode II and III sets. The variation between line-to-line voltages shall not exceed the specified percentage of rated voltage (see 3.1) for the 3-phase, 120/208-volt connection under the condition of a single-phase, line-to-line, unity Pf load (resistive) of 25 percent of rated current and no other load on the generator.

3.7.7 Phase balance (voltage) mode II and III sets. When the generator is connected for 3-phase, 120/208-volt output, the maximum difference in the line-to-line and line-to-neutral voltages under open circuit at rated voltage and speed shall not exceed the specified percentage of the respective rated line-to-line or line-to-neutral voltage (see 3.1).

3.7.8 Voltage waveform, mode II and III sets. The deviation factor and single frequency harmonics shall not exceed the specified percentage values (see 3.1). These waveform requirements shall be met for all line-to-line and line-to-neutral voltages with the generator under control of the excitation system, operating at rated voltage and rated speed, and at normal ambient conditions, except as otherwise specified (see 3.1).

3.7.9 Output voltage ripple, mode IV sets. The output voltage ripple shall not exceed the specified value (see 3.1).

3.7.10 Saturation curves. With the generator temperature stabilized at normal ambient conditions, the exciter field current for rated voltage shall not exceed the specified ampere values (see 3.1).

3.7.11 Voltage adjustment range. The minimum set voltage adjustment range shall be as specified (see 3.1). This voltage adjustment range shall apply for all loads between no load and rated kW, rated power factor and rated frequency (speed), under all temperature conditions as specified in 3.4.1, except as otherwise specified (see 3.1).

3.7.12 Voltage performance. The set shall meet all the voltage requirements specified with the speed or frequency regulation of the set adjusted to not more than 3 percent. The generator together with the excitation system shall automatically keep the voltage within the specified band under the specified conditions of load, speed, and voltage operating range, when measured with true root-mean square (rms) sensing and indicating meters.

3.7.12.1 Voltage regulation. The voltage regulation from no-load to rated load and from rated load to no-load shall not exceed the specified percentage of rated voltage (see 3.1). The voltage regulation requirements apply for all the voltage adjustment conditions (see 3.7.11). For mode II and III sets an additional 1 percent voltage regulation shall be allowed for the 240 volt, single phase or 120/240 volt, single phase connections, as applicable.

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3.7.12.2 Voltage steady-state performance. At constant loads from no-load to rated load, the voltage at the set terminals shall remain within the specified bandwidth (see 3.1), when measured with the recording instrument specified in 4.8.1 and analyzed as specified in MIL-STD-705, method 608.1.

3.7.12.3 Voltage transient performance. Performance of the set under transient conditions (as measured by a magnetic oscillograph having a no-load voltage deflection of not less than 3-1/2 inches) shall be as follows: with the set initially operating at rated frequency and rated voltage and following any sudden change in load from no-load to rated load, the instantaneous voltage shall not dip more than the specified percentage of rated voltage (see 3.1), and shall reach stable conditions (see 6.4.8) within 2 seconds. 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 the specified percentage of rated voltage (see 3.1).

3.7.13 Phase sequence (rotation), mode II and III sets. Phase rotation shall be L_1 , L_2 , and L_3 .

3.7.14 Generator efficiency. The generator, including the excitation system, shall have a minimum efficiency (see 6.4.9) at normal ambient temperatures as specified (see 3.1).

3.8 Circuit interrupter. The circuit interrupter shall be as specified (see 3.1).

3.9 Instruments. The allowable inaccuracy or error (see 6.4.11) of each metering system including the electrical circuit, under all conditions specified in 3.4.1, shall be as specified (see 3.1).

3.10 Electromagnetic interference. The electromagnetic emission characteristics of the set shall meet the limits of CE04 and RE02 of Notices 5 and 6, class V, to MIL-STD-461 at rated load and no load.

3.11 Workmanship. Workmanship shall be in accordance with MIL-STD-454, requirement 9. In addition, workmanship shall be of a quality to assure delivery of sets which are free from defects resulting from defective material and incorrect manufacturing or assembly practices. Defective components or parts and assemblies which have been repaired or modified to overcome deficiencies shall not be furnished.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for performance of the inspection requirements specified herein unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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4.1.1 Components and material inspection. The contractor is responsible for insuring that components and material used are manufactured, examined, and tested in accordance with referenced specifications, standards, and drawings, as applicable.

