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MILITARY SPECIFICATION

GENERATOR SETS, DIESEL ENGINE, ALTERNATING CURRENT, FOR FACILITIES CONSTRUCTION: 10 KW THROUGH 1000 KW (NOT STOCKED)

This specification is approved for use by the Naval Facilities Engineering Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for diesel-engine-driven, alternating current (ac), electric generator sets to be used in military construction projects, and for the replacement of generator sets in existing installations which are used to supply, standby, or prime power service. The generator sets are not intended to be stocked or supported from stock in the supply system.

* 1.2 Classification. The generator sets shall be of the following types styles, classes, voltage ratings, and sizes, as specified (see 6.2):

Type I - Standby power - 10 to 1000 kilowatts (kw), (see 6.4.1).
Type II - Prime power - 100 to 1000 kw, (see 6.4.2).

Style A - Self-contained generator set (see 6.4.3).
Style B - Fixed installation generator set (see 6.4.4).

Class 1 - Single set operation.
Class 2 - Parallel operation.

Voltage rating:

120 volts (V), single phase, 2 wire, 1.0 power factor (pf), 60 Hertz (Hz).
120/240 V, single phase, 3 wire, 1.0 pf, 60 Hz.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer (Code 156), Naval Construction Battalion Center, Port Hueneme, CA 93043, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 6115

120/208 V, 3 phase, 4 wire, 0.8 pf, 60 Hz.
139/240 V, 3 phase, 4 wire, 0.8 pf, 60 Hz.
240 V, 3 phase, 3 wire, 0.8 pf, 60 Hz.
277/480 V, 3 phase, 4 wire, 0.8 pf, 60 Hz.
480 V, 3 phase, 3 wire, 0.8 pf, 60 Hz.

Size:

Standard commercial ratings, in kw of useable net output at rated pf, frequency, and voltage from 10 kw to 1000 kw, inclusive.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

W-B-131 - Battery, Storage: Vehicular, Ignition, Lighting, and Starting.
VV-F-800 - Fuel Oil, Diesel.

MILITARY

MIL-V-173 - Varnish, Moisture and Fungus Resistant (For Treatment of Communications, Electronic, and Associated Equipment).
MIL-L-2104 - Lubricating Oil, Internal Combustion Engine, Tactical Service.
MIL-G-28554 - Generator Sets, Mobile Electric Power and Supplemental Equipment; Packaging of.

STANDARDS

FEDERAL

FED-STD-H28 - Screw-Thread Standards for Federal Services.

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

* 2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

C37.13 - Low Voltage AC Power Circuit Breakers Used in Enclosures.
C39.1 - Requirements for Electrical Indicating Instruments.
C50.10 - General Requirements for Synchronous Machines.
C50.12 - Requirements for Salient Pole Synchronous Generators and Generator/Motors for Hydraulic Turbine Applications.
C57.13 - Requirements for Instrument Transformers.

(Application for copies should be addresssed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

Boiler and Pressure Vessel Code, Section VIII
Pressure Vessels, Division I.
PTC 26 - Performance Test Codes, Speed Governing Systems for Internal Combustion Engine-Generator Units.

(Application for copies should be addressed to the American Socie.v of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.)

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

115 - Test Procedures for Synchronous Machines.
126 - Recommended Specification for Speed Governing of Internal Combustion Engine-Generator Units.
C50.5 - General Requirements for Synchronous Motors.

(Application for copies should be addressed to the Institute of Electrical and Electronic Engineers, Inc., 345 East 47th Street, New York, NY 10017.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

AB 1 Molded Case Circuit Breakers.
ICS 1 General Standards for Industrial Controls and Systems
ICS 2 Industrial Control Devices, Controllers and Assemblies
ICS 6 Enclosures for Industrial Controls and Systems
MG 1 Motors and Generators

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

No. 30 - Flammable and Combustible Liquid Codes.
No. 70 - National Electrical Code.

(Application for copies should be addressed to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE Handbook.

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

UNDERWRITERS LABORATORIES INC. (UL)

UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids.
UL 1236 - Electric Battery Charger.

(Application for copies should be addressed to the Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

* 3.1 Description. Each generator set shall be a diesel engine-generator assembly mounted on a formed flat steel or a structural steel subbase, with auxiliaries, accessories, and controls as required for operation as specified. Type I (standby-power) generator sets (see 6.4.1), shall have adequate capacity to deliver rated net output kw for the duration of the outage. The standby power generator sets shall operate as much as 1,000 hours per year. The generator sets (see 6.4.2) shall have adequate capacity to produce 110 percent of rated net output kw for any 2 hour period out of any 24 consecutive hours of operation. Prime power shall be the engine manufacturers prime power rating. The prime power generator sets shall operate as much as 4,000 hours per year. The generator sets shall operate in the above prescribed manner without failure or interruption of service for the full time between manufacturer's recommended maintenance periods. Style A generator sets (see 6.4.3), shall be self-contained generator sets, with auxiliaries, accessories, and controls mounted on the engine-generator assembly or the subbase. Style B generator sets (see 6.4.4), shall consist of a nonhoused engine-generator assembly suitable for mounting at a fixed location, such as a concrete slab or structural foundation. The day (fuel) tank, if required, generator control panel, and other accessories may be remote from the engine-generator assembly. Wiring shall conform to NFPA No. 70.

