



Customer Engineering Bulletin

Title: G-Drive Engine Exercising and Low Load Operation		This CEB is for the following applications: ☐ Automotive ☐ Industrial ☐ Marine ☒ G-Drive
Date: 15 December 2015	Refer to CEB00044 for Safety Practices, Guidelines and Procedures	CEB Number: 00159
Engine models included: All		
Owner: Kedar Sapkal	Approver: per Procedure GCE-AS-1	Page 1 of 4

This CEB supersedes AEB 10.17 dated October 12, 2012.

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 operation without load can cause combustion-related and exhaust aftertreatment 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.

This is not applicable for engines with aftertreatment because of high exhaust 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.

Aftertreatment Damage - Aftertreatment damage is caused by running the engine at no load or low load for extended period of time that can lead to plugging the aftertreatment filter.

Cummins Exercising Recommendations

Cummins recommends the engine be exercised monthly with a minimum load of 10% (engines with MCRS and HPCR fuel systems without aftertreatment) and 30% (other engines) 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. Note the MCRS engine has been designed to withstand light load conditions due to its closed nozzle injectors, precise fuel metering, stable idle, stable combustion and precise electronic controls. Therefore, the HPCR and MCRS engines have the least restriction on light load requirements.

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 operation and any additional exercising required by the control and switchgear manufacturers are in addition to Cummins required annual exercising. For additional guidance on running at no-Load and low load conditions contact Cummins application engineer. There is no Cummins requirement to exercise the engine at 100% of the Standby Power rating.

Cummins requires that operator allow complete regeneration for about 40 minutes if aftertreatment light comes on for automatic regeneration after several exercised periods and make sure lamp turns off before engine shut down to prevent aftertreatment damage. Refer to AEB 24.40 for exhaust after treatment functionality and AEB 15.98 for regeneration switches.

NFPA110 Standards

The U.S. National Fire Protection Assoc. (NFPA 110 – 2010) states:

8.4.2 Diesel generator sets in service shall be exercised at least once monthly, for a minimum of 30 minutes, using one of the following methods:

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

8.4.2.1 The date and time of day for required testing shall be decided by the owner, based on facility operations.

8.4.2.2 Equivalent loads used for testing shall be automatically replaced with the emergency loads in case of failure of the primary source.

8.4.2.3 Diesel-powered EPS installations that do not meet the requirements of 8.4.2 shall be exercised monthly with the available EPSS (Emergency Power Supply System) load and shall be exercised annually with supplemental loads at not less than 50 percent of the EPS nameplate kW rating for 30 continuous minutes and at not less than 75 percent of the EPS nameplate kW rating for 1 continuous hour for a total test duration of not less than 1.5 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>
A Series	450 °F	338 °F
B3.3	550 °F	415 °F
B Series	550 °F	415 °F
QSB5	550 °F	415 °F
QSB7	600 °F	450 °F
C Series	600 °F	450 °F
QSL9	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
QSX15	700 °F	525 °F
KTA19	650 °F	500 °F
QSK23	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
QSK50	700 °F	525 °F
QSK60	700 °F	525 °F
QSK78	700 °F	525 °F

Exhaust Gas Temperature Measuring Guidelines

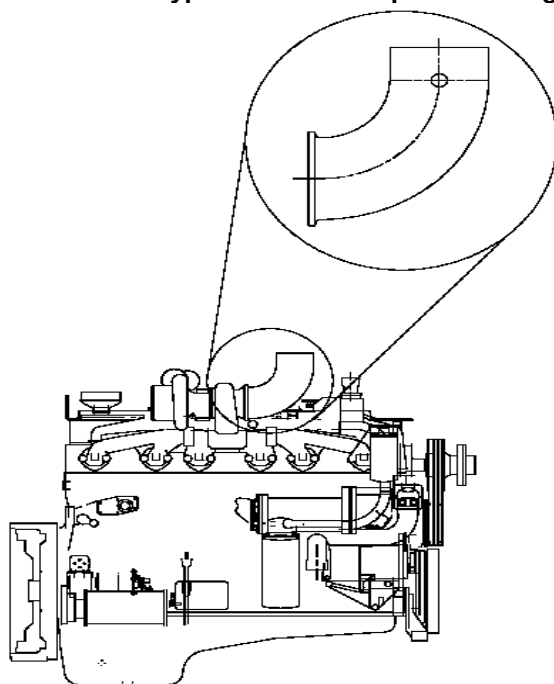
For an accurate measurement of the exhaust gas temperature, Cummins recommends mounting a thermocouple in the exhaust outlet elbow. The thermocouple should be “K” type (chromium/aluminum) to handle the temperature range. A suitable alloy wiring should be used while minimizing the number of connections 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



Cool Down 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.

Change Log

Revision	Date	Author	Description	Page(s)
03	15Dec15	Liz McLean	Initial creation of CEB from AEB 10.17.	All
02	12October12	O. Jinadu	Updated “Cummins Exercising Recommendations and Requirements”.	2-3
01	30May12	O. Jinadu	Updated AEB to most recent format. Updated AEB title. Updated “Operating the Engine at Low Load”, “Cummins Exercising Recommendations and Requirements”, and “NFPA 110 Standards” sections.	All 1 2-3
00	30May07	D. Bugert	Added A Series, B3.3, QSB5, QSB7, QSL9, QSX15 and QSK50 engine families to Table 1, Recommended Minimum Exhaust Stack Temperatures	3