4.1.2 Parts and components. Parts and components detailed on the drawings shall be inspected in accordance with the quality assurance provisions (QAP) shown on the drawings. The drawings specify the characteristics requiring QAP inspection, the sampling plan, and the basis for acceptance and rejection (see 6.4.12 and 6.7).

4.1.3 Disassembly inspection. Failure of any examination or test by the preproduction model shall be cause for disassembly, in the presence of a Government representative, of the preproduction model to the extent necessary to determine the cause of the failure. Each disassembled part shall be examined (see 6.4.10) in detail for compliance with this specification and referenced drawings in regard to materials, dimensions, tolerances, and workmanship. Parts not complying with such requirements shall be rejected and shall be cause for rejection of the preproduction model. Reassembly with replacement parts and retesting shall be the responsibility of the contractor.

4.2 Classification of inspections. The inspection requirements are classified as follows:

- a. First article inspection (see 4.3).
- b. Individual generator inspection (see 4.4.1).
- c. Individual set inspection (see 4.4.2).
- d. Initial production inspection (see 4.5).
- e. Quality conformance inspection (see 4.6).
- f. Inspection comparison (see 4.9).
- g. Inspection of packaging (see 4.10).

4.3 First article inspection.

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

4.3.2 Examination of generator, control box, and sets. Examination of the generator with control box and the two sets shall be made without disassembly. Evidence that the generator, control box, or sets do not comply with the drawings shall be cause for rejection of the generator control box or sets.

4.3.3 Tests. The generator, generator with control box assembly, and the sets shall be subjected to the applicable tests marked "X" in column 2 of table I at the contractor's expense. Failure of any test shall be cause for performing the inspection specified in 4.1.3. When required by the contracting officer, the sets shall also be subject to the optional tests in table II.

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4.3.4 Inspection report. The contractor shall furnish, within the time interval specified (see 6.2), an inspection report in accordance with MIL-STD-831 covering first article inspection. The inspection report shall also include the following:

- a. All test data obtained from applicable tests.
- b. Description of malfunctions, damages, failures, and adjustments (other than adjustments permitted by this specification) which occur during inspection.
- c. Causes and analysis of malfunctions, damages, or failures, and reasons for adjustments.
- d. Corrective actions taken or required.

4.4 Individual generator and individual set inspection.

4.4.1 Individual generator inspection. Inspection shall be performed prior to assembly into a set.

4.4.1.1 Examination. Each generator shall be examined without disassembly for conformance to the drawings. Evidence that the generator does not conform to the drawings shall be cause for rejection.

4.4.1.2 Tests. Before final assembly of the generator, each generator shall be subjected to the first two tests marked "X" in column 1 of table I. Failure of either test shall be cause for rejection.

4.4.2 Individual set inspection.

4.4.2.1 Examination. Each set shall be examined without disassembly for conformance to the drawings. Evidence that the set does not conform to the drawings shall be cause for rejection.

4.4.2.2 Tests. Each set shall be subjected to the applicable tests marked "X" under column 1 of table I. Failure of any test shall be cause for rejection.

4.5 Initial production inspection. When specified, one or more initial production sets will be selected at random by the Government from sets being produced from production tooling and will be subjected to the tests marked "X" in column 3 of table I, to determine conformance to the requirements of the specification. These sets shall have successfully passed the examination and tests specified in 4.4. The inspection will be performed by the Government at a site selected by the Government, utilizing the appropriate technical manual for maintenance and servicing and procedures. Acceptance of an initial production set shall not exclude the remaining sets from the quality conformance inspection and acceptance provisions specified in section 4. In addition to any test specified as part of the initial production test, the Government reserves the right to conduct any and all other tests contained in the specification as part of the initial production test and failure of such additional tests shall have the same effect as failure of those tests specified as initial production tests.

