



Subject: G-Drive Engine Exercising		This AEB is for the following applications: <input type="checkbox"/> Automotive <input type="checkbox"/> Industrial <input checked="" type="checkbox"/> Power Generation	
Date: April, 2000	Page 1 of 4	AEB Number 10.17	
(This AEB supersedes AEB 10.17 dated November, 1995)			

Cummins Engine Company recommends that their Standby Duty G-Drive engines be exercised on a regular basis for the following reasons.

- * Demonstrate that most of the key engine and generator subsystems are functioning
- * Contractual requirements
- * NFPA110 requirements
- * Maintain a coating of lubricating oil around the engine bearings
- * Maintain a coating of corrosion inhibitor throughout the cooling system.

Typically, a generator set is exercised at No-Load for 30 minutes, or until the engine has reached stabilized coolant temperatures. This No-Load exercising is performed on Weekly, Bi-Weekly or Monthly intervals dependent on contractual requirements.

Standby generator sets are often “exercised” by starting and operating at rated frequency (hz or RPM) with no load since non-critical load is not always available for testing. However, repeated or extended testing without load can cause combustion-related problems that have the potential to cause engine damage.

Exercise and test of a Generator Set System should include operation of the emergency transfer switch(es).

Operating the Engine at Low Load

Operating engines at no-load or loads less than 30% of the Standby Power Rating for prolonged periods of time may result in:

- * **Wet Stacking** – Wet stacking manifests itself in the accumulation of carbon particles, unburned fuel, lube oil, condensed water and acids in the exhaust system. This accumulation is due to incomplete combustion caused by low combustion temperatures.
- * **Carboning** - Carboning is the result of carbon particles deposited on top of the piston rings and in the injectors due to incomplete burning of fuel.

- * Fuel Dilution of Lube Oil - Piston rings are designed for optimum sealing under elevated combustion pressures. When these pressures are not achieved due to the application of low loads, the fuel injected into the combustion chamber can get past the piston rings causing a fuel dilution situation in the lubricating oil.
- * Water Contamination of Lube Oil - If the lubricating oil does not attain the desirable operating temperature, condensation of water may form in the engine oil pan.
- * Piston Detonation – Piston detonation damage is caused by excessive engine idling or low load conditions that lead to localized burning of fuel above the top ring when larger loads are required of the engine.

Cummins Exercising Recommendations

Cummins recommends the engine be exercised monthly with a minimum load of 30% of the Standby Power Rating or loaded to the recommended exhaust stack temperature, see table 1. The engine should be operated with stabilized coolant temperatures for thirty minutes.

Cummins Exercising Requirements

Cummins requires the engine be exercised once per year with a minimum load of 30% of the Standby Power Rating or loaded to the recommended exhaust stack temperature, see table 1. Operate the engine with stabilized coolant temperatures for thirty minutes. No-Load exercising and any additional exercising required by the control & switchgear manufacturers are in addition to Cummins required annual exercising. There is no Cummins requirement to exercise the engine at 100% of the Standby Power Rating.

NFPA110 Standards

The U.S. National Fire Protection Assoc. (NFPA 110 – 1999) states the generator set should be exercised monthly at 30% of the nameplate rating or loaded to the minimum engine exhaust gas temperature recommended by the engine manufacturer.

6-4.2 Generator sets in Level 1 and Level 2 service shall be exercised at least once monthly, for a minimum of 30 minutes using one of the following methods:

- (a) Under operating temperature conditions or at not less than 30 percent of the EPS (Emergency Power Supply) nameplate rating
- (b) Loading that maintains the minimum exhaust gas temperatures as recommended by the manufacturer

- 6-4.2.2** Diesel-powered EPS installations that do not meet the requirements of 6-4.2 shall be exercised monthly with the available EPSS (Emergency Power Supply System) load and exercised annually with supplemental loads at 25 percent of nameplate rating for 30 minutes, followed by 50 percent of nameplate rating for 30 minutes, followed by 75 percent of nameplate rating for 60 minutes, for a total of 2 continuous hours.

Table 1. Recommended Minimum Exhaust Stack Temperatures

<u>Engine Family</u>	<u>Exhaust Stack Temperatures</u>	
	<u>Calibrated Thermocouple</u>	<u>Infrared Instrument</u>
B Series	550°F	415°F
C Series	600°F	450°F
LTA10	650°F	500°F
M11	650°F	500°F
NT(A)855	650°F	500°F
N14	650°F	500°F
KTA19	650°F	500°F
VTA28	650°F	500°F
QST30	650°F	500°F
KTA38	650°F	500°F
QSK45	700°F	525°F
KTA50	700°F	525°F
QSK60	700°F	525°F

Exhaust Gas Temperature Measuring Guidelines

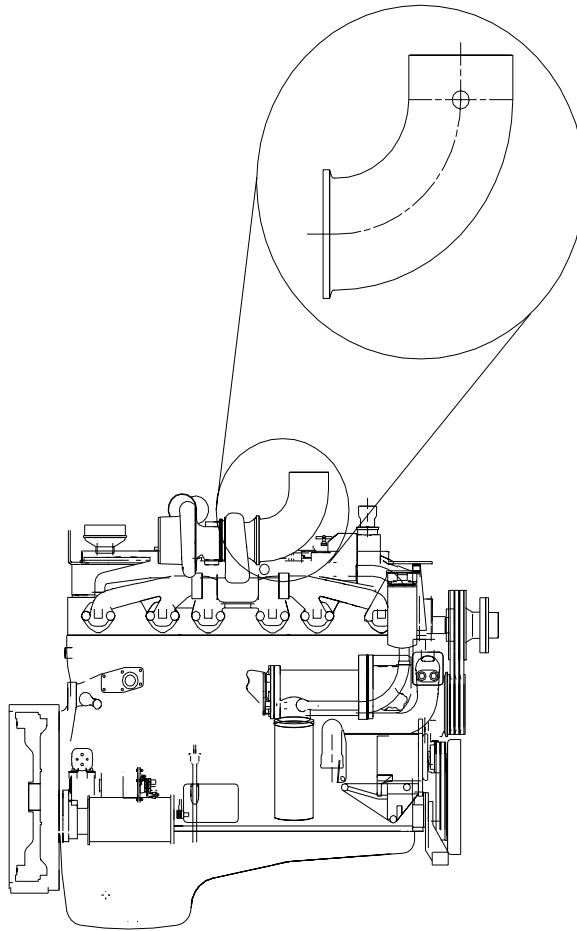
For an accurate measurement of the exhaust gas temperature, Cummins recommends mounting a thermocouple in the exhaust outlet elbow. The thermocouple should be “K” type (chromium/aluminum) to handle the temperature range. A suitable alloy wiring should be used while minimizing the number of connections to increase accuracy. Also, the thermocouple should be permanently installed in the exhaust outlet elbows, see figure #1. The insertion depth of the thermocouple should position the tip in the center of the exhaust stream.

Recent testing at our facility has shown temperature measurements with hand-held infrared instruments to be off by as much as 25% when compared with test cell grade calibrated thermocouples. There are many variables involved with taking an accurate reading with a hand-held infrared instrument. The following factors can affect the measurement.

- * Infrared instruments only measure surface temperatures, not actual gas temperatures.
- * Stack insulation may prevent a surface temperature reading.
- * Infrared instrument readings may differ with the surface finish of the exhaust stack.
- * The distance between the infrared instrument and the exhaust stack will affect the reading.

Figure #1

Typical thermocouple mounting location



Cooldown Period

Cummins recommends that G-Drive engines be operated “off-load” for 5 to 10 minutes, after the engine has been either exercised “loaded” or operated under normal application guidelines.

This duration of time is recommended to allow the engine temperatures (lube oil, turbo, etc.) to cool sufficiently. “Hot shutdowns” can cause permanent damage to the engine, genset, or associated electrical equipment and should be avoided. If the engine experiences an inadvertent (i.e. operator error or known quickly correctable cause) hot shutdown, attempt to restart engine immediately. If the shutdown is due to an alarm/safety switch condition, do not attempt a restart until the cause is determined and properly corrected. Do not attempt a restart sooner than 15 minutes after an alarm/safety switch condition shutdown unless operating in a critical emergency.