

## GENERATOR LOAD BANK TESTING PROCEDURE

### I. General

A. Provide all equipment, labour, materials and supervision necessary to test the generator set specified. Tests shall be performed prior to acceptance or as installed on-site.

B. Acceptance testing of the installed generator set shall be conducted by a factory trained representative of Powercity. An authorized representative of the customer will also witness the acceptance tests. The test results shall be submitted to and approved by the customer before the generator set is accepted. Powercity shall furnish all testing equipment, materials, fuel\*, etc., needed to demonstrate the set is in compliance with the specification. Any deficiencies brought to the attention of Powercity shall be corrected and if warranted or requested by the customer, the test shall be re-performed prior to acceptance. Final Operations & Maintenance (O&M) manuals shall be submitted before the acceptance tests commence.

C. The acceptance tests shall be performed during a field test during which Powercity's representative shall demonstrate that the system performs in complete compliance with the specifications. As a minimum, a load bank test performed in accordance with the Philippine Electrical Code (PEC) and the National Fire Protection Association 110 (NFPA 110) section 7.13.4.2 to 7.13.4.3.2 (copy of which is included at the end of this section) shall be conducted. The load test shall use resistive type load banks specifically utilized for this purpose. The load bank will be capable of definite and precise incremental loading and shall not be dependent on the generator control instrumentation to read voltage and amperage of each phase. The test instrumentation will serve as a check of the generator set meters. Salt water brine tank load banks are not acceptable for this purpose and are disallowed and will not be utilized for this test.

D. Witnessed by a customer representative, load bank testing shall be performed for a period of two (2) hours which is initiated as follows:

Duration	% load
First 30 minutes	Not less than 30%
Next 30 minutes	Not less than 50%
Next 60 minutes	100%

\*Note: Fuel for the purpose of this testing shall be at the expense of the customer if testing is more than the two (2) hour limit.

## II. Generator and Load Bank Testing Outline

### 1. Prechecks

- Check proper generator position. Is the generator on a firm, dry and level ground?
- Check generator physical appearance for any damages.
- Check engine oil level, engine coolant level, and battery solution if non-maintenance free battery is used. Also check for leaks.
- Check all electrical connections at terminal panel of the generator set to the load bank if properly connected. If they are wired and tightened correctly?
- Check that the generator is properly grounded to a good earthen ground per local and PEC regulations.
- Verify required load voltage, phase and frequency.
- Check engine drive belt tension and condition.
- Locate the battery switch and turn it ON.

2. Run the generator without load to warm up the engine for at least 5 minutes.

3. Switch on the generator main circuit breaker.

4. In lieu of PEC and NFPA 110, perform a stepped load test on the generator at 30% for 30 minutes. This is the first 30 minutes of load test. Record the results of the following parameters:

Line voltages

Current

Battery voltage

Frequency

Engine speed

Engine temperature

Oil pressure

Test duration time

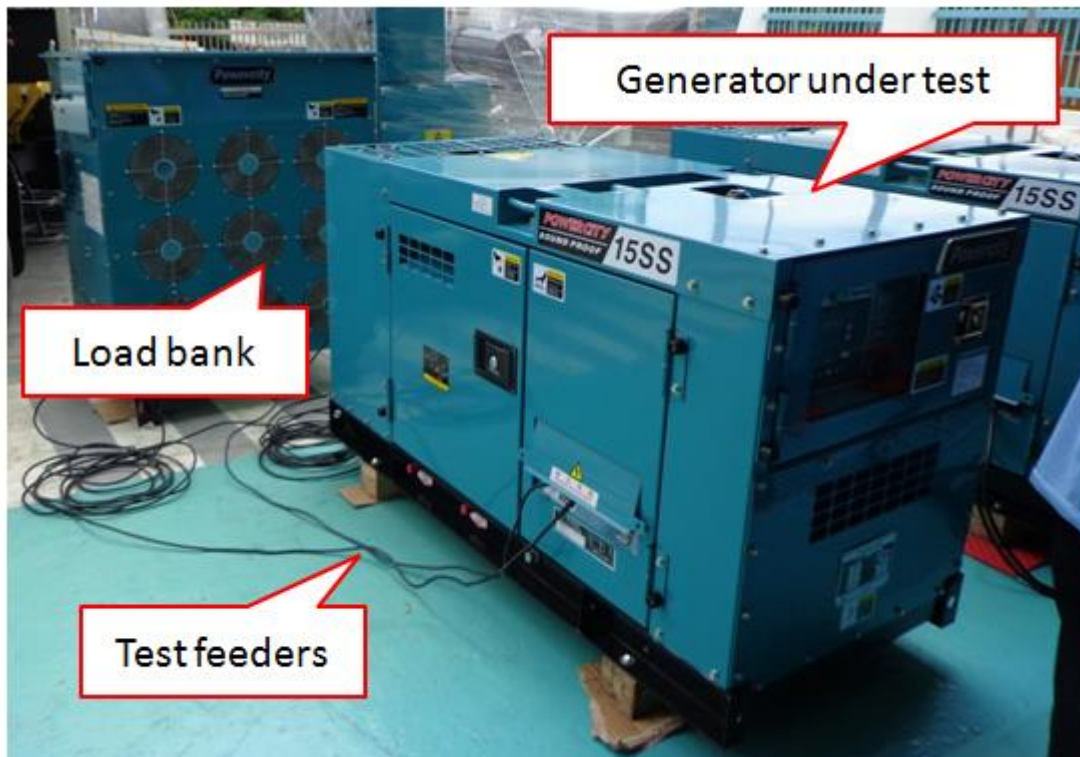
Also, take note of exhaust colour (black, gray, white, or clear), abnormal noise and fluid leaks if there is any.

5. Increase the stepped load on the generator at 50% for 30 minutes. This is the second 30 minutes of load test. Record again the results of the above parameters.

6. Increase the stepped load on the generator at 100% for 60 minutes. Record again the results of the above parameters.

7. Gradually switch off all step loads and allow the generator to cool down for at least 5 minutes.
8. Switch of the generator main circuit breaker and stop the generator.

Typical Generator and Load Bank Test Setup:



### III. Documentation

The following documentation is to be submitted to the customer prior to acceptance:

1. Installation certificates, if any.
2. A final on-site performance and inspection report summarizing load bank test results, engine controls testing, observations and other information relative to generator testing. This data is to be included as part of the product manual. All problems, findings or any corrective actions necessary to bring generators into compliance shall also be well documented.
3. Shop drawings.

#### APPENDIX A – The Philippine Electrical Code

**Chapter 7. Special Conditions**

**ARTICLE 7.0 — EMERGENCY SYSTEMS**

**7.0.1 General**

**7.0.1.1 Scope.** The provisions of this article apply to the electrical safety of the installation, operation, and maintenance of emergency systems consisting of circuits and equipment intended to supply, distribute, and control electricity for illumination, power, or both, to required facilities when the normal electrical supply or system is interrupted. Emergency systems are those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in systems in health care facilities, see Article 5.17.

**7.0.1.2 Application of Other Articles.** Except as modified by this article, all applicable articles of this Code shall apply.

**7.0.1.3 Equipment Approval.** All equipment shall be approved for use on emergency systems.

**7.0.1.4 Tests and Maintenance.**

(a) **Conduct or Witness Test.** The authority having jurisdiction shall conduct or witness a test of the complete system upon installation and periodically afterward.

(b) **Tested Periodically.** Systems shall be tested periodically on a schedule acceptable to the authority having jurisdiction to ensure the systems are maintained in proper operating condition.

(c) **Battery Systems Maintenance.** Where battery systems or unit equipments are involved, including batteries used for starting, control, or ignition in auxiliary engines, the authority having jurisdiction shall require periodic maintenance.