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4.5.1 Inspection failure. Should the Government elect to perform or repeat any inspection or test in this specification, failure of a set to meet any requirement specified herein shall be cause for refusal by the Government to accept production sets 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 any sets previously produced and accepted under the contract. Any deficiencies found as the result of such elective inspection or test will be considered prima facie evidence that all sets accepted prior to the completion of such inspection or test are similarly deficient unless evidence to the contrary is furnished by the contractor and such evidence is acceptable to the contracting officer. The provisions of this paragraph apply, notwithstanding any prior acceptance of first articles or first article test reports. In addition to any test specified as part of the initial production test, the Government reserves the right to conduct any and all tests contained in this specification as part of the initial production test and failure of such additional tests shall have the same effect as failure of those tests specified as initial production tests.

4.6 Quality conformance inspection.

4.6.1 Generator with control box assemblies. Lots shall be formed from generators which have successfully passed the inspection specified in 4.4.1 and control boxes that have successfully passed the inspection specified in 4.1.1. Sampling for tests shall be in accordance with MIL-STD-105, inspection level S-2. AQL shall be 6.5 percent defective.

4.6.2 Sets. This inspection will be performed on a reducing or regressive basis on production increments of 25 units according to the following plan from sets which have successfully passed the inspection in 4.4:

First	25 sets	1 sample
Next	50 sets	1 sample
Next	75 sets	1 sample
Next	100 sets	1 sample
Next	125 sets	1 sample
Next	150 sets	1 sample
Next	175 sets	1 sample
Each successive 250 sets for the remainder of contract quantity.		1 sample

4.6.2.1 Implementation.

4.6.2.1.1 Step 1. The Government shall select a sample at random from the first production increment of 25 generator sets produced. The contractor shall conduct required tests on the selected sample set.

- a. If acceptable, the contractor will hold the 25 sets toward accumulation of 75 uncrated sets.

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- b. In the event of a failure, the Government may reject the sample test. In such an event, the contractor shall furnish objective evidence that corrective action has been taken to eliminate the condition which caused the rejection. The rejected increment shall be screened for like conditions and the rejected increment resubmitted for random selection of another sample for tests. Resubmitted increments passing the required tests may be offered for acceptance.

4.6.2.1.2 Step 2. If the first sample is rejected, the Government shall select a sample set from the next production increment of 25 and the contractor shall repeat step 1. This procedure shall be repeated until a sample representing an increment of 25 is accepted on initial submission, then the contractor shall progress to an increment of 50 each, testing one randomly selected set.

- a. If acceptable, the Government will authorize release of 75 uncrated sets.
- b. If rejected by the Government, the contractor shall screen inspection increments of 25 and 50 units and furnish objective evidence of corrective action, and resubmit increments for tests.

Resubmitted increments passing the required tests may be offered for acceptance. Whether resubmitted increments are accepted or rejected by the Government, the contractor shall revert to step 1 and start accumulation of 75 sets.

4.6.2.1.3 Step 3. Once the accumulation of consecutive increments of 25 and 50 units have passed the required tests on initial submission without failure of the basis of sampling, the contractor shall proceed into the reducing or regressive phase of the plan in which "Moving Lots" (increments) apply as defined in 4.6.2.1.4.

4.6.2.1.4 Moving inspection increment. Units of production shall be continuously offered for inspection in the order produced or received. The beginning and end of the lot shall be identified against time, or a specific quantity of items. If, however, a sample set representing an increment is rejected, the contractor shall return immediately to step 1 and accumulation of 75 sets shall be a prerequisite before the contractor may proceed into the reducing or regressive phase of the sampling plan. All units produced as part of the production increment represented by the rejected sample on hand in the contractor's plant shall be inspected for like defects.

4.6.3 Tests. Samples selected in accordance with 4.6.1 and 4.6.2 shall be subjected to the tests marked "X" in column 4 of table 1 as applicable. For initial starting of the high temperature test, the set shall be operated from the set fuel tank until the fuel supply runs low. The fuel selector valve shall then be switched to an auxiliary fuel supply in the temperature chamber for the duration of the test. All other set tests may be performed utilizing either fuel position.

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4.7 Test schedule.

4.7.1 Table I, required tests. The test schedule shall be as shown in table I. Nonconformance to the applicable requirement paragraph shown in column 7 of table I shall constitute failure of this test and rejection of the generator, the generator with assembled control cabinet, or the set, 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 and table I shall apply to all tests performed as parts of another test.

