

FACTORY TESTING

G3600 • G3500

G3400 • G3300

3600 • C175 • 3500

C32 • C30 • 3412E

3400 • 3126B

C18 • C-16 • C-15 • C15

C13 • C-12 • C11 • C-10

C9 • C-9 • C7

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Foreword

This section of the Application and Installation Guide generally describes Factory Testing for Caterpillar® engines listed on the cover of this section. Additional engine systems, components and dynamics are addressed in other sections of this Application and Installation Guide.

Engine-specific information and data are available from a variety of sources. Refer to the Introduction section of this guide for additional references.

Systems and components described in this guide may not be available or applicable for every engine.

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Factory Testing

All Caterpillar Engines are factory tested on a dynamometer to applicable engine test specifications and performance tolerances. Even engines that will be factory packaged and tested later as a package, receive the standard engine test. The test consists of a preparatory check, a break-in run, a full load performance check, a torque check, and high idle & low idle checks. In addition to the standard test, customer specified optional and special tests are available.

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Standard Engine & Generator Set Testing

The purpose of a production engine test is to demonstrate with the engine performance that:

- The components affecting engine performance are manufactured properly.
- The governors are set for rated speed at low and high idle.
- The engine is assembled properly.
- The engine settings are correct.

The purpose of a packaged generator set test is to:

- Check the mechanical and electrical integrity of the assembly.
- Set the generator voltage regulators.
- Check the steady state and transient response characteristics of the generator set for conformance to specification, assuring good quality electrical power.

In addition to the specified performance characteristics, other engine characteristics must be observed. Typical examples include blow-by, slobber, combustion gas leaks into the cooling system, exhaust system and air intake system leaks, excessive vibration and unusual noise. Engines exhibiting abnormalities in these areas, or in any other area that is determined to be detrimental, are not shipped.

The following summary of the testing procedure gives an excellent picture of the instrumentation, testing and test data of the Caterpillar dynamometer tests.

Standard Diesel Engine Performance Testing

Preparation for Running

Prior to running the engine, the following preparatory steps are taken:

- Visual inspection for leaks and loose fasteners.
- Engine's prelubrication system is checked and engine is prelubricated.
- When necessary, external oil supply is provided for auxiliary power-take-offs not lubricated by the engine's lubrication system.
- Proper oil level is provided.

Break-In Run

The break-in run, or engine warm-up, is done in order to condition the engine.

Full Load Performance Check

With the engine at the full load point and stabilized, the following data is calculated and/or recorded:

- Engine Speed
- Torque
- Fuel Rate
- Corrected Fuel Rate
- Oil Pressure
- Fuel Pressure
- Adjusted Boost (T/C engines only)
- Jacket Water Pump Inlet Temperature
- Jacket Water Outlet Temperature
- Jacket Water Outlet – Inlet Temperature (ΔT)
- Inlet Air Temperature, Dry Barometric Pressure, Inlet Air Restriction, Inlet Air Pressure, Fuel Density
- Inlet Fuel Temperature
- Inlet Fuel Pressure
- Observed Full Load Power
- Corrected Full Load Power
- Corrected Specific Fuel Consumption (CSFC)
- Water Temperature to Separate Circuit Aftercooler
- Total Correction Factor

Torque Check

After the full load performance check, the dynamometer load is increased until the engine lugs to the speed specified for torque check. When engine speed and load have stabilized, the following data is calculated and/or recorded:

- Torque Check Speed
- Torque
- Corrected Torque at Torque Check Speed
- Fuel Rate at Torque Check Speed
- Corrected Fuel Rate at Torque Check Speed
- Adjusted Boost at Torque Check Speed (Turbocharged engines only)

Note: Generator set engines are not required to perform the torque check portion of the test since they are not designed to operate at speeds lower than rated speed.

High Idle Check

After the torque check, the dynamometer load is removed, and the following data is recorded:

- Test High Idle Speed
- High Idle Stability

Low Idle Check

While operating at low idle speed, the following data is recorded:

- Low Idle Speed
- Oil Pressure
- Low Idle Stability

Standard Gas Engine Performance Testing

Preparation for Running

Prior to running the engine, the following preparatory steps are taken:

- Visual inspection for leaks and loose fasteners.
- Engine's prelubrication system is checked and engine is prelubricated.
- When necessary, external oil supply is provided for auxiliary power-take-off not lubricated by the engine's lubrication system.
- Proper oil level is provided.
- Engine inlet fuel to the gas pressure regulator is provided at the pressure shown in the individual engine performance specification.

Break-In Run

The break-in run, or engine warm-up, is done in order to condition the engine.

Full Load Performance Check

The gas engine performance test is only slightly different from the diesel engine test. With the engine at the full load point and stabilized, the following data is calculated and/or recorded:

- Engine Speed
- Torque
- Inlet Fuel Pressure - abs
- Fuel Rate
- Corrected Fuel Rate
- Oil Pressure
- Compressor Outlet Pressure - abs (Turbocharged engines only)
- Inlet Manifold Pressure - abs
- Jacket Water Pump Inlet Temperature
- Jacket Water Outlet Temperature
- Jacket Water Outlet – Inlet Temperature (ΔT)
- Inlet Air Temperature, Dry Barometric Pressure, Inlet Air Restriction, Inlet Air Pressure
- Observed Full Load Power
- Corrected Full Load Power
- Corrected Specific Fuel Consumption (CSFC)
- Water Temperature to Separate Circuit Aftercooler
- Total Correction Factor

Torque Check

After the full load performance check, the dynamometer load is increased until the engine lugs to the speed specified for torque check. When engine speed and load have stabilized, the following data is calculated and/or recorded:

