

SECTION 263213 – PACKAGED ENGINE GENERATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for standby power supply with the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Performance requirements for sensitive loads.
 - 5. Load banks.
 - 6. Outdoor enclosure.
- B. Related Sections include the following:
 - 1. Division 26 Section "Automatic Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 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. Diesel #2 fuel

1.4 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- 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. Wiring Diagrams: Power, signal, and control wiring.

- C. **Manufacturer Seismic Qualification Certification:** Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Supporting Devices." 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."
 - b. 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.**
- D. **Qualification Data:** For installer, manufacturer and testing agency.
- E. **Source quality-control test reports.**
 - 1. Certified summary of prototype-unit test report.
 - 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 - 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 - 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - 5. Report of sound generation.
 - 6. Report of exhaust emissions showing compliance with applicable regulations.
 - 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- F. **Field quality-control test reports.**
- G. **Operation and Maintenance Data:** For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Maintenance Manuals," include the following:
 - 1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- H. **Warranty:** Special warranty specified in this Section.

1.5 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 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASME B15.1.
- G. Comply with NFPA 37.
- H. Comply with NFPA 70.
- I. Comply with NFPA 110 requirements for Level 2 emergency power supply system.
- J. Comply with UL 2200.
- K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- L. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then

only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: -4 to +104°F.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 700 feet.

1.7 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are shown in the project drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years or 3000 hours whichever occurs first to guarantee from defective material/workmanship from date of initial startup. Warranty is comprehensive including labor travel and parts.

1.9 MAINTENANCE SERVICE

A. Beginning at Substantial Completion, provide (1) visit in the initial year for planned maintenance by service technician of manufacturer's designated local service organization. Provide oil and fuel filters parts as part of these visits and supplies same items as those used in the manufacture and installation of original equipment.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Caterpillar; Engine Div.
 2. Generac Power Systems, Inc.
 3. Kohler Co.; Generator Division.
 4. Cummins Power Generation; Industrial Business Group.
 5. MTU Detroit Diesel.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
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.
- C. Capacities and Characteristics: 300 kW / 375 kVA, 0.8 PF, 277/480 volt, 3-phase 4-wire, alternator capable of supplying 1325 SKVA (min.) for motor starting loads with maximum instantaneous voltage dip of 35%.
1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
 2. Output Connections: Three-phase, four wire.
 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
1. Steady-State Voltage Operational Bandwidth: ± 3 percent of rated output voltage from no load to full load.
 2. 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.
 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 4. 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.

5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. 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. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, 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.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 1950 fpm.
- D. 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.
- E. Engine Fuel System:
 1. Main Fuel Pump: 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. Retain paragraph below where required by NFPA 110, which prescribes engine water-jacket temperature requirements. Coordinate with Drawings for electrical supply.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump. Design for peak ambient air temperature of 110°F.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and no collapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. (See Sound enclosure for sound requirements for total system)
- J. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- K. Starting System: 12 or 24 -V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project 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 Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice 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°C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 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°C to plus 60°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.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- 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.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Double Wall Secondary Containment Sub-base Fuel Tank Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
 - 1. Tank level indicator.
 - 2. Capacity: Fuel for 24 hours (minimum) continuous operation at 100 percent rated power output (or 500 gallons minimum).
 - 3. Vandal-resistant fill cap.
 - 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.
- C. State of Ohio Fire Marshall Requirements – Include required components below; obtain permits and arrange inspection from State of Ohio Fire Marshall for tank pressure test. Tank pressure test by generator supplier.
- D. Fuel fill option – The fuel fill is equipped with a 5 gallon above ground fill/spill container that contains fuel over spills that may occur during fill-ups and the normal vent will be extended to 12’ above the grade
- E. Decal – The fuel tank will be equipped with a combustible liquids decal and NFPA 704 marker decal.
- F. 5 Gallon Fill/Spill Containment- Aboveground fill/spill container, contains fuel overflow spills that may occur during fill-up

- G. Fuel fill option – The fuel fill is equipped with a 5 gallon above ground fill/spill container that contains fuel over spills that may occur during fill-ups and the normal vent will be extended to 12’ above the grade.
- H. High fuel level switch – A fuel level switch will be installed in the tank and the contacts will close when the fuel level reaches 90%.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. 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.
- D. Indicating and Protective Devices and Controls:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.
 - 7. Running-time meter.
 - 8. Ammeter-voltmeter, phase-selector switch(es).
 - 9. Generator-voltage adjusting rheostat.
 - 10. Start-stop switch.
 - 11. Overspeed shutdown device.
 - 12. Coolant high-temperature shutdown device.
 - 13. Coolant low-level shutdown device.
 - 14. Oil low-pressure shutdown device.
 - 15. Fuel tank derangement alarm.
 - 16. Fuel tank high-level shutdown of fuel supply alarm.
 - 17. Generator overload.