TABLE I. Test schedule.

Indiv.	First art. (pre-prod.)	Init. prod.	Qual conf.	Test	Test Method MIL-STD-705 test paragraph or as required below	Requirement para.
1	2	3	4	5	6	7
X	-	-	-	<u>Generators only</u> Winding resistance	401.1 (Use Kelvin and Wheatstone bridge method. Measure all windings before installation of rectifiers.)	3.7.5
X	-	-	-	High potential	302.1 (Test each winding before installation of rectifiers.)	3.7.3
-	X	-	X	<u>Generator with Assembled Control Cabinet</u> Overspeed (generator)	505.3	3.7.1
-	X	-	X	Generator power input	415.1	3.7.14
-	X	-	X	Voltage dip and rise for rated load	619.2	3.7.12.3
-	X	-	X	Open-circuit saturation curve	410.1 (One point at rated voltage)	3.7.10

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TABLE I. Test schedule. (Continued).

Indiv.	First art. (pre-prod.)	Init. prod.	Qual conf.	Test	Test Method MIL-STD-705 test paragraph or as required below	Requirement para.
1	2	3	4	5	6	7
-	X	-	X	Rated-load-saturation curve	413.1 (One point at rated voltage)	3.7.10
-	X	-	X	Short circuit (mechanical strength)	625.1	3.7.4
-	X	-	X	Ripple voltage	650.1 (mode IV sets only)	3.1 and 3.7.9
-	X	-	X	Voltage waveform (harmonic analysis)	601.4 and 4.8.3 (Mode II and III sets only)	3.7.8
-	X	-	X	Voltage unbalance with unbalanced load	620.2 (Mode II and III sets only, 120/208 volt, 3 phase)	3.1 and 3.7.6
-	X	X	-	<u>Generator Set</u> Drop test (free fall)	740.2 and 4.8.4	3.4.3
-	X	X	-	Drop test (ends)	740.3 and 4.8.6	3.4.3
-	X	X	-	Railroad impact test	740.5 and 4.8.7	3.4.3
-	X	X	-	Humidity	711.1 (Measure insulation resistance of stator windings only)	3.4.4
X	X	-	-	Frequency and voltage regulation, stability and transient response (short term)	608.1 (1-1/2 hours operation at rated load will be considered as stabilizing the set)	3.6.4 and 3.7.12
-	X	-	-	Maximum power	640.1	3.5
X	-	-	-	Maximum power	640.4	3.5
X	X	-	-	Start and stop	503.2 (size 5 and 10 sets only) (omit step (d) of procedure)	3.1 and 3.4.1

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TABLE I. Test schedule. (Continued).

Indiv.	First art. (pre-prod.)	Init. prod.	Qual conf.	Test	Test Method MIL-STD-705 test paragraph or as required below	Requirement para.
1	2	3	4	5	6	7
-	X	-	X	High temperature	710.1 and 4.8.9 (at 125° F (51.7° C))	3.4.1, 3.7.2, and 3.8
-	X	-	X	Phase balance	508.1 (mode II and III sets only @ 120/208 volt 3 phase)	3.1 and 3.7.7
X	X	-	-	Phase sequence	507.1 (mode II and III sets only, 120/208 volt 3 phase and 120 volt 3 phase)	3.1 and 3.7.13
X	X	-	-	Overspeed	505.1	3.4.2
X	X	-	-	Indicating instrument	513.1 and 4.8.9	3.9 and 3.7.11
-	X	X	-	Endurance run	690.1, omit 690.1.3.2.3 (b), (c) of post endurance (500 hrs for initial production; 250 hrs for preproduction)	3.4.1
-	-	-	X	Endurance run	690.1, omit 690.1.3.2.3 (b), (c) of post endurance (50 hrs at rated load)	3.4.1

4.7.2 Table II. The optional tests shall be as shown in table II. These tests shall be performed when required by the contracting officer to prove suitability and set compliance as a result of any changes in parts or material. Nonconformance to the applicable requirement paragraph shown in column 7 of table II shall constitute failure of these tests. 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 and table I shall apply to all tests performed as a part of another test.

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Table II. Optional tests.

