



Recommended Practice for Maintaining Emergency and Standby Engine-Generator Sets

SCOPE

This recommended practice applies to emergency and standby power systems from several hundred kilowatts to several megawatts, provided the individual engine-generator sets are no larger than 2 megawatts (MW) net power output each. Level-1 and Level-2 generators, as defined by the NFPA, are covered. This recommended practice applies to both portable and stationary units connected to the building's electrical system through manual transfer switches or automatic transfer switches (ATS). Standby or peak shaving power systems that are capable of synchronizing with the power grid are beyond the scope of this paper.

INTRODUCTION

Engine-generator sets, provide limited power in the event of a power outage. They consist of an engine, a generator, control panels, and possibly a fuel storage tank. The engine drives the generator to create electrical power.

The National Fire Protection Association (NFPA) defines two classes of electric generators: Level-1 generators provide support for life safety systems, such as emergency lighting, fire protection and ventilation to provide for safe egress in the event of an emergency; Level-2 generators encompass all other uses such as backup power for data centers, auxiliary systems, process controls, refrigeration, and HVAC systems. For the purposes of this recommended practice, Level-1 generators are referred to as emergency generators and level-2 generators as standby generators.

Emergency generators are typically 200 kW or smaller and run on gasoline, natural gas or #2 diesel fuel. Standby generators are typically much larger diesel engine units, often between 200 kW and 2,000 kW (2 MW). The use of natural gas for the larger units is often limited by the size of the available supply line. For instance, a 150 kW natural gas fired unit typically requires at least a 3" diameter supply line. Natural gas can be advantageous in smaller systems due to availability, reduced maintenance costs and reliability.

Emergency and standby generators are usually stationary units hard wired into the building's electrical distribution system through a transfer switch. Automatic Transfer Switches (ATS) are the most common type of transfer switches used for these applications. An ATS can provide a signal for the generator to start and transfer the load from the main supply to the generator.

Improper or poorly maintained generator sets are more prone to failure and are more likely to fail when needed most. The most common engine failures can be attributed to the starting, cooling, lubrication or fuel delivery systems. Failure of the electric generator is often attributed to excessive moisture in the generator windings. These types of failures can be minimized or prevented, by implementing regularly scheduled, comprehensive, generator maintenance and testing programs.

Depending on your location, it may be possible to contract with a local service provider or equipment dealer to provide/develop a preventive maintenance plan. In-house maintenance and testing should only be performed by qualified technicians. Either way, implementing a regular maintenance program is important in ensuring that your emergency generator works when you need it.

PROGRAM OVERVIEW

Many components of a good maintenance program can be likened to routine maintenance of your car: competent visual inspection of the apparatus, surrounding area and fluid levels; changing the lubrication, coolant and fuel on a regular basis; and testing the starting system, including the batteries. And like people, regular exercise of your engine-generator will keep it working at optimum performance levels.

Extreme temperatures, the presence of salt water, or excessive exposure to debris, such as dust or sand, may require more frequent inspections. Account for this while planning your maintenance program, and ask the manufacturer or your service provider for recommendations when housing a generator in an area subjected to these conditions.

Keeping a maintenance log is also important. A record of all maintenance, inspections, fluid levels, and test results will enable more accurate planning of future maintenance. Well-kept logs may also be important for warranty and insurance purposes.

This recommended practice is meant to compliment the OEM recommended maintenance. Any maintenance program that you develop should be based on the OEM recommended maintenance.

**VISUAL
INSPECTION**

The surrounding area should also be kept free of debris and provide sufficient ventilation during operation. When the generator is not running, conduct weekly inspections of the surrounding area to ensure fluids, such as oil and coolant, are not leaking. Inspect the exhaust system, including the manifold, muffler, and exhaust pipe. All connecting gaskets, joints, and welds should be thoroughly checked for potential leaks. Clean the starting and electrical system terminals. Connections should be tight and free from corrosion. Any adverse conditions should be corrected promptly by a qualified technician.

COOLING SYSTEM

Periodically check the coolant level. The cooling fluid mix is a balanced solution and varies from manufacturer to manufacturer. Don't mix your own. Make sure the solution you use is approved for use in your engine. Clean the radiator to remove any dust and/or debris, taking care not to damage the fins. Check that the coolant heater is operating correctly by monitoring the discharge temperature.

