

Generator Insulation System Cleaning and Drying Procedures

The purpose of this Service Procedure is to provide a guide to cleaning and drying the insulation system of a synchronous AC generator that has either been subjected to high levels of moisture and/or contamination in the air stream – for example an engine with a defective rear main seal that discharging significant amounts of engine oil that have been drawn through with the generator cooling air flow.

Generators that have been pressure washed or have been in storage for an extended period in damp and/or unheated locations may have significant amounts of moisture present. In this case the insulation system must be thoroughly dried before the generator can be placed back in to service. A generator should have ≥ 500 megaohms resistance on all windings before being placed back in service.

This Service Procedure **does not** address units which have been flooded.



DISABLE AND LOCKOUT ANY ENGINE CRANKING DEVICES BEFORE ATTEMPTING TO SERVICE THE GENERATOR. FOR ELECTRIC START SETS, DISCONNECT THE CRANKING BATTERY. FOR AIR START, DISCONNECT THE AIR SUPPLY. FOR MOTOR GENERATOR SETS, OPEN THE POWER SUPPLY TO THE DRIVE MOTOR. FAILURE TO COMPLY WITH THESE SAFETY PROCEDURES COULD RESULT IN SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE.

SAFETY

1. **LOCK OUT / TAG OUT the Gen-Set.**
2. Remove Automatic Voltage Regulator power leads or fuse.
3. Remove and isolate Exciter Stator leads from Automatic Voltage Regulator

CLEANING THE INSULATION SYSTEM

Several cleaning methods are presented below. The appropriate cleaning method is determined by the amount and type of dirt and residue present in the unit. Regardless of the cleaning method selected, care must be taken to prevent damage to the winding insulation system during any cleaning process.

Use of a Pressure Washer is NOT Recommended

DRY CLEANING

If only dry dirt is present, cleaning with a soft, dry cloth, soft bristle brush, compressed air and/or a vacuum can be effective. Use a cloth or brush to dislodge large amounts of dry dirt and remove from the generator. A gentle cleaning motion is strongly recommended as aggressive scrubbing may damage the insulation system.

Blowing dirt out with clean, dry compressed air (≤ 30 psi) can be effective particularly when dirt has collected in spaces that cannot be reached by hand with a cloth or brush. A combination of a soft bristle brush and a vacuum can be very effective in loosening and removing larger deposits of dry dirt. **Do not** use wire brushes as these may damage the insulation system.

SOLVENT BASED CLEANING

If the unit has been contaminated with oil, grease, high levels of moisture or layers of caked on dirt that cannot be removed with the above **DRY CLEANING** methods, solvent based cleaning will be required.

Use only a Non-Alkaline Cleaning Solvent with a $\text{pH} \leq 8.5$. Solvent must be approved for use on polyester or epoxy varnishes. Take measures to protect the bearing from solvent and water application. Some disassembly of the generator – such as removal of the exciter stator may be required depending on the amount of dirt and contamination present.

1. Spray down the generator windings generously with the solvent from both the drive end and opposite drive end of the generator using an aerosol can or spray bottle for application. Allow sufficient time for the solvent to dissolve oil, grease, dirt and other contaminants.
2. Flush generator with tap water. A low pressure garden hose is sufficient. Use of a high pressure nozzle or setting is not recommended.
3. Repeat Steps 1 and 2 until the insulation system appears clean, all debris has been removed and there is no feel of an oily film or residue.
4. Blow remaining water out of the generator using clean, dry compressed air (≤ 30 psi).
5. Thoroughly dry the insulation system as detailed in the next section before placing the generator back in service.

DRYING THE INSULATION SYSTEM

Generators that have been in service can be accidentally exposed to water intrusion in to the windings systems due to storm, spray or wave action. In addition, generators that have been in storage for an extended period in damp and/or unheated locations may have significant amounts of moisture present. In either case the insulation system must be thoroughly dried before the generator can be placed back in to service. A generator should have ≥ 500 megaohms resistance on all windings before being placed back in service.

If you are unsure of the condition of the generator windings, best practice is to test the insulation system. The Service Procedure for Generator Insulation Testing may be found at the Marathon Generators website under Technical Support > Service Procedures:

<http://www.marathonelectric.com/generators/docs/manuals/SP0002.pdf>

SAFETY

Use LOCK OUT / TAG OUT procedures as appropriate for the gen-set.

There are several methods available for drying the generator insulation system. Two are covered in this paper – the **Forced Air Method** and the **Short Circuit Method**. A portable jobsite heater will typically be required when using the Forced Air Method. A MegOhm Meter (megger) will be required for testing the insulation system resistance, regardless of the drying method selected.

FORCED AIR METHOD

1. Remove Automatic Voltage Regulator power leads.
2. Remove and isolate Exciter Stator leads from Automatic Voltage Regulator
3. Start and run the gen-set without excitation.
4. Position a portable job site heater to direct hot air in to the generator air intake. Air temperature at point of entry to the generator should not exceed 66°C (150°F).
5. Run gen-set for an extended period. Depending on the condition of the windings and the amount of moisture present. A run time of 10-12 hours is not unusual. If a job site heater is not available, the drying time may be prolonged significantly.
6. After a minimum run time of 8 hours, shut down the gen-set and megger the generator main stator and exciter stator windings. Reference Generator Insulation Testing : <http://www.marathonelectric.com/generators/docs/manuals/SP0002.pdf> for procedure.
7. Repeat steps 3 – 6 until consistent megger readings ≥ 500 megaohms are obtained on all windings.
8. Reattach Automatic Voltage Regulator power leads.
9. Reattach Exciter Stator leads to Automatic Voltage Regulator.
10. Check all connections making sure they are tight and correct.
11. Start and run the gen-set at No-Load and thoroughly test, prior to placing back in service.

SHORT CIRCUIT METHOD

1. Remove Automatic Voltage Regulator power leads.
2. Remove and isolate Exciter Stator leads from Automatic Voltage Regulator
3. Short circuit all of the generator output lead wires together (L1 to L2 to L3). If using jumpers, be sure they are large enough to carry full load amperage.
4. Connect a variable DC power supply to exciter stator leads F+ (F1) and F- (F2). A Basler MVC300 or similar power supply will work.

If a variable DC power supply is not available the 24V gen-set battery system may be used with a rheostat (rated approximately 2 amps) in series with the battery will work.

5. Start and run the gen-set, while measuring the output current using a clip-on ammeter.
6. Adjust the voltage source to produce approximately 80% of the rated ac nameplate amps, but in no case, exceed nameplate amps. If an adjustable source is not available and current is excessive, use a lower dc source voltage or a larger resistor in series with the source.
7. Run gen-set for an extended period. Depending on the condition of the windings and the amount of moisture present. A run time of 8 -10 hours is not unusual.
8. After a minimum run time of 8 hours, shut down the gen-set, disconnect DC power supply and megger the generator main stator and exciter stator windings. Reference Generator Insulation Testing:
<http://www.marathonelectric.com/generators/docs/manuals/SP0002.pdf> for procedure.
9. Repeat steps 4 – 8 until consistent megger readings \geq 500 megaohms are obtained on all windings.
10. Disconnect the DC power supply.
11. Reattach Automatic Voltage Regulator power leads.
12. Reattach Exciter Stator leads to Automatic Voltage Regulator.
13. Check all connections making sure they are tight and correct.
14. Start and run the gen-set at No-Load and thoroughly test, prior to placing back in service.