Indiv.	First art. (pre-prod.)	Init. prod.	Qual conf.	Test	Test Method MIL-STD-705 test paragraph	Requirement para.
1	2	3	4	5	6	7
-	X	X	-	Vibration test	4.8.5	3.4.3
-	X	X	-	Electromagnetic interference	4.8.8	3.10

4.8 Tests.

4.8.1 Test procedures. Tests shall be conducted in accordance with MIL-STD-705, measurements and instrumentations in accordance with MIL-HDBK-705 and as specified herein. During tests, operating instructions shall be explicitly followed for the test conditions specified. New lubricants as specified (see 3.6.3), shall be used during all tests, except that the lubricant used during the individual tests (see 4.4) and the quality conformance tests (see 4.6) shall conform to MJL-L-21260, grade 2, and shall remain in the crankcase during engine preservation (see 5.1). Fuel conforming to VV-G-1690, regular grade, class A shall be used for all tests. Test instruments shall have been calibrated within 30 days prior to the start of testing and at intervals not greater than 6 months thereafter. Direct-reading instruments shall have at least 0.5 percent instrument manufacturer's rated accuracy. The recording meters shall be the combination frequency and voltmeter Texas Instrument (TI) Model PDRHXF HXVA-A16-XT in accordance with TI drawing number 162782 for mode II and III sets and dc voltmeter Texas Instruments, model PRRHX-A16-AT in accordance with TI drawing number 164117 for mode IV sets. The Gould Voltage/Frequency Recorder model 2108-2202-005542 may be used for the 1.5 kW mode III (60 Hz) and 3 kW mode III (60 Hz) generator sets. Oscillograph galvanometer frequency response shall be flat (+5 percent) to 3,000 cps. When recording meters are specified for any part of a test, turn on the recording meters prior to starting the warmup period of the set and record continuously for the duration of the test. The recording meters shall be operated at a minimum speed of 6 inches per hour during the portions of the test where steady-state loading conditions exist and shall be operated at a minimum speed of 6 inches per minute at least 30 seconds before, during, and after a load change. Unless otherwise specified herein, mode II and III sets shall be tested in the 120-volt single phase connection. Tests may be performed in any order except that the endurance test shall be performed last.

4.8.2 Engine preventative maintenance services. Preventative maintenance services for the engine shall be performed within the service periods as specified (see 3.1). During the initial 50 hours of running time, the speed of the engine shall not exceed 110 percent of rated speed; and thereafter, the speed shall not exceed 125 percent of rated speed.

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4.8.3 Voltage waveform. On preproduction sets, measure all line-to-line and line-to-neutral voltage harmonics at each voltage connection for no-load, rated load and rated kW at 1.0 power factor. On quality conformance sets, measure only the voltage harmonic at the condition which yielded the greatest harmonic during the preproduction set test.

4.8.4 Drop (free fall). The set shall be dropped three times to land flat in its normal operating position. The height of the drop (in inches) shall be as specified (see 3.1).

4.8.5 Vibration. The set shall be tested in accordance with method 514 of MIL-STD-810 with the following exceptions:

Curve:

Frequency (Hz)	Input to Set
7 to 26.6	1.3 g
26.6 to 52	0.036-inch D.A.
52 to 500	5 g

Resonance: A resonance search shall be conducted in each axis of the set with the vibration inputs as delineated above. Resonant points shall be noted visually, with the aid of a stroboscopic light, and by instrumentation with data being recorded at least every hertz from 7 to 30 hertz and at least every 5 hertz from 30 to 500 hertz to indicate the ratio of transmitted g to excitation g. Input vibration levels shall be measured by means of an accelerometer mounted as near as practicable to the center of the vibration table. Another accelerometer shall be located at the tapped hole for the generator set lifting eye, or as specified (see 3.1). The output of the two accelerometers shall be used to compute transmissibility. The resonance dwell portion of this test shall be 30 minutes per axis with the time equally divided between a maximum of three resonant frequencies. The frequency at which the resonance was originally detected shall be maintained throughout each resonance dwell. Additional requirements shall be specified (see 3.1). All bolts and screws shall be tightened as necessary before vibration in each axis or whenever relative vibration between parts increases as a result of their loosening.