FUEL SYSTEM

Check the fuel delivery system periodically for leaks and correct pressure during exercise. Check fittings and connections; tighten them as needed. Drain and clean fuel filters monthly. Examine charge-air piping, and supply hoses for leaks, holes, and damaged seals. The fuel system and charge-air cooler should also be free of dirt and debris. Also check the fuel delivery system for leaks and the correct pressure.

Fuel maintenance is another important aspect of generator maintenance. Gasoline and diesel fuel degrade over time, separating and even growing micro-biological organisms. The fuel tank should be equipped with a plug or valve which allows the water to be drained from the tank periodically. A fuel sample, taken from the bottom and from the supply line, should be visually examined monthly. The fuel should look like new fuel; otherwise it should be filtered or replaced.

Fuel tanks should be sized so that the fuel is turned over on a regular basis. As a rule of thumb diesel fuel should be turned over or replaced on an annual basis. A proper fuel maintenance program is important.

Please see HSB's Recommended Practice for a Diesel Fuel Maintenance Program for more information.

**BATTERIES AND
WIRING**

Batteries should be checked to make sure they are fully charged. The batteries must be tested under load. Simply checking the voltage is an inaccurate method of testing power, as batteries change internally over time. They should be kept clean and free of corrosion. Where appropriate, check the specific gravity and electrolyte levels. All engine wiring should have tight connections and be free of corrosion or damage. Check with your generator manufacturer for their recommended battery and wiring practices, cleaning agents and solutions.

**GENERATOR
EXERCISE**

Exercise your engine-generator under a load monthly. Like humans, regular exercise keeps generators fit and in prime condition. During dynamic testing engine parts become lubricated, oxidation is prevented, old fuel is consumed, and overall functionality is ensured. Operate the generator monthly at a load of at least 30% of the nameplate rating for no shorter than 30 minutes. The generator should be operated for a minimum of 1 hour at 100% of the nameplate capacity at least annually. When testing a stationary unit, testing should be done *through* the ATS to ensure the entire system works properly. If it is not possible or practical to use a site load for the test a load bank should be used.

Sometimes problems only become noticeable during operation. Therefore it is important operators remain attentive for unusual circumstances, e.g. abnormal sights, sounds, vibration, excessive smoke or changes in fuel consumption. Remember to check for leaks, loose connections or components, and abnormal operating conditions. Correct these as necessary.

These recommendations are intended to supplement the equipment manufacturers' recommendations - not replace them. Always consult with your manufacturer before implementing any new service program.

HSB Recommended Best Practices –Maintenance Checklist

Weekly Procedures	Repairs (as necessary)	Pass/Fail
Visual inspection of unit – leaks, wear, damage, loose connections/components, corrosion	Correct	
Check engine oil level	Adjust	
Check engine coolant level	Adjust	
Check fuel delivery system – leaks, pressure	Tighten connections	
Check air inlets/outlets for debris	Clean	
Check battery charger – verify operation	Adjust	
Return the unit to standby setup for operation	When required	

Monthly Procedures	Repairs (as necessary)	Pass/Fail
Check engine coolant thermal protection level	Correct	
Check gearbox oil level (if equipped)	Adjust	
Check battery electrolyte level and specific gravity (where appropriate)	Adjust	
Check battery posts, cables, and charger –connections, corrosion, proper operation	Correct	
Check wiring – connections, corrosion, damage	Correct	
Check engine drive belts, fan coupling device – tension, wear, weather cracking, damage	Correct	
Automatic start and transfer to a load bank (or site load). Exercise for at least 30 minutes at a min. capacity of 30% of the nameplate rating. Check for leaks, connections, components, abnormal operating conditions	Correct	

Annual Procedures	Repairs (as necessary)	Pass/Fail
Engine oil and filters	Change and replace	
Gearbox Oil (if applicable)	Change	
Drive belts, fan coupling device for tension, wear, weather cracking, damage	Replace	
Clean and re-cap spark plugs	Replace	
Engine air filters	Replace	
Automatic start and transfer to a load bank (or site load). Exercise it for at least 1 hour at 100% of the nameplate capacity. Check for leaks, connections, components, abnormal operating conditions	Correct	