SECTION 26 32 13 - PACKAGED ENGINE GENERATOR (16232)

PART 1 - GENERAL

1.01 SUMMARY

A. Compliance with NFPA 110 shall be required. Field installation shall comply with CEC Article 702, Optional Standby Systems, except as noted. The engine generator package shall comply with UL 2200 and be UL listed.

B. The diesel engine generator package shall be synchronous brushless excitation type. The generator shall be rated 45 kW, 1-Phase, 120/240 VAC, 60 Hz.

C. This Section includes packaged diesel engine-generator set with the following features and accessories:
   1. Battery charger.
   2. Base tank.
   3. Engine-generator set.
   5. Exhaust piping external to engine-generator set.
   6. Outdoor-rated sound reduction and weatherproofing enclosure.
   7. Remote start/stop switch.
   8. Starting battery.

D. Related Sections include the following:
   1. General Requirements
   2. Division 3 - Concrete
   3. Division 1 – General Requirements
   4. Section 26 05 53 – Tests and Identification
   5. Section 16080 – Overcurrent Protection
   6. Section 16233 – Transfer Switches
   7. Section 26 05 26 – Grounding and Bonding

1.02 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
B. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

1.03 SUBMITTALS

A. Product Data: Include the following:
   1. Data on features, components, accessories ratings, and performance.
   2. Thermal damage curve for generator.
   3. Time-current characteristic curves for generator protective device.
   4. Load analysis identifying SKW, SkVA, RKW, RkVA for sequential starting of loads identified in this specification.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
   2. Design Calculations: Signed and sealed by a qualified California professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.

C. Welding certificates.

D. Manufacturer Seismic Qualification Certification: Submit certification that day tank, engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Seismic Controls for Electrical Work." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: Provide for equipment manufacturer and installation contractor.

F. Certified summary of prototype-unit test report.

G. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

H. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet performance criteria for sensitive loads.

I. Test Reports:
   1. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   3. Report of exhaust emissions showing compliance with applicable regulations.
   4. Field quality-control test reports.

J. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.

K. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals, include the following:
   1. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

L. Manufacturer’s certified letter stating that unit complies with all California State Codes, Uniform Building Code (UBC), California Electrical Code (CEC) and National Electric Manufacturer’s Association (NEMA) standards for emergency power plant.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer’s authorized representative who is trained and approved for installation of units required for this Project.
   1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer’s standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

1. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D. Product Options: Drawings shall indicate size, profiles, and dimensional requirements of packaged generator sets and shall represent the specific system indicated. All drawings and data shall be marked to identify the option(s) being provided.

E. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX for welding exhaust-system piping.

F. Electrical Components, Devices, and Accessories: UL listed and labeled and marked for intended use. Where UL listing is not available labeling may be provided by a Third-Party testing agency acceptable to the College.

G. Comply with NFPA 30.

H. Comply with NFPA 37.

I. Comply with NFPA 70.

J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

K. Engine Exhaust Emissions: Comply with applicable SCAQMD requirements.

L. Noise Emission: Comply with Owner requirements and not exceed a 75dB for maximum noise level at 20 feet in any direction due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.05 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
1.06 WARRANTY
  A. Warranty Period: Comprehensive with no additional cost to University for two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
  A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
     1. Generac
     2. Or equal

2.02 ENGINE-GENERATOR SET
  A. Packaged engine-generator set shall be a coordinated assembly of compatible components.
  B. Power Output Ratings: Nominal ratings as indicated on drawings, with capacity as required to operate as a unit as evidenced by records of prototype testing.
  C. Output Connections: Single Phase, 3-Wire.
  D. Safety Standard: Comply with ASME B15.1.
  E. Nameplates: Each major system component shall be equipped with a nameplate to identify manufacturer's name and address, and model and serial number of component.
  F. Fabricate engine-generator-set mounting frame and attachment of components to resist generator-set movement during a seismic event when generator-set mounting frame is anchored to building structure.
  G. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.
     1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

2.03 GENERATOR PERFORMANCE
  A. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.
B. Steady-State Voltage Modulation Frequency: Less than 1 Hz.
C. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
E. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
F. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
G. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
H. Sustained Short-Circuit Current: For a bolted short circuit at system output terminals, the system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
I. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.04 GENERATOR PERFORMANCE FOR SENSITIVE LOADS
A. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
   1. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
B. Steady-State Voltage Operational Bandwidth: 2 percent of rated output voltage from no load to full load.
C. Steady-State Voltage Modulation Frequency: Less than 1 Hz.
D. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
E. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.

F. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

G. Transient Frequency Performance: Less than 2-Hz variation for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.

H. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

I. Sustained Short-Circuit Current: For a bolted short circuit at system output terminals, the system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

J. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

K. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.05 SERVICE CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   1. Ambient Temperature: -40 to 70 deg C.
   2. Relative Humidity: 0 to 100 percent.
   3. Altitude: Sea level to 1500 feet

2.06 ENGINE

A. Fuel: Diesel.

B. Lubrication System: The following items are mounted on engine or skid:
   1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
   2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

C. Engine Fuel System:
1. Main Fuel Pump: Gear type, positive displacement, mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
3. Primary fuel strainer
4. Secondary fuel filter
5. Lube-oil filter
6. Intake air filter

D. Block Heater: 1000W.

E. Governor: Electronic, Frequency regulation, isochronous.
   1. Steady state regulation +/- 0.33%

2.07 ENGINE COOLING SYSTEM

A. Description: Closed loop, liquid cooled, with radiator factory mounted on engine-generator set mounting frame and integral engine-driven coolant pump.

B. Radiator: Rated for specified coolant. Size to maintain safe engine temperature in ambient temperature of 120 deg. F. Radiator airflow restriction shall be 0.5 inches of water maximum.
   1. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
   2. Fan: Driven by multiple belts from engine shaft.

C. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

D. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

E. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
1. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and non-collapsible under vacuum.

2. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.08 FUEL SUPPLY SYSTEM

A. Base Tank: Comply with UL 142, freestanding, factory-fabricated fuel tank assembly, with integral, float-controlled transfer pump and the following features:

1. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of day tank.
   a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.

2. Tank Capacity: As recommended by engine manufacturer for an uninterrupted period of 17 hours operation at 100 percent of rated power output of engine generator system without being refilled.

3. Low-Level Alarm Sensor: Liquid-level device to operate alarm contacts at 25 percent of normal fuel level.
   a. Low level sensor

4. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve, all in accordance with UL 142.

2.09 ENGINE EXHAUST SYSTEM

A. Muffler: Critical type, sized as recommended by engine manufacturer; sound level measured at a distance of 10 feet from exhaust discharge shall be 79 dBA or less.

B. Condensate Drain for Muffler: Schedule 40, black steel pipe connected to muffler drain outlet through a petcock.

C. Connection from Engine to Exhaust System: Flexible section of corrugated stainless-steel pipe.

D. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liner.

E. Exhaust Piping External to Engine: ASTM A 53/A 53M, Schedule 40, welded, black steel, with welded joints and fittings.

2.10 COMBUSTION-AIR INTAKE
A. Description: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

2.11 STARTING SYSTEM

A. Description: 24V electric, with negative ground and including the following items:

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article.

2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article to provide specified cranking cycle at least three times without recharging.

5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article. Include accessories required to support and fasten batteries in place.


8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

   a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

   b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to
prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.


e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.12 CONTROL AND MONITORING

A. Functional Description: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in a separate automatic transfer switch initiate starting and stopping of the generator set. When mode-selector switch is switched to the on position, the generator set starts. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

1. A digital microprocessor-based control panel with two 4 line x 20 character displays shall be included.

2. System Status shall be displayed on the control panel.

3. A modem shall be included for remote communication and monitoring.

4. All connections shall be waterproof.

C. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
D. Data Link: Internal modem for communication.

E. Remote Alarm Annunciator: Comply with NFPA 99. Labeled LED shall identify each alarm event. Common audible signal shall sound for alarm conditions. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface-mounting type to suit mounting conditions indicated.

1. Engine high-temperature shutdown.
2. Lube-oil low-pressure shutdown.
3. Overspeed shutdown.
5. Engine high-temperature pre-alarm.
6. Lube-oil low-pressure pre-alarm.
7. Fuel tank, low-fuel level.
8. Low coolant level.
11. Control switch not in auto position.

