

7.12.6 The starting battery units shall be located next to the prime mover starter to minimize voltage drop.

7.12.6.1 Battery cables shall be sized to minimize voltage drop in accordance with the manufacturer's recommendations and accepted engineering practices.

7.12.6.2 Battery charger output wiring shall be permanently connected to the primary side of the starter solenoid (positive) and the EPS frame (negative), or other grounding location.

7.13 Installation Acceptance.

7.13.1 Upon completion of the installation of the EPSS, the EPS shall be tested to ensure conformity to the requirements of the standard with respect to both power output and function.

7.13.2 An on-site acceptance test shall be conducted as a final approval test for all EPSSs.

7.13.2.1 For new Level 1 installations, the EPSS shall not be considered as meeting this standard until the acceptance tests have been conducted and test requirements met.

7.13.2.2 The test shall be conducted after completion of the installation with all EPSS accessory and support equipment in place and operating.

7.13.3 The authority having jurisdiction shall be given advance notification of the time at which the acceptance test is to be performed so that the authority can witness the test.

7.13.4 The EPSS shall perform within the limits specified in this standard.

7.13.4.1 The on-site installation acceptance test shall be conducted in accordance with 7.13.4.1.1 through 7.13.4.1.3.

7.13.4.1.1* In a new and unoccupied building or facility, with the prime mover in a cold start condition and the emergency load at operating level, a normal power failure shall be initiated by opening all switches or circuit breakers supplying the normal power to the building or facility.

7.13.4.1.2* In an existing occupied building or facility, with the prime mover in a cold start condition and the emergency load at operating level, a normal power failure shall be simulated by operating at least one transfer switch test function or initiated by opening all switches or breakers supplying normal power to all ATSs that are part of the EPSS being commissioned by this initial acceptance test.

7.13.4.1.3 The tests conducted in accordance with 7.13.4.1.1 and 7.13.4.1.2 shall be performed in accordance with (1) through (12).

- (1) When the EPSS consists of paralleled EPSSs, the quantity of EPSSs intended to be operated simultaneously shall be tested simultaneously with building load for the test period identified in 7.13.4.1.3(10).

Subsection 7.13.4.1.3(1) was revised by a tentative interim amendment (TIA). See page 1.

- (2) The test load shall be all loads that are served by the EPSS. There is no minimum loading requirement for this portion of the test.
- (3) The time delay on start shall be observed and recorded.
- (4) The cranking time until the prime mover starts and runs shall be observed and recorded.
- (5) The time taken to reach operating speed shall be observed and recorded.

- (6)*The engine start function shall be confirmed by verifying operation of the initiating circuit of all transfer switches supplying EPSS loads.
- (7) The time taken to achieve a steady-state condition with all switches transferred to the emergency position shall be observed and recorded.
- (8) The voltage, frequency, and amperes shall be recorded.
- (9) Where applicable, the prime mover oil pressure and water temperature shall be recorded.
- (10) The load test with building load, or other loads that simulate the intended load as specified in Section 5.4, shall be continued for not less than 1.5 hours, and the run time shall be recorded.
- (11) When normal power is restored to the building or facility, the time delay on retransfer to normal power for each switch with a minimum setting of 5 minutes shall be recorded.
- (12) The time delay on the prime mover cooldown period and shutdown shall be recorded.

7.13.4.2 After completion of the test performed in 7.13.4.1, the prime mover shall be allowed to cool for not less than 5 minutes.

7.13.4.3* A load shall be applied for a 2-hour, full-load test. The building load shall be permitted to serve as part or all of the load, supplemented by a load bank of sufficient size to provide a load equal to 100 percent of the nameplate kW rating of the EPS, less applicable derating factors for site conditions.

7.13.4.3.1 This full-load test shall be initiated after the test specified in 7.13.4.1.3 by any method that starts the prime mover and, upon reaching rated rpm, picks up not less than 30 percent of the nameplate kW rating for the first 30 minutes, not less than 50 percent of the nameplate kW rating for the next 30 minutes, and 100 percent of the nameplate kW rating for the next 60 minutes, less applicable derating factors for site conditions.

7.13.4.3.2 A unity power factor shall be permitted for on-site testing, provided that rated load tests at the rated power factor have been performed by the manufacturer of the EPS prior to shipment.

7.13.4.3.3 Where the EPS is a paralleled multi-unit EPS, each unit shall be permitted to be tested individually at its rating.

7.13.4.3.4 The data specified in 7.13.4.1.3(4), (5), (7), (8), and (9) shall be recorded at first load acceptance and every 15 minutes thereafter until the completion of the test period identified in 7.13.4.1.3(10).

Subsection 7.13.4.3.4 was revised by a tentative interim amendment (TIA). See page 1.

7.13.4.4 Any method recommended by the manufacturer for the cycle crank test shall be utilized to prevent the prime mover from running.