3.2 Standard commercial product. The generator shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer's standard commercial product. Additional or better features which are not specifically prohibited by this specification but which are a part of the manufacturer's standard commercial product, shall be included in the generator being furnished. A standard commercial product is a product which has been sold or is being currently offered for sale on the commercial market through advertisements or manufacturer's catalogs, or brochures, and represents the latest production model.

3.3 Materials. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products are allowed under this specification unless otherwise specified.

3.3.1 Identical items. All generator sets of the same classification furnished under a specific contract shall be physically, electrically, and mechanically identical. Parts, accessories, assemblies, and components are included in this requirement. Written approval for deviations must be obtained in advance from the contracting officer.

3.3.2 Hardware. The number of different sizes and types of hardware shall be kept to a minimum.

3.3.2.1 Blind hardware. A nut located so that it cannot be grasped by the thumb and forefinger of one hand or by a common tool, shall be caged, or some equivalent means shall be used to obviate the need for handling of the nut during removal or assembly.

3.3.2.2 Fasteners. Each fastener (screw, bolt, pin, or other similar fastener, but excluding some cap screws and stud bolts used in engine assembly) shall be equipped with a suitable locking device to prevent loosening due to vibration. Locking shall be by locknuts, castellated nuts with cotter pins, lockwashers, lock wire, or lock plates. No swaging, peening, or staking of parts subject to removal or adjustment will be permitted. Covers and plates that must be removed for operating or servicing shall be equipped with quick-disconnect fasteners or easily removable bolted fastenings.

3.3.3 Screw threads. All screw threads shall be in accordance with FED-STD-H28.

* 3.4 Environmental and operational requirements. When equipped with all accessories, each set shall start (see 6.4.5), and operate as follows:

3.4.1 Starting.

* 3.4.1.1 Without engine preheat system. Each set shall start within 5 minutes under the following conditions:

a. Temperatures and altitude as specified (see 6.2) covering a range of:
Temperature: + 125 degrees Farenheit (°F) [+51.7° Centigrade (C)] to 0°F (-17.8°C).

Altitude: Sea level, barametric pressure 760 millimeters of mercury (mm hg) up to and including 8000 feet (ft) (23.16 mm hg). Only altitudes exceeding 3000 ft need be specified.

Glow plugs, ether priming, or other low temperature starting aids are permitted at temperatures below 40°F.

* 3.4.1.2 With preheat system. For engine sets requiring preheat systems, after maintaining the engine in a preheated, ready to start condition for not less than 12 hours, the engine shall start and accept 100 percent rated load within one minute under the following conditions:

a. Temperatures and altitude specified (see 6.2), covering a range of:
Ambient temperature: From +125°F (+51.7°C) to -25°F (-31.7°C).
Altitude: Sea level - barametric pressure 760 mm hg up to and including 8000 ft (23.16 mm hg). Only altitudes exceeding 3000 ft need be specified.

* 3.4.2 Storage, transport temperature and humidity. When the sets are in storage or transport, and without the use of the engine preheat system, if so equipped, the sets shall not be damaged by ambient temperatures from +155°F (+68.3°C) to -65°F (-59.3°C) and at the highest percent of moisture saturation possible within that temperature range. Heating units in the generator and generator control panels, if used, are to be operative during these periods.

* 3.4.3 Operating. After a starting and warmup period as recommended by the engine manufacturer the set shall operate under the temperature and altitude environments specified in accordance with the provisions specified herein at loads up to and including rated load continuously.

* 3.4.4 Operating speed. The rated operating speed of the generating sets shall be not more than 1,800 revolutions per minute. Each set shall operate at speeds up to and including 110 percent of rated speed for a period of not less than 5 minutes without damage when tested in accordance with 4.3.2.

3.5 Additional requirements.

3.5.1 Safety. Exposed parts which are subject to high operating temperatures or which are energized electrically, and moving parts which are of such nature or so located as to be a hazard to operating personnel, shall be insulated, enclosed, or guarded. Safety devices and safety measures shall not impair the proper functioning of any part of the sets.

3.5.2 Maintainability. Parts which required adjustment or servicing, (not repair or replacement) to permit operation of the sets, shall be arranged to provide optimum ease of servicing. Adjustment, repair, and replacement of parts, assemblies, and accessories shall be possible with minimum drainage and minimum disturbance of the sets. Maintenance shall be possible by the use of common tools.

3.5.3 Dissimilar metals. Intimate contact between dissimilar metals which can be expected to cause galvanic corrosion shall be avoided as much as practicable. When such contact cannot be avoided, an interposing insulating material shall be provided to minimize the corrosion effect.

3.6 Diesel engine. Each set shall have a standard, current production model, liquid cooled diesel engine. The use of more than one engine (tandem drive) to meet the performance requirements for a set is not acceptable. Each engine shall be complete with all accessories and auxiliaries as specified herein and as required for operating. Accessories and auxiliaries shall be suitable for prime power operation at 110 percent of rated capacity. Each engine shall develop maximum torque at a speed which is not greater than the rated operating speed of the respective set.