F. Remote Emergency-Stop Switch: Surface; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.13 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Circuit Breaker Sizing as noted on plans.
3. Trip Settings: Matched to generator thermal damage curve as closely as possible.
4. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

5. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Generator Protector: Microprocessor-based unit that continuously monitors current level in each phase of generator output, integrates generator heating effect over time, and predicts when thermal damage of the alternator will occur. When signaled by the protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from the load circuits. Protector shall perform the following functions:

1. Initiates a generator overload alarm when the generator has operated at an overload equivalent to 100 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.

2. Under single or three-phase fault conditions, regulates the generator to 300 percent of rated full-load current for up to 10 seconds.

3. As the overcurrent heating effect on the generator approaches the thermal damage point of the unit, the protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.

4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.14 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1 and specified performance requirements.

B. Drive: Generator shaft shall be directly connected to engine shaft.

C. Electrical Insulation: Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 100 percent of rated capacity.

F. Permanent magnet (PM) generator set shall provide the source of excitation to the exciter to increase immunity to non-linear loads and to maintain 300% of rated current for 10 seconds during short circuit conditions. Excitation shall use no slip or collector rings, or brushes, and shall be arranged to sustain generator output under short-circuit conditions as specified.
G. Digital Voltage Regulator: The microprocessor based digital voltage regulator shall maintain generator set output voltage within +/- 1% for any load between no load and full load across the entire operating temperature range. The regulator shall employ a programmable volts per Hertz regulation characteristic with adjustable slope (volts / Hertz), adjustable constant voltage corner frequency, and adjustable under voltage corner frequency. It shall be adjustable for low response to noise and high harmonic tolerance to VFDs specified in this Section. Sensing shall be three-phase true RMS. The regulator shall provide programmable over / under voltage protection, over-excitation protection, diode failure monitor, and logged fault and service codes to aid in trouble-shooting. It shall incorporate an RS-232 and RS-485 and modem communications ports allowing external monitoring and control of the regulator. The regulator shall be environmentally sealed.

H. Enclosure: Drip proof.

I. Instrument Transformers: Mounted within generator enclosure.

J. Subtransient Reactance: 12 percent, maximum.

2.15 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Prefabricated or pre-engineered enclosure with the following features:
   2. Structural Design and Anchorage: Wind resistant up to 100 mph.
   3. Space Heater: Thermostatically controlled and sized to prevent condensation.
   4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
   5. Hinged Doors: With padlocking provisions
   6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
   7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
   8. Muffler Location: Within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for
2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

2.16 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.17 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 energy converters in Paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2.


3. Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype shall have been factory tested to demonstrate compatibility and reliability.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
B. Concrete base is specified in Division 16 Section “Basic Electrical Materials and Methods,” and concrete materials and installation requirements are specified in Division 3.

3.03 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions.

B. Install packaged engine generators level on 6” raised concrete pad concrete base.
   1. Vibration Isolation: Mount packaged engine generator directly on concrete pad. Engine generator shall have Internal vibration isolation devices.

C. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.04 CONNECTIONS

A. Ground equipment according to Division 16 Section “Grounding and Bonding.”

B. Connect wiring according to Division 16 Section “Conductors.”

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 IDENTIFICATION

A. Identify system components according to Division 16 Section “Electrical Identification.”

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.15.2.1 and 7.22.1 (except for vibration baseline test). Certify compliance with test parameters.
   2. Perform tests recommended by manufacturer.
a. Perform load tests that represent load conditions identified in “Normal Conditions of Service” located in this Section.

3. Battery Tests: Equalize charging of battery cells according to manufacturer’s written instructions. Record individual cell voltages.
   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer’s specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer’s written allowable limits for the engine.

7. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

8. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at locations 20 feet in any direction, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switch and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of the National Institute for Standards and Technology, and adequate for making positive observation of test results. Make calibration records available for examination on request.
E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units, reinspect, and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.07 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train University maintenance personnel to adjust, operate, and maintain packaged engine generators. Minimum training time shall be four hours.

1. Coordinate this training with that for transfer switches.

END OF SECTION 26 32 13