7.13.4.4.1 The control switch shall be set at "run" to cause the prime mover to crank.

7.13.4.4.2 The complete crank/rest cycle specified in 5.6.4.2 and Table 5.6.4.2 shall be observed.

7.13.4.4.3 The battery charge rate shall be recorded at 5-minute intervals for the first 15 minutes or until charge rate stabilization.

7.13.4.5 All safeties specified in 5.6.5 and 5.6.6 shall be tested on site as recommended by the manufacturer.

Exception: It shall be permitted for the manufacturer to test and document overcrank, high engine temperature, low lube oil pressure and overspeed safeties prior to shipment.

MONTHLY TEST

7.13.4.6 Items (1) through (4) shall be made available to the authority having jurisdiction at the time of the acceptance test:

- (1) Evidence of the prototype test as specified in 5.2.1.2 (for Level 1 systems)
- (2) A certified analysis as specified in 5.6.10.2
- (3) A letter of compliance as specified in 5.6.10.5
- (4) A manufacturer's certification of a rated load test at rated power factor with the ambient temperature, altitude, and fuel grade recorded

Chapter 8 Routine Maintenance and Operational Testing

8.1* General.

8.1.1 The routine maintenance and operational testing program shall be based on all of the following:

- (1) Manufacturer's recommendations
- (2) Instruction manuals
- (3) Minimum requirements of this chapter
- (4) The authority having jurisdiction

8.1.2 Consideration shall be given to temporarily providing a portable or alternate source whenever the emergency generator is out of service.

8.2* Manuals, Special Tools, and Spare Parts.

8.2.1 At least two sets of instruction manuals for all major components of the EPSS shall be supplied by the manufacturer(s) of the EPSS and shall contain the following:

- (1) A detailed explanation of the operation of the system
- (2) Instructions for routine maintenance
- (3) Detailed instructions for repair of the EPS and other major components of the EPSS
- (4) An illustrated parts list and part numbers
- (5) Illustrated and schematic drawings of electrical wiring systems, including operating and safety devices, control panels, instrumentation, and annunciators

8.2.2 For Level 1 systems, instruction manuals shall be kept in a secure, convenient location, one set near the equipment, and the other set in a separate location.

8.2.3 Special tools and testing devices necessary for routine maintenance shall be available for use when needed.

8.2.4 Replacement for parts identified by experience as high mortality items shall be maintained in a secure location(s) on the premises.

8.2.4.1 Consideration shall be given to stocking spare parts as recommended by the manufacturer.

8.3 Maintenance and Operational Testing.

8.3.1* The EPSS shall be maintained to ensure to a reasonable degree that the system is capable of supplying service within the time specified for the type and for the time duration specified for the class.

8.3.2 A routine maintenance and operational testing program shall be initiated immediately after the EPSS has passed acceptance tests or after completion of repairs that impact the operational reliability of the system.

8.3.2.1 The operational test shall be initiated at an ATS and shall include testing of each EPSS component on which maintenance or repair has been performed, including the transfer of each automatic and manual transfer switch to the alternate power source, for a period of not less than 30 minutes under operating temperature.

8.3.3 A written schedule for routine maintenance and operational testing of the EPSS shall be established.

8.3.4 A permanent record of the EPSS inspections, tests, exercising, operation, and repairs shall be maintained and readily available.

8.3.4.1 The permanent record shall include the following:

- (1) The date of the maintenance report
- (2) Identification of the servicing personnel
- (3) Notation of any unsatisfactory condition and the corrective action taken, including parts replaced
- (4) Testing of any repair for the time as recommended by the manufacturer

8.3.5* Transfer switches shall be subjected to a maintenance and testing program that includes all of the following operations:

- (1) Checking of connections
- (2) Inspection or testing for evidence of overheating and excessive contact erosion
- (3) Removal of dust and dirt
- (4) Replacement of contacts when required

8.3.6 Paralleling gear shall be subject to an inspection, testing, and maintenance program that includes all of the following operations:

- (1) Checking of connections
- (2) Inspection or testing for evidence of overheating and excessive contact erosion
- (3) Removal of dust and dirt
- (4) Replacement of contacts when required

8.3.7* Storage batteries, including electrolyte levels or battery voltage, used in connection with systems shall be inspected weekly and maintained in full compliance with manufacturer's specifications.

8.3.7.1 Maintenance of lead-acid batteries shall include the monthly testing and recording of electrolyte specific gravity. Battery conductance testing shall be permitted in lieu of the testing of specific gravity when applicable or warranted.

8.3.7.2 Defective batteries shall be replaced immediately upon discovery of defects.

8.3.8 A fuel quality test shall be performed at least annually using tests approved by ASTM standards.

8.4 Operational Inspection and Testing.

8.4.1* EPSSs, including all appurtenant components, shall be inspected weekly and exercised under load at least monthly.