**For testing and maintenance procedures of emergency power supply systems (EPSS), see NFPA 110-2002, Standard for Emergency and Standby Power Systems.**

**7.0.1.5 Capacity.**

(a) **Capacity and Rating.** An emergency system shall have adequate capacity and rating for all loads to be operated simultaneously. The emergency system equipment shall be suitable for the maximum available fault current at its terminals.

(b) **Selective Load Pickup, Load Shedding, and Peak Load Shaving.** The alternate power source shall be permitted to supply and power systems during maximum anticipated load conditions shall be provided.

FPN: For testing and maintenance procedures of emergency power supply systems (EPSS), see NFPA 110-2002, Standard for Emergency and Standby Power Systems.

FPN No. 2: For further information regarding performance and maintenance of emergency systems in health care facilities, see NFPA 99-2002, Standard for Health Care Facilities.

FPN No. 3: Emergency systems are generally installed in places of assembly where artificial illumination is required for safe exiting and for panic control in buildings subject to occupancy by large numbers of persons, such as hotels, theaters, sports arenas, health care facilities, and similar institutions. Emergency systems may also provide power for such functions as ventilation where essential to maintain life, fire detection and alarm systems, elevators, fire pumps, public safety communications systems, industrial processes where current interruption would produce serious life safety or health hazards, and similar functions.

FPN No. 4: For specification of locations where emergency lighting is considered essential to life safety, see NFPA 101B-2003, Life Safety Code®.

FPN No. 5: For further information regarding performance of emergency and standby power systems, see NFPA 110-2002, Standard for Emergency and Standby Power Systems.

## APPENDIX B – The NFPA 110

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EMERGENCY AND STANDBY POWER SYSTEMS

**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 EPSS 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.

(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).

APPENDIX C – LOAD TEST REPORT



GENERATOR LOAD TESTING CLIENT : \_\_\_\_\_ DATE : \_\_\_\_\_

SITE NAME : \_\_\_\_\_ ADDRESS: \_\_\_\_\_

GENERAL SPECIFICATIONS			
MODEL		RATED VOLTAGE	
SERIAL NUMBER		PHASE	( ) 1 PH ( ) 3 PH
RATED KVA		RATED FREQUENCY	

RUN HOURS STARTED :

RUN HOURS FINISHED :

TEST METHOD	_____ %	_____ %	_____ %	_____ %
AC ( LINE – LINE ) VOLTAGE	L1-L2 _____	L1-L2 _____	L1-L2 _____	L1-L2 _____
	L2-L3 _____	L2-L3 _____	L2-L3 _____	L2-L3 _____
	L3-L1 _____	L3-L1 _____	L3-L1 _____	L3-L1 _____
AC (LINE-NEUTRAL) VOLTAGE	L1-N _____	L1-N _____	L1-N _____	L1-N _____
	L2-N _____	L2-N _____	L2-N _____	L2-N _____
	L3-N _____	L3-N _____	L3-N _____	L3-N _____
AC AMPERES	L1 _____	L1 _____	L1 _____	L1 _____
	L2 _____	L2 _____	L2 _____	L2 _____
	L3 _____	L3 _____	L3 _____	L3 _____
BATTERY VOLTAGE				
FREQUENCY ( HZ )				
ENGINE SPEED ( RPM )				
COOLANT TEMP ( °C )				
OIL PRESSURE ( BAR / PSI )				
TEST DURATION	___ ( ) HOURS	___ ( ) HOURS	___ ( ) HOURS	___ ( ) HOURS
	___ ( ) MINUTES	___ ( ) MINUTES	___ ( ) MINUTES	___ ( ) MINUTES

Noted by:  _____	Powercity Representative:  _____	Customer Representative:  _____
Signature over printed name	Signature over printed name	Signature over printed name
Date:	Date:	Date:

END OF SECTION