Cycling: The generator set shall be subjected to a cycling vibration test with the frequency being varied at a logarithmic rate from 7 to 500 to 7 hertz in fifteen minutes at the inputs specified above. The test shall be conducted a sufficient number of times to obtain a total of one hour of vibration (resonance search, dwell, cycling) in each axis.

Operation: The generator set shall not be operated during the vibration tests. Following each axis of vibration, test method 614.1 of MIL-STD-705 shall be performed after 15 minutes stabilization at rated load, rated pf.

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4.8.6 Drop (ends). The set shall be dropped from a height of 6 inches.

4.8.7 Railroad impact. Perform method 740.5 of MIL-STD-705 with the sets positioned 180 degrees with respect to each other for a total of four impacts at 10 miles per hour (± 0.5 mph). Two impacts shall be made with sets positioned longitudinally with respect to the axis of the car and two impacts with the sets rotated 90 degrees from the longitudinal position. The sets shall not be packaged for the railroad hump tests except as otherwise specified (see 3.1). Impact speed shall be measured within 60 inches of impact and the speed measurement interval shall not exceed 60 inches in length. Accuracy of the speed measurement shall be ± 5 percent. The engine oil shall be at its normal operating level, the fuel tank shall be drained and dummy or dry batteries shall be used during the impact portion of the test.

4.8.8 Electromagnetic interference. For conducted and radiated emissions, the set shall be evaluated using test method CE04 (conducted emissions, 50 k Hz to 50 M Hz, power leads) and RE02 (radiated emissions, electric field) of notice 3 to MIL-STD-462. Test method CE04 shall be performed over the range of 20 K Hz to 50 M Hz. Tests shall be performed at rated load and no load.

4.8.9 Instrument. The instrument readings need only be recorded at no-load, 50 percent and 100 percent of rated load. On the preproduction sets, the instrument test (including method 511.1) shall be performed at all voltage connections.

4.9 Inspection comparison. The Government may select sets or components at any time during the contract production period and subject these sets or components to to any examination and test necessary to determine that the selected sets or components meet all requirements in section 3. The inspection will be performed by the Government at a site selected by the Government. Sets or components will be selected at random from those which have been accepted by the Government and will not include the previously inspected preproduction models and initial production sets or components. Acceptance of an inspection comparison component or set shall not exclude the remaining sets from the quality conformance inspection and acceptance provisions specified in section 4.

4.9.1 Inspection failure. Failure of an inspection comparison component or set to meet any requirement specified herein during and as a result of the examination and tests specified in 4.9 shall be cause for rejection of the inspection component or set and shall be cause for refusal by the Government to continue acceptance of production sets 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 sets previously accepted and produced under the contract. Any deficiencies found as a result of the inspection comparison will be considered prima facie evidence that all sets accepted prior to the completion of the inspection comparison are similarly deficient unless evidence to the contrary is furnished by the contractor and such evidence is acceptable to the contracting officer. In addition to any test specified as part of the inspection comparison, the Government reserves the right to conduct any and all other tests contained in this specification as part of the inspection comparison and failure of such additional tests shall have the same effect as failure of those tests specified as inspection comparison.

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4.10 Inspection of packaging. Preservation, packing and marking shall be examined and tested in accordance with the quality assurance provisions of MIL-G-28554.

5. PACKAGING

5.1 Preservation, packing and marking. The preservation, packing, and marking of the generator sets shall be in accordance with MIL-G-28554. The degree of preservation and degree of packing shall be level A, B, or C as specified (see 6.2).

6. NOTES

6.1 Intended use. The sets are intended to supply power for general purpose use in military field applications.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number, and date of this specification, and of the applicable detail specification (see 3.1).
- b. Mode and size required (see 1.2).
- c. Whether first article/preproduction inspection is required and number of sets to be furnished (see 3.2).
- d. Whether the Government will conduct any or all of the first article examination and tests. When the Government will conduct some but not all of the first article 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 3.3).
- e. Whether first article/initial production inspection is required and number of sets to be furnished (see 3.2).
- f. Time interval for submission of first article test reports (see 4.3.4).
- g. Degree of preservation and degree of packing required (see 5.1).