8.4.1.1 If the generator set is used for standby power or for peak load shaving, such use shall be recorded and shall be permitted to be substituted for scheduled operations and testing of the generator set, providing the same record as required by 8.3.4.

NOTE THAT IT INCLUDES ATS TEST

8.4.2* Diesel generator sets in service shall be exercised at least once monthly, for a minimum of 30 minutes, using one of the following methods:

- (1) Loading that maintains the minimum exhaust gas temperatures as recommended by the manufacturer
- (2) Under operating temperature conditions and at not less than 30 percent of the EPS nameplate kW rating

8.4.2.1 The date and time of day for required testing shall be decided by the owner, based on facility operations.

8.4.2.2 Equivalent loads used for testing shall be automatically replaced with the emergency loads in case of failure of the primary source.

8.4.2.3 Diesel-powered EPS installations that do not meet the requirements of 8.4.2 shall be exercised monthly with the available EPSS load and shall be exercised annually with supplemental loads at not less than 50 percent of the EPS nameplate kW rating for 30 continuous minutes and at not less than 75 percent of the EPS nameplate kW rating for 1 continuous hour for a total test duration of not less than 1.5 continuous hours.

8.4.2.4 Spark-ignited generator sets shall be exercised at least once a month with the available EPSS load for 30 minutes or until the water temperature and the oil pressure have stabilized.

8.4.2.4.1 The date and time of day for required testing shall be decided by the owner, based on facility operations.

8.4.2.4.2 Equivalent loads used for testing shall be automatically replaced with the emergency loads in case of failure of the primary source.

8.4.3 The EPS test shall be initiated by simulating a power outage using the test switch(es) on the ATSS or by opening a normal breaker. Opening a normal breaker shall not be required.

8.4.4 Load tests of generator sets shall include complete cold starts.

8.4.5 Time delays shall be set as follows:

- (1) Time delay on start:
 - (a) 1 second minimum
 - (b) 0.5 second minimum for gas turbine units
- (2) Time delay on transfer to emergency: no minimum required
- (3) Time delay on restoration to normal: 5 minutes minimum
- (4) Time delay on shutdown: 5 minutes minimum

8.4.6 Transfer switches shall be operated monthly.

8.4.6.1 The monthly test of a transfer switch shall consist of electrically operating the transfer switch from the standard position to the alternate position and then a return to the standard position.

8.4.7* EPSS circuit breakers for Level 1 system usage, including main and feed breakers between the EPS and the transfer switch load terminals, shall be exercised annually with the EPS in the "off" position.

8.4.7.1 Circuit breakers rated in excess of 600 volts for Level 1 system usage shall be exercised every 6 months and shall be tested under simulated overload conditions every 2 years.

8.4.8 The routine maintenance and operational testing program shall be overseen by a properly instructed individual.

8.4.9* Level 1 EPSS shall be tested at least once within every 36 months.

8.4.9.1 Level 1 EPSS shall be tested continuously for the duration of its assigned class (see Section 4.2).

8.4.9.2 Where the assigned class is greater than 4 hours, it shall be permitted to terminate the test after 4 continuous hours.

8.4.9.3 The test shall be initiated by operating at least one transfer switch test function and then by operating the test function of all remaining ATSS, or initiated by opening all switches or breakers supplying normal power to all ATSS that are part of the EPSS being tested.

8.4.9.4 A power interruption to non-EPSS loads shall not be required.

8.4.9.5 The minimum load for this test shall be as specified in 8.4.9.5.1, 8.4.9.5.2, or 8.4.9.5.3.

8.4.9.5.1 For a diesel-powered EPS, loading shall be not less than 30 percent of the nameplate kW rating of the EPS. A supplemental load bank shall be permitted to be used to meet or exceed the 30 percent requirement.

8.4.9.5.2 For a diesel-powered EPS, loading shall be that which maintains the minimum exhaust gas temperatures as recommended by the manufacturer.

8.4.9.5.3 For spark-ignited EPSS, loading shall be the available EPSS load.

8.4.9.6 The test required in 8.4.9 shall be permitted to be combined with one of the monthly tests required by 8.4.2 and one of the annual tests required by 8.4.2.3 as a single test.

8.4.9.7 Where the test required in 8.4.9 is combined with the annual load bank test, the first 3 hours shall be at not less than the minimum loading required by 8.4.9.5 and the remaining hour shall be at not less than 75 percent of the nameplate kW rating of the EPS.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1.4 See NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*.

A.1.1.5(3) See Chapter 4.

A.3.2.1 **Approved.** The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 **Authority Having Jurisdiction (AHJ).** The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a

ANNUAL
2 HR
LOADS
TEST

4 HR
TEST

COMBINED
TEST
2 1/2 HR

3 YR
4 HR
TEST