

**DRY SYSTEMS TECHNOLOGIES®**

**OPERATION AND MAINTENANCE MANUAL**

**DST DRY SYSTEM®**

**SECTION B  
OPERATION**

**For machine operator**

**M301-017-01**

DRY SYSTEMS TECHNOLOGIES®

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## **OPERATION AND MAINTENANCE MANUAL PART B, M301-017-01**

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### **OPERATING INSTRUCTIONS FOR THE DST DRY SYSTEM™**

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#### Background:

The DST Management System™ is designed to be a low maintenance, explosionproof emissions control system. It reduces the diesel particulates by an average of more than 95%, minimizes diesel odor and reduces the carbon monoxide by up to 90%. Concentration and composition on NOx remains nearly unchanged and is a function of the diesel engine design and operation. It is important for the system that performance is properly monitored by the machine operator and that the prescribed basic maintenance procedures are followed.

**It is the responsibility of the Trained and Authorized Machine Operator to monitor the intake restriction, the exhaust backpressure, the exhaust gas temperature gauges and engine gauges frequently while operating this machine. The gauges are installed to provide necessary feedback for safe equipment operation and to maintain a clean working environment.**

#### **Pre-Operation Check (MSHA required)**

Before starting the engine, a **PRE-OPERATION CHECK** of the machine, safety power package and engine (Per the Pre-Op Instruction Form provided with the DST Dry System® and the Machine Operating Manual) must be performed. Follow the engine manufacturers, machine manufacturers and MSHA guidelines.

**Do not start the engine, unless you have verified that the machine is safe to operate and the area around the machine is secure.**

#### **Starting up the Engine: (Start of shift procedure)**

There are some precautions that must be followed to start the engine. Follow the engine manufacturer's recommendations and proceed in the following sequence:

- The area is clear and the parking brakes are set.
- Simultaneously engage the starter-override button and the start button and hold both until the engine starts running.
- Continue to hold the starter-override button until the oil pressure has built to the normal operating level, then release.
- Check the engine oil pressure gauge and other operating gauges to be in the normal operating range
- Allow the engine to warm-up for a few minutes at idle.
- Put the engine into high idle speed under no load.

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- Check the intake restriction gauge and the exhaust backpressure gauge to be in their normal range. If necessary, change the intake air cleaner and/or the exhaust particulate filter. See also M301-016-01 if a change of the exhaust particulate filter is necessary and the machine manual if an intake air cleaner change is necessary.  
For the MWM D916-6 engine, the maximum allowable intake restriction is 20" WG and the maximum allowable exhaust backpressure is 40" WG.  
For the Caterpillar 3300 Series PCNA engine, the maximum allowable intake restriction is 30" WG and the maximum allowable exhaust backpressure is 34" WG.  
For the Caterpillar 3300 Series PCTA engine, the maximum allowable intake restriction is 30" WG and the maximum allowable exhaust backpressure is 27" WG.  
For the Cummins C8.3 engine, the maximum allowable intake restriction is 25" WG and the maximum allowable exhaust backpressure is 41" WG or 60" WG, see approval.  
For the Isuzu 6BG1 Engine, the maximum allowable intake restriction is 25" WG and the maximum allowable exhaust backpressure is 41" WG.  
For the FPT N45 Engine, the maximum allowable intake restriction is 18" WG and the maximum allowable exhaust backpressure is 40" WG.

It is normal to notice diesel fuel odor for a short time during the initial engine start-up until the engine has warmed up. The odor will go away within a short time and should not cause any concern. The odor comes from unburned fuel that is exhausted from the engine before it starts. There may also be visible water vapor from the exhaust pipe during warm-up. This is evaporated water that has condensed inside the exhaust system while the vehicle was parked and cooled off. This is not a safety or health hazard.

Because the safety shutdown system does not allow the starter to be engaged without engine oil pressure, the **Starter Override Valve** needs to be engaged until the oil pressure has built to its normal pressure range. Failure to hold the Starter Override Valve engaged long enough to build up oil pressure will cause the engine to shut down.

There are also several temperature and other safety shutdown sensors that may prevent the engine from starting. **It is not possible to start the engine while any of the safety sensors are triggered.**

The **Starter Interlock Valve** prevents the engine starter from being re-engaged, once the engine is running.

Depending on the machine, the engine starting system may use compressed air or hydraulic oil for starting the engine. The supply for multiple starts is stored on the machine and replenished while the engine is running. Due to the limited storage capacity, the number of starting attempts is limited. The (pneumatic or hydraulic) system pressure must be above the minimum specified by the machine manufacturer to start the engine. If there is less system pressure, it must be recharged from external sources. (See machine operating manual or mine procedures for using external starting sources)

### Starting a cold Engine: (After extended parking)

There is no different procedure to start a cold engine. A permissible (Inby) engine can NOT be fitted with electrical glow plugs and the use of ether as a starting aid is restricted by MSHA and the engine manufacturer. Starting a cold engine may be difficult. Follow the engine manufacturer's recommendations.

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If starting aid is used, the use must be limited to MSHA legal locations and in strict compliance to all applicable MSHA rules and regulations and to the engine manufacturer's recommendations.