* 3.6.1 Engine horsepower. The standby brake horsepower (hp) developed by type I engine sets at rated operating speed shall be adequate to operate the respective set at rated load under all conditions specified herein. The type II generator sets will have engines rated at prime brake hp adequate to operate the respective set at rated load under all conditions specified herein. The generator set manufacturer shall have certification available for each engine furnished as follows:

a. That the engine is approved by the engine manufacturer for a specific generator to form a generator set.
b. The safe stress levels in the crankshaft and generator shaft, that have been determined by a mathematical or actual torsional vibration analysis, conducted by the engine manufacturer.

3.6.2 Fuels and lubricants. The engines shall meet all requirements specified herein when operating on diesel fuel conforming to VV-F-800, grade DF-1 or DF-2. The engines shall meet all requirements specified herein using lubricating oil conforming to MIL-L-2104, viscosity grade as recommended by the engine manufacturer.

3.6.3 Air pollution control. Each set shall comply with all Federal regulations governing the control of air pollution, as applicable on the date of manufacture. When specified (see 6.2), each set shall also comply with local regulations at the installation site governing air pollution control, as applicable on the date of manufacture.

3.6.4 Combustion air filters. Each engine shall have oil bath or dry type air cleaners of adequate capacity to remove dust and abrasives from the engine combusion air. The filters shall remove not less than 97 percent of all dust particles of 5 microns and larger, and shall have an overall average efficiency of not less than 99 percent when tested with ac fine dust test in accordance with SAE J726.

3.6.5 Engine lubricating oil system. The engine lubricating oil systems shall be the full forced-feed type. Each lubricating oil system shall consist of an engine-driven, positive displacement type oil pump, a lubricating oil strainer, a lubricating oil filter, a lubricating oil cooler (if required) and

associated piping. The lubricating oil filter shall be the full-flow type, complete with filter element(s). All elements of the lubricating oil system shall be manufactured by, or acceptable to, the engine manufacturer for each engine furnished.

3.6.6 Fuel system. The engine fuel systems shall include an engine-driven fuel pump, fuel strainer and filter, and fuel injection system, complete with piping and accessories as specified herein to supply fuel to the engine from the fuel tank. Copper tubing or piping shall not be used for fuel piping. All elements of the fuel system shall be manufactured by, or acceptable to, the engine manufacturer for each engine furnished. A remote fuel storage tank is not included herein.

3.6.6.1 Day tank. When specified (see 6.2), a day tank shall be furnished with the generator set. The day tank shall meet all applicable requirements of NFPA No. 30 and UL 142, and shall include hangers, brackets, fittings, vents, and other accessories required for installation. Unless otherwise specified (see 6.2), the storage capacity of the tank shall be adequate for operation of the generator set at rated load for not less than 8 hours.

3.6.6.2 Fuel transfer pump. When specified (see 6.2), a fuel transfer pump shall be furnished for use in conjunction with the day tank (see 3.6.6.1). The fuel transfer pump shall be a horizontal, positive displacement, rotary pump, direct-connected to an electric motor. The motor shall be a dripproof, single phase motor conforming to NEMA MG1 and rated for 115 V ac, 60 Hz. The pump shall be capable of delivering not less than three times the maximum fuel consumption of the engine in gallons per hour of fuel conforming to VV-F-800, grade DF-2, at a temperature of 0°F (-17.8°C), against a total dynamic head of 20 pounds force per square inch and a suction lift of 10 feet. When specified (see 6.2), the fuel transfer pump shall be automatically controlled by a float switch in the day tank. The motor controller shall conform to NEMA ICS 1 and ICS 2 and have a HAND-OFF-AUTO selector switch. The fuel transfer-day tank system shall also have a positive shutoff so that when the day tank is full, no fuel can flow into the day tank even though the external fuel supply system is pressurized.

3.6.7 Engine cooling system. Each engine shall have a closed, liquid cooling system complete with engine-driven coolant circulating pump, radiator, fan, piping, and controls. The cooling system shall have sufficient capacity to dissipate not less than the total British thermal units per hour rejected by the engine at 110 percent of rated output when operating under conditions as specified herein. The cooling system shall have a thermostatic control to maintain optimum engine operating temperatures. The filler cap shall provide for pressure relief prior to removal.

3.6.8 Exhaust system. Each engine shall have a complete exhaust system, including exhaust pipe, flexible exhaust section, industrial type silencer, with fittings and accessories required for installation. When specified (see 6.2), a residential type silencer shall be furnished in lieu of the industrial type silencer. The flexible exhaust section shall not be required when the silencer is designed to be direct-mounted to the exhaust manifold with no supporting brackets.

3.6.9 Engine speed governing systems. The engine speed governing systems shall be suitable for controlling the speed of the generator sets within the requirements specified herein without intermediate adjustment. The speed governing systems shall maintain the specified stability without hunting, cycling, or other irregularities.

* 3.6.9.1 Speed (frequency) governing system - class 1 sets. Unless otherwise specified (see 6.2), each class 1 set shall have an engine speed (frequency) governing system conforming to IEEE 126, section II. The engine speed governing system shall be adjusted to meet the performance requirements of IEEE 126, section II, when tested in accordance with 4.3.3.