6.3 Design. These sets were designed to start and operate and meet all performance requirements without winterization.

- a. At 8,000 feet above sea level (564.9 mm Hg) at an ambient temperature of +95° F (35° C).
- b. With 3 inches of rain per hour impinging on the set at angles from vertical up to 15 degrees from the vertical in all directions.

In addition, this design permits storage at temperatures to -70° F (-56.7° C).

6.4 Definitions.

6.4.1 Start. A set is considered to have started when it is maintaining rated voltage and rated speed without the use of starting aids.

6.4.2 Rough handling damage. Rough handling damage is defined as any condition resulting in malfunctioning of the set, deformation, loosening, breakage, or change of fit of any component or part.

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6.4.3 Temperature and humidity damage. Temperature and humidity damage is defined as corrosion, breakage, deformation, reduction of insulation resistance below one megohm, or conditions causing malfunction of any component or part.

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

6.4.5 Rated load. Rated load is rated kW at rated power factor, rated frequency (speed) and rated voltage.

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

6.4.7 Normal ambient conditions. Normal ambient conditions are considered to be at sea level with the ambient temperature between 60° F (15.6° C) and 85° F (29.4° C).

6.4.8 Stable operation (voltage). Stable operation (voltage) is operation within the specified bandwidth of rated voltage (see 3.1).

6.4.9 Generator efficiency. Generator efficiency is defined as output load multiplied by 100 divided by the generator input power required for that load.

6.4.10 Examination. Examination is defined as an element of inspection that includes chemical, physical and dimensional checks on the complete item including components and subassemblies and visual and tactile investigations.

6.4.11 Meter accuracy. Inaccuracy is a number 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 the indication of the meter is greater than the true value.

6.4.12 Quality assurance provisions (QAP). A QAP is a contractual requirement that supplements section 4 of the specification. QAP indicates the minimum requirements which must be inspected on the product drawings to verify the design objectives of the product and assure interchangeability of repair parts.

6.5 Government-furnished property. The contracting officer should arrange to furnish the property specified in 3.6.1. Information and installation instructions regarding the engine should be furnished by the contracting officer.

6.6 First article. First article is required and shall consist of a preproduction (see 4.3) inspection and an initial production (see 4.5) inspection. The contracting officer shall include specific instructions in acquisition documents regarding arrangements for inspections (examination and test), approval of the first article test results and disposition of the first article report and samples.

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6.6.1 First article/preproduction model. When specified (see 6.2) the first article preproduction model shall consist of one generator and control box assembly and two complete assembled sets.

6.6.1.1 Preproduction model. Any changes or deviations of production sets from the approved preproduction models during production shall be subject to the approval of the contracting officer. Approval of the preproduction models will not relieve the contractor of his obligation to furnish sets conforming to this specification.

6.6.2 First article/initial production model. When specified (see 6.2) the first article initial production model shall consist of one or more sets (see 4.5).

6.7 Quality assurance provisions (QAP) records. The contracting officer should require the contractor to maintain records of all QAP inspections. A suggested paragraph is as follows:

"The contractor shall maintain complete records of all examinations and tests performed to verify the requirements of classified QAP characteristics. The records shall include, as a minimum, lot size, sample size, drawing requirements, actual measurements, number and type of deficiencies found, quantity approved, quantity rejected, and corrective action taken when applicable."

6.8 International standardization. International standardization limitations shall be as specified on applicable specification sheets.

6.9 Normal railroad transportation. Normal railroad transportation shall be interpreted to mean humping speed up to and including 10 miles per hour under the test conditions specified in 4.8.7.

6.10 Normal aircraft or helicopter transportation. Normal aircraft or helicopter transportation is defined as the conditions encountered during free fall drop and the 6-inches end drop under the test conditions specified in MIL-STD-705, methods 740.2 and 740.3 respectively.

6.11 Data requirements. The contracting officer should include requirements for such data as technical publications, instructional materials, illustrated parts lists, and contractor's maintenance and operation manual to be furnished with each generator set.

6.12 Provisioning. It is encouraged that recycled material be used when practical provided the material meets the requirements of the specification and all associated drawings.

Custodians:
 Army - ME
 Air Force - 99
 Navy - YD

Preparing activity:
 Army - ME

Project 6115-0236

Review activities:
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 Air Force - 80
 DLA - GS

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