As a precaution, the machine should never be parked for long times in areas of the mine where there are very cold temperatures or high air volumes. If possible, it should be parked in a crosscut where there is little airflow. During downshifts, a location such as the shop or a crosscut with minimum airflow should be chosen. This will greatly enhance the starting of the engine.

- During the warm-up of the engine, and during the first 15-30 minutes of operation, water vapor may be vented from the exhaust pipe. This is normal and should not cause any concern. The water vapor is the moisture that has condensed inside the exhaust system while the machine was parked and cooled off, and is vented when heated by the exhaust gas.
- During the initial startup, some diesel odor may be noticed. This odor will go away within a short time and should not cause any concern. The odor comes from the unburned fuel that is exhausted during cranking before the engine starts.

### **Automatic Safety Shut-down Features:**

The Dry System™ Diesel Power Package is fitted with four automatic safety shutdown sensors:

- High coolant temperature sensor: Located near the thermostat and is triggered when the coolant temperature rises to above 205°F
- High exhaust temperature sensor: Located in the exhaust system, just upstream of the filter housing and is triggered when the exhaust temperature rises above 285°F
- Fire suppression system sensor: Incorporated into the fire suppression system and is triggered when the fire suppression system is activated either automatically or manually.
- Low oil pressure sensor: Installed on the engine and is triggered when the engine oil pressure drops below 10 Psi. There is an override valve that must be used during the starting of the engine

These sensors are provided to detect and prevent operation of the Diesel Engine and Diesel Power Package under unsafe conditions. Each of these sensors will shut down the engine's fuel supply immediately. Restarting of the engine is not possible, as long as any of the safety sensors is triggered. These sensors are all part of the MSHA Diesel Power Package Approval and must not be removed or tampered with.

**TAMPERING WITH OR DISABLING THE SAFETY SENSORS WILL VOID THE APPROVAL OF THE MACHINE.**

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Automatic shutdown of the engine is not a frequent occurrence. When it does happen, the cause needs to be investigated. Optional diagnostic indicators are available. A button will pop up when there is an automatic shutdown and allows the mechanic to pinpoint which sensor triggered the shutdown.

Whenever the engine automatically shuts down more than once in an 8-hour shift, the machine must be removed for service, the cause of the shut-down must be investigated and if necessary corrected by an authorized and qualified mechanic.

#### **Manual Shut-down Features:**

The diesel power package is fitted with two manual shutdown valves, both located in the operator's cab:

- **Regular Engine Shut-down:** Pull knob in operator's cab any time the engine should be stopped. The Regular Engine Shutdown will immediately close off the engine's fuel supply at the fuel injection pump and thereby stop the engine. Restarting of the engine is possible, once the engine has stopped, unless one of the safety shut-down valves is tripped...
- **Emergency Engine Shut-down:** Pull knob in operator's cab only if the Regular Engine Shut-down will not stop the engine. The Emergency Engine Shutdown will immediately shut down the engine's intake air supply. Restarting of the engine is not possible until the air intake shut-off valve has been re-set. (See machine manual)

#### **Excessive Idling:**

Excessive idling of the engine is not permitted and is also harmful to the performance of the diesel power package. The MWM D916-6 engine idles normally at 850 rpm. The Cat 3300 engine idles normally at 650 rpm. The Cummins C8.3 engine idles normally at 1000 rpm. The Isuzu 6BG1 engine idles normally at 850 rpm. At idle speed, unburned engine oil is exhausted and will deposit inside the exhaust system. This causes premature fouling and the need for frequent flushing of the exhaust system.

Idling for 3-5 minutes at a time would not be considered excessive, but anytime the machine is parked for more than 5 minutes would be excessive. Leaving a running machine outside of visual contact would also require that the engine is turned off.

#### **Operating recommendations:**

The operation of the engine is described in the engine manual. Follow the engine manufacturers and the equipment manufacturer's recommendations.

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### **OPERATING INSTRUCTIONS FOR THE DST DRY SYSTEM™**

We have prepared some useful recommendations that will help the machine to be operated more efficiently and to reduce exposure to diesel exhaust.

- Avoid lugging. Always use lower gears when carrying a load. The engine speed should always be operated above 1,700 rpm when under load, but never below 1,400 rpm for best performance of the engine and the DST Dry System.
- Avoid facing the radiator end of the machine into the ventilation air, when possible. This could lead to overheating of the cooling system.
- If traveling in the same direction as the ventilation air, try to keep the vehicle speed either below or above the velocity of the ventilation air. This will prevent accumulations of exhaust gases near the operator.
- Avoid prolonged idling, as this will lead to system fouling.
- Keep the radiator free from mud and obstructions, the fan intact and the fan belts from slipping. Use only 50-50 premix in the cooling system. This will prevent overheating.
- Keep intake and exhaust restrictions within the required limits. This will keep emissions under control.

### Stopping the engine and Parking the machine: (End of Shift Procedure)

To stop the engine, follow the engine and machine recommendations in the sequence described below:

- Park the machine at a safe location in compliance with all MSHA, State and Company safety procedures
- Make sure the engine is not overheated.
- If needed, allow the engine to cool down by idling it for about 2-3 minutes.
- Check all gauges to be in their normal operating range.
- Set the parking brakes.
- Turn off the engine.
- Complete the necessary forms, if applicable.
- **Report all unsafe conditions to maintenance.**
- If possible, fill the fuel tank before parking the machine for a full shift or longer.