* 3.6.9.2 Speed (frequency) governing system - class 2 sets. The speed (frequency) governing system for each class 2 set shall be suitable for controlling the set independently or in parallel with other sets having similar speed governing systems. Unless otherwise specified, the engine speed governing system shall conform to IEEE 126, section II. When specified (see 6.2), the engine speed governing system shall have provision for adjusting the speed changer from a remote location. If a separate power source is required to enable remote adjustment of the speed changer, the operating voltage of the separate power source shall be as specified (see 6.2). The engine speed governing system shall be adjusted to meet the performance requirements of IEEE 126, section III, when tested in accordance with 4.3.3.

* 3.6.9.3 Overspeed shutdown device. Each engine shall have an overspeed shutdown device which shall operate independently of the engine speed governing system. The overspeed shutdown device shall be positive in action and, should the engine speed reach or exceed 118 percent of synchronous speed, shall react to shut off the fuel supply to the engine and trip the set output circuit breaker. The overspeed shutdown device shall require manual resetting after it has functioned to shut down the generator set, when tested in accordance with 4.3.4.

* 3.6.10 Engine cranking system. Each engine shall have an electric cranking system rated for either 12-, 24-, or 36-V, direct current, with negative polarity grounded. The cranking system shall be energized by storage batteries, and shall have adequate capacity to crank the engine and enable starting under all conditions specified in 3.4.1, when tested in accordance with 4.3.5.

3.6.10.1 Overcranking relay. The cranking system shall have an overcranking relay to limit the cranking period to a value recommended by the engine manufacturer if the engine fails to start.

3.6.10.2 Storage batteries. The storage batteries shall be either 12- or 24-V batteries conforming to W-B-131, class II, or class VI. The voltage and ampere-hour rating of the batteries shall be sufficient to provide not less than five consecutive cranking cycles under all conditions specified in 3.4.1. Each cranking cycle shall consist of 15 seconds of continuous cranking on an inactive engine (engine fuel shut-off solenoid de-energized), followed

by a 30-second rest period. All batteries furnished with any one generator set shall have identical voltage and ampere-hour ratings. The batteries shall be complete with connectors and cable terminals, and shall be mounted in a metal frame or rack of corrosion-resisting material or suitably protected from corrosion. Unless otherwise specified (see 6.2), batteries shall be shipped charged and dry. When specified (see 6.2), one filling of electrolyte of the required specific gravity shall be furnished for each battery.

* 3.6.10.3 Battery charger. The battery charger shall be the enclosed, wall-mounted, constant-voltage, heavy-duty, industrial type designed for operation from 120 V, single-phase, 60 Hz, ac power, and shall conform to UL 1236. The charger shall be suitable for keeping the diesel engine starting batteries in a charged condition during periods when the engine is idle. Rectifier elements shall be silicon diodes capable of continuous operation at full rated load using convection cooling in ambient temperatures up to 125°F. The charger shall automatically adjust from full rated output to trickle charge and from trickle charge to full rated output depending on the state of charge of the starting battery. An ammeter shall be provided to show the charger output. The charger shall meet the requirements specified during test of 4.3.5.

3.6.11 Engine protective devices. Each engine shall have protective devices which shall act to simultaneously trip the set output circuit breaker and shut down the engine. The protective devices shall include low lubricating oil pressure and high coolant temperature. The high coolant temperature and the low oil pressure protective devices shall be actuated as recommended by the engine manufacturer. The low lubricating oil pressure protective device shall be automatically deactivated during the engine starting cycle.

3.6.12 Engine control panel. Each engine shall have a control panel mounted on the engine-generator assembly, and adequately isolated from vibration. Instruments and controls as required or recommended by the engine manufacturer for operation of the set shall be included. The required instruments shall include the following:

a. Lubricating oil pressure gage.
b. Coolant temperature indicator.
c. Engine hour meter.

Instruments shall be not less than 2-inch dial size and shall be the back connected, flush mounting type. Instrument cases shall be metal, with integral mounting flange. Dials shall be of contrasting background and marking to insure legibility. The dial scale shall cover an arc of not less than 90°. Indicating pointers shall be dull black and of unembellished design. The dial cover shall be clear glass, free from blemishes, and secured in a manner to exclude the entry of dust and permit removal. Instruments shall have a means for adjusting the zero setting of the indicating pointer.

3.6.13 Engine preheat system. When specified (see 6.2), each engine shall have a preheat system to maintain the engine in a preheated, ready-to-start condition under all conditions specified in 3.4.1.2. The preheat system shall

consist of an electrically operated, thermostatically controlled engine coolant heater, coolant circulating system, piping, valves, controls, and auxiliary equipment required for operation as specified herein. The heated engine coolant shall be circulated from the heater, through the lubricating oil cooler (if so equipped), the engine coolant jacket, and back to the heater. When required to maintain the engine heat, the preheat system shall include a lubricating oil circulating system to circulate the oil from the engine oil sump. The thermostat shall limit the temperature of the coolant to the value recommended by the engine manufacturer. The engine preheat system shall be automatically deactivated when the engine is operating. The preheat system shall be rated for operation on 120 V, 60 Hz, single phase, ac, power supply.