- E. 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.
- F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals.

2.6 ACCESSORIES

- A. Battery Charger – An automatic float to equalize battery charger with the following features:
 - 1. 12 or 24 VDC output
 - 2. Voltage regulation of 1% from no to full load over 10% AC input line voltage variations
 - 3. Ammeter and voltmeter with 5% full-scale accuracy
 - 4. LED lamp for power indication
 - 5. Current limited during engine cranking, short circuit, and reverse polarity conditions
 - 6. Temperature compensated for ambient temperatures for -40°C to 60°C
 - 7. UL Listed
- B. Battery, Rack and Cables – Battery, battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied
- C. Rodent Guards – Generator rodent guards shall prevent intrusion and protect internal components
- D. Block Heater – The block heater shall be thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.
- E. Dry Contacts – 2 Input/5 Output Module kit provides two additional analog inputs and 5 additional dry contact outputs. The analog inputs can be used for analog or digital input functions. They can be set up for 0-5VDC, ± 3 VDC resistive or relay contact sensor devices
- F. Remote emergency generator stop button – generator shall be furnished with an externally mounted, recessed, emergency stop switch, Pilla model GS series with clear protective cover # PILCLHCOV1 or equal, NEMA 4X rated.
- G. Supply flexible fuel lines to provide a flexible connection between the engine fuel fittings and the fuel supply tank piping and for the fuel return lines from the injector pump per engine manufacturer's recommendations. Flex line shall have a protective steel wire braid to protect the hose from abrasion.
- H. Remote annunciator panel

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: 600A; 80% rated; electronic trip; complying with NEMA AB 1 and UL 489.
 - 1. Tripping Characteristic: Designed specifically for generator protection.
 - 2. Trip Rating: Matched to generator rating.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H
- 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 110 percent of rated capacity.
- F. Enclosure: Dripproof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof aluminum or steel housing, wind resistant up to 150 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure. The generator set shall be supplied with a Sound Attenuated Enclosure, providing a sound pressure of 80 dB(A) while the generator is operating at 100% load at 7 meters (23 feet).
- B. Description: Prefabricated enclosure with the following features:

1. Construction: Galvanized-steel, metal-clad, or aluminum, integral structural-steel-framed building erected on concrete foundation.
 2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
 3. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
 4. Hinged Doors: With padlocking provisions.
 5. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
 6. Thermal Insulation: Manufacturer's standard materials and thickness selected to maintain winter interior temperature within operating limits required by engine-generator-set components.
- C. 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.
- D. Convenience Outlets: GFCI. Arrange for external electrical connection.

2.10 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil-and-water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

2.11 FINISHES

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

2.12 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 and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 2. Full load run.
 3. Maximum power.

4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access for periodic maintenance without removing connections or accessories.
- C. Install packaged engine generator with elastomeric isolator pads on 4-inch-high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 26 Section "Supporting Devices."
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

- A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- B. Connect engine exhaust pipe to engine with flexible connector.
- C. Connect fuel piping to engines with a gate valve and union and flexible connector.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 26 Section "Electrical Identification."

3.5 FIELD QUALITY CONTROL

A. Non-Conforming Work

1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
 - a. Design Prototype Tests. Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
 - i. Maximum power (kW)
 - ii. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
 - iii. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
 - iv. Governor speed regulation under steady-state and transient conditions.
 - v. Voltage regulation and generator transient response.
 - vi. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
 - vii. Three-phase short circuit tests.
 - viii. Alternator cooling air flow.
 - ix. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
 - x. Endurance testing.
 - b. Final Production Tests. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
 - i. Single-step load pickup
 - ii. Safety shutdown device testing
 - iii. Rated Power @ 0.8 PF
 - iv. Maximum power
 - v. Upon request, a witness test, or a certified test record sent prior to shipment.
 - c. Site Tests. The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
 - i. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
 - ii. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block

heaters, battery chargers, alternator strip heaters, remote annunciators, etc.

iii. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.

- B. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.
- B. Load Bank test- 2-hour resistive load bank test shall be performed. Data shall be recorded every 15 minute for first hour with 25%, 50%, 75% and last hour 100% load. The temporary portable load bank will be provided by generator manufacturer.
- C. Tank testing- Electrical installer shall obtain permits and arrange inspection from State of Ohio Fire Marshall for tank pressure test. Tank pressure test to be included with generator supplier.

END OF SECTION 263213