* 3.7 Generator. Each generator shall be a single bearing, synchronous, revolving field, brushless, air-cooled, self-ventilated, ac generator, direct-connected to the engine crankshaft through a flexible steel coupling designed to compensate for minor misalinement between the engine and generator shafts without causing injurious stresses and loads on the connected equipment. The generators shall conform to the applicable requirements of ANSI C50.10, ANSI C50.12. and NEMA MG1. The generator windings shall be copper. The balanced and residual component telephone influence factor shall not exceed the values specified in NEMA MG1. The generators shall have either class F or H insulation system and shall also have amortisseur windings designed to minimize slot harmonics. The generators shall have dripproof enclosures. The bearings shall be shielded, grease-lubricated, anti-friction bearings. The generators shall have adequate capacity to deliver the required net output under conditions specified herein. When specified (see 6.2), each generator shall have strip heaters mounted therein to prevent the accumulation of moisture in the generator windings. The heaters shall be suitable for operation on 120 V, 60 Hz, single phase, ac, power supply.

3.7.1 Mechanical balance. Each generator shall be balanced in accordance with NEMA MG1. Operating at rated speed and voltage, and at any load from no load to rated load, the vibration amplitude, peak-to-peak, shall not exceed the value specified in NEMA MG1 for the rated speed of the generator furnished. The vibration amplitude shall be measured in all three axis (vertical, longitudinal, and transverse) at the bearing housing or on the generator frame adjacent to the bearing housing.

* 3.7.2 Generator excitation system. The generator excitation system shall consist of a rotating brushless exciter with rectifier assembly, voltage regulator, and voltage adjusting control, together with all other accessories necessary to provide excitation and control the generator output under all operating conditions specified herein.

3.7.2.1 Exciter. Each generator shall have an integral exciter, with cooling from the air supplied by the generator cooling fan. The exciters shall be of the rotating armature, rotating rectifier type conforming to IEEE C50.5. The rotating rectifier assemblies shall be mounted in a manner to provide ready access for inspection and replacement of rectifier diodes.

3.7.2.2 Voltage regulator. Each voltage regulator shall be the solid-state type and shall automatically control the generator field current

through action on the exciter. The voltage regulator shall have provisions for manual adjustment of the set output voltage, while the set is operating, by a voltage adjusting control on the generator control panel. The ouput voltage shall be adjustable to any value within a range of not less than ±5 percent of the rated ouput voltage of the respective set. Class 2 sets shall have voltage regulators, that will enable parallel operation by the droop method with like generator sets and with commercial power by adjustment of the reactive load compensation control mounted behind the generator control panel. Suitable provision shall be made to assure automatic voltage buildup when the set is started.

* 3.7.3 Generator performance. Each generator, together with the excitation system, shall provide performance as specified herein when tested in accordance with 4.3.7.

* 3.7.3.1 Voltage regulation. The voltage regulation from no load to rated load and from rated load to no load shall be within 3 percent of the rated voltage. When specified (see 6.2), the voltage regulation shall be maintained within 1 percent of rated voltage.

3.7.3.2 Short term stability (30 seconds). At every constant load from no load to rated load, the voltage at the set terminals shall remain within a bandwidth equal to 2 percent of rated voltage.

3.7.3.3 Long term stability (4 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 a 4-hour operating period.

3.7.3.4 Voltage - transient performance. Performance of each set under transient conditions (class 2 sets shall have the paralleling switch in the SINGLE UNIT OPERATION position) shall be as follows:

a. With the set initially operating at rated voltage, rated frequency, and any load between no load and 75 percent rated load, a sudden 25 percent increase in load shall not cause the instantaneous root mean square terminal voltage to drop to less than 80 percent of rated voltage and the voltage shall reach stable conditions within 3 seconds. No overshoot or undershoot of the final voltage may exceed the initial voltage transient in amplitude. When specified (see 6.2), the voltage shall reach stable conditions in not more than 2 seconds.
b. The above requirements shall also apply when the load is suddenly changed from full load to no load, except that the initial voltage transient shall not exceed 130 percent of rated voltage. When specified (see 6.2), the initial voltage transient shall not exceed 120 percent of rated voltage.

* 3.7.4 Generator control panel. Generator control panels shall conform to ICS1, 2, and 6, type 2. Each generator control panel shall be a hinged, sheet metal panel, mounted on a sheet metal enclosure. All instruments and controls required to operate and monitor performance of the generator shall be

included, but shall be not less than specified herein. Auxiliaries, such as instrument transformers and voltage regulator, may be located behind the control panel in the sheet metal enclosure. Instruments, controls, and indicating lights shall be flush mounted on the hinged generator control panels and wired for proper operation. The vertically hinged generator control panels shall have positive manual latches to secure the panels in the closed position and lock-open devices which will permit the panels to swing open through an arc of not less than 120° and hold in the open position until manually released. The generator control panels for style A sets shall be an integral part of the generator set. The generator control panels for style B sets shall be integral or detached units, as specified (see 6.2). Detached control panels shall be suitable for wall mounting or adaptable for free standing installation, and provided with suitable matching terminal strips for interconnect with the generator set.

3.7.4.1 Generator control panel - class 1 sets. Generator control panels for class 1 sets shall include instruments and controls as follows:

a. Voltmeter, with selector switch.
b. Ammeter, with selector switch.
c. Frequency meter.
d. Voltage adjusting control.
e. Circuit breaker.

Generator control panels for class 1 sets, when integral with the set, may be combined with the engine control panel (see 3.6.12), to provide a single generator set control panel.

3.7.4.2 Generator control panel - class 2 sets. Generator control panels for class 2 sets shall include instruments, controls, and indicating lights as follows:

a. Voltmeter, with selector switch.
b. Ammeter, with selector switch.
c. Frequency meter.
d. Voltage adjusting control.
e. Speed (frequency) control (when remote adjustment of speed changer required (see 3.6.9.2).
f. Paralleling switch.
g. Synchronizing lights.
h. Synchroscope when specified, (see 6.2).
i. Circuit breaker.

3.7.4.3 Instruments. Instruments shall be 3-1/2 inch rectangular or round, flush mounted, indicating, dial and pointer, panel type meters conforming to ANSI C39.1. Instrument dials shall be of contrasting background and marking to insure legibility. Pointers shall be dull black and of unembellished design. The scales of voltmeters and ammeters shall be selected so that the normal operating range (rated load conditions) is indicated in the upper third of the scale. Frequency meter scales shall have an indicating range from 55 Hz to 65 Hz.

3.7.4.4 Controls. Control devices, mounted on generator control panels, as required, and connected for proper operation shall be as specified in the following paragraphs. Each control device shall have an escutcheon plate for function and operation identification.

3.7.4.4.1 Voltmeter selector swtich. Voltmeter selector switches for class 1 and class 2, 3-phase generator sets shall have selective conneccions on the voltmeter to indicate the voltage of each phase of the generator and the phase to neutral voltage of the 3 phase, 4-wire generator sets. The voltmeter selector switch shall also have an OFF position.

3.7.4.4.2 Ammeter selector switch. Ammeter selector switches shall enable selective connection of the ammeter to indicate the current in each phase of the respective generator output, and an OFF position. Switch contacts shall be so arranged that the secondary windings of the current transformers are never open circuited during switching operations.

3.7.4.4.3 Voltage adjusting control. The voltage adjusting control shall be a manually operated variable resistor to enable adjustment of the set output voltage, while the set is operating, through control of the voltage regulator.

* 3.7.4.4.4 Speed (frequency) control - class 2 sets. When provision for adjusting the engine speed changer from a remote location is specified, (see 3.6.9.2), the speed control shall be mounted on the generator control panel.

3.7.4.4.5 Paralleling switch - class 2 sets. The paralleling switch shall be a two-position, toggle-operated, maintained contact switch. In the UP position of the toggle operator, marked PARALLEL OPERATION, the reactive load compensation control shall be fully operative. In the DOWN position of the toggle operator, marked SINGLE UNIT OPERATION, the reactive load compensation control shall be inoperative.

3.7.4.5 Circuit breaker. Unless otherwise specified, circuit breakers shall be single-pole, two-pole, or three-pole molded case circuit breakers, as required for the application, conforming to NEMA AB1. When specified (see 6.2), circuit breakers shall be low voltage power circuit breakers conforming to ANSI C37.13. The voltage and continuous current ratings of the circuit breakers shall be suitable for the respective application. However, the continuous current shall not be less than 100 percent of the rated full load current of the set. The interrupting current rating for molded case circuit breakers shall be not less than 10,000 amperes for single-pole breakers, 14,000 amperes for two-pole breakers, and 25,000 amperes for three-pole breakers. Each circuit breaker shall have a trip device to trip the circuit breaker when a generator set protective device is actuated. Circuit breakers shall have inverse time automatic tripping and shall be ambient temperature compensating, suitable for the operating temperature range specified in 3.4. When specified (see 6.2), the circuit breakers shall be electrically operated.

3.7.4.6 Synchronizing lights - class 2 sets. The synchronizing lights shall consist of two indicating lights, with colorless, nondiffusing

lens, mounted side-by-side in horizontal configuration directly above the paralleling switch. The lights shall be connected to separate phases, of the 3 phase sets, so that they are extinguished (dark) only when the generator is properly synchronized and ready for closing of the circuit breaker.

3.7.4.7 Instrument transformers. Instrument transformers shall be 600 V insulation class, instrument transformers conforming to ANSI C57.13. The accuracy class and burden ratings of instrument transformers shall be compatible with the application requirements.

* 3.7.5 Reverse power device. When specified (see 6.2), class 2 sets shall have a reverse power device to prevent motoring of the set when operating in parallel (see 3.7.1.2). The reverse power device shall open the circuit breaker of the set in not more than 3 seconds when the power flow into the set exceeds 15 percent of the rating of the set. The reverse current protective device shall function independently of any other protective device.

* 3.8 Electromagnetic interference. When specified (see 6.2), electromagnetic interference tests shall be conducted in accordance with 4.3.8 to the testing criteria specified.

* 3.9 Fungus resistance. When specified (see 6.2), electrical components and circuit elements, including terminal and circuit connections, shall be coated with varnish meeting the performance requirements of MIL-V-173, except that:

a. Components and elements inherently inert to fungi or in hermetically sealed enclosures need not be coated.
b. Current-carrying contact surfaces, such as relay contact points, shall not be coated.

* 3.10 Cleaning, treatment, and painting. Surfaces normally painted in good commercial practice shall be cleaned, treated, and painted as specified herein. The color of the finish coat shall be as specified (see 6.2). Surfaces to be painted shall be cleaned and dried to insure that they are free from contaminants such as oil, grease, welding slag and spatter, loose mill scale, water, dirt, corrosion product, or any other contaminating substances. As soon as practicable after cleaning, and before any corrosion product or other contamination can result, the surfaces shall be prepared or treated to insure the adhesion of the coating system. The painting shall consist of at least one coat of primer and one finish coat. The primer shall be applied to a clean, dry surface as soon as practicable after cleaning and treating. Painting shall be with manufacturer's current materials according to manufacturer's current processes and the total dry film thickness shall be not less than 2.5 mils over the entire surface. The paint shall be free from runs, sags, orange peel, or other defects.

* 3.11 Wiring diagram. Each generator set supplied shall be provided with a wiring diagram showing all electrical circuits with identification of all terminals.

3.12 Workmanship.

3.12.1 Steel fabrication. The steel used in fabrication shall be free from kinks, sharp bends, and other conditions which would be deleterious to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. All bends shall be made by controlled means to insure uniformity of size and shape.

* 3.12.2 Bolted connections. Boltholes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

* 3.12.3 Riveted connections. Rivet holes shall be accurately punched or drilled and shall have the burrs removed. Rivets shall be driven with pressure tools and shall completely fill the holes. Rivet heads, when not countersunk or flattened, shall be of approved shape and of uniform size for the same diameter of rivet. Rivet heads shall be full, neatly made, concentric with the rivet holes, and in full contact with the surface of the member.

* 3.12.4 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

* 3.12.5 Castings. All castings shall be sound and free from patching, misplaced coring, warping, or any other defect which reduces the castings ability to perform its intended function.

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the 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.

* 4.1.1 Component and material inspection. Components and materials shall be inspected in accordance with all the requirements specified herein and in applicable referenced documents.

4.2 Examination. Each generator shall be examined for compliance with the requirements specified in section 3 of this specification. Any redesign or

modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection.

4.3 Test procedure. Each generator set shall be inspected and tested for acceptable performance and for compliance with other applicable requirements of this specification and the contract. Tests shall include those specified below and such other tests as are deemed necessary.

4.3.1 Instruments. The pressure, temperature, and speed indicators shall be tested to determine conformance to the requirements specified herein. Test instruments shall be accurately calibrated and of a sensitivity suitable for determining the accuracy of the engine instruments.

* 4.3.2 Operating speed test. The generator set shall be adjusted to an operating speed of 110 percent of rated speed for a period of 5 minutes and inspected for any component damage in conformance with 3.4.4. This test is to be performed prior to nonstop load test (see 4.3.6).

* 4.3.3 Speed governing test. The engine speed governing system shall be tested in accordance with ASME PTC 26 for conformance to 3.6.9.1 and 3.6.9.2.

4.3.4 Safety shutdown controls. Operation of the low lubricating oil, high coolant temperature, and overspeed safety shutdown controls shall be tested to determine conformance to the requirements of 3.6.9.3 and 3.6.11.

* 4.3.5 Cranking system. The engine cranking system shall be operated, as necessary, to determine conformance to 3.6.10, 3.6.10.1, 3.6.10.2 and, 3.6.10.3 as applicable. Unless otherwise specified (see 6.2), test shall be performed at room ambient conditions.

4.3.6 Run-in test. The engine shall be subjected to a run-in and conditioning period in accordance with the manufacturer's standard practice. During the test period, the general operation of the generator sets shall be observed and any necessary adjustments made to assure that it is functioning properly.

* 4.3.7 Nonstop load test. During this test the voltage regulation, stability, and voltage transient requirements shall be verified for conformance to 3.7.3, in addition to normal system checks for proper operation. The generator set shall be tested at rated speed and voltage for a total of 6 hours of continuous operation, approximately 1 hour each at 0, 50, 75, 100, 110, and back to 100 percent of rated load, consecutively, at either 0.8 or 1.0 pf. Readings shall be taken at 1/2-hour intervals throughout the test in order to prove that component parts are functioning properly. If any parts are found to have failed, they shall be replaced and the test restarted.

* 4.3.8 Tests for electromagnetic interference. When electromagnetic interference suppression is specified (see 3.8 and 6.2), tests shall be

conducted on the diesel-engine generator sets. Test limits shall be as specified in the contract (see 6.2). All testing equipment, instruments, personnel for making the test, and test location, which shall be reasonably free from radiated and conducted interference, and other necessary facilities, shall be furnished by the contractor. Tests for electromagnetic interference will not be required for diesel-engine generator sets that are physically and electrically identical to those that have previously met the requirements.

* 4.4 Packaging inspection. The inspection of the preservation, packing, and marking shall be in accordance with the requirements of section 4 of MIL-G-28554.

5. PACKAGING

* 5.1 Preservation, packing, and marking. Preservation, packing, and marking shall be in accordance with the requirements of MIL-G-28554 with the level of preservation and the level of packing as specified (see 6.2).

6. NOTES

6.1 Intended use. The generator sets are intended for use in military construction projects for new construction of fixed installation generator sets, and for the replacement of existing generator sets procured on previous contracts (see 3.1). The sets are not intended for use in tactical application.

* 6.2 Ordering data. Acquisitioning documents should specify the following:

a. Title, number, and date of this specification.
b. Type, style, class, voltage rating, and size of set (kw rating) required (see 1.2).
c. Ambient temperature of operation (see 3.4.1.2).
d. Operating altitude if exceeding 3000 ft (see 3.4.1.1, and 3.4.1.2).
e. When the set shall also comply with local regulations governing air pollution (see 3.6.3).
f. When a day tank shall be furnished (see 3.6.6.1).
g. When the capacity of the day tank shall be other than specified (see 3.6.6.1).
h. When a fuel transfer pump shall be furnished (see 3.6.6.2).
i. When the fuel transfer pump shall be automatically controlled (see 3.6.6.2).
j. When a residential type exhaust muffler shall be furnished (see 3.6.8).
k. When the speed governing system for class 1 sets shall be other than specified (see 3.6.9.1).
l. When the speed governing system for class 2 sets shall be other than specified (see 3.6.9.2).
m. When the governing system for class 2 sets shall have provision for adjusting the speed changer from remote location (see 3.6.9.2).
n. Specify the operating voltage for remote adjustment of the speed changer (see 3.6.9.2).
o. When batteries are to be shipped other than charged and dry (see 3.6.10.2).

p. When electrolyte is to be furnished and the specific gravity required (see 3.6.10.2).
q. When an engine preheat system is required (see 3.6.13).
r. When generator shall have strip heaters (see 3.7).
s. When the voltage regulation shall be maintained at not more than 1 percent of rated voltage (see 3.7.3.1).
t. When the set voltage shall become stable in not more than 2 seconds (see 3.7.3.4).
u. When the initial voltage transient shall not exceed 120 percent of rated voltage (see 3.7.3.4).
v. Whether generator control panel for style B set shall be integral or detached (see 3.7.4).
w. When a synchroscope is required (see 3.7.4.2).
x. When low voltage power circuit breakers are required (see 3.7.4.5).
y. When circuit breakers shall be electrically operated (see 3.7.4.5).
z. When class 2 sets shall have a reverse power device (see 3.7.5).
aa. When electromagnetic interference suppression is required, specify required characteristics and test limits (see 3.8 and 4.3.8.)
* bb. When electrical components shall be coated with varnish (see 3.9).
cc. Color of finish coat required (see 3.10).
dd. If cranking tests are to be performed under room ambient conditions (see 4.3.5).
ee. Level of preservation and level of packing required (see 5.1).

6.3 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL) and invokes the provisions of paragraph 52.227-7031 of the Federal Acquisition Regulations (FAR), the data requirements will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL (DD Form 1423) incorporated into the contract. When the provisions of FAR 52.227-7031 are not invoked, the data shall be delivered in accordance with the contract requirements.

6.4 Definitions.

* 6.4.1 Type I (standby power). The type I generator sets are for providing the minimum power requirements to enable an activity to perform its mission, when the prime source of power is not available.

* 6.4.2 Type II (primer power). The type II generator sets are for providing the prime source of power for long time use at an activity, with primary consideration being given to long life and reliability.

* 6.4.3 Style A (self-contained generator set). The style A self-contained generator sets are defined as generator sets that require no external means in order to operate at design use. The unit is fully independent to produce electric power.

6.4.4 Style B (fixed installation generator set). The style B fixed installation generator sets are defined as generator sets that require special foundations, protection from the elements and/or remote assemblages (other than fuel supply) to become operational; and when removed from the above described installed environment, are not capable of independently producing electric power.

6.4.5 Start. A generator set is considered to have started when it is operating at rated voltage and speed without further use of the starting system or starting aids.

6.5 The following paragraphs should be included in each acquisitioning document:

Operating experience. Each bidder shall furnish to the contracting officer with his bid, the following information concerning the engine generating set being furnished:

* a. That the generator set offered is of a class, configuration, and capacity of those provided within a 2 year period on at least two installations and successfully operated within specified requirements.
b. That units, cited to show experience, were in stationary electric generating service.
c. That units, cited to show experience, had the same engine model as that being offered. Engine model is considered to be a given series of class of identical bore and stroke engines of the same type such as in-line or V. In-line and V engines are regarded as two separate model(s).
d. That units, cited to show experience, are identical or higher in number of cylinders, rotative speed, maximum firing pressure, and brake mean effective pressure.
e. That units, cited to show experience, were operated on oil in 60 cycle ac service.

* 6.6 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

6.7 Cross reference:

*

MIL-G-19826E	Cross reference: MIL-G-19826F
Type I	None
Type II	Type I
Type III	Type II

Custodian:

Navy - YD

Preparing Activity:

Navy - YD

(Project 6115-N483)

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

6115-N483

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-G-19826F(YD)	GENERATOR SETS, DIESEL ENGINE, ALTERNATING CUR FOR FACILITIES CONSTRUCTION; 10 KW THROUGH 1000 KW (NOT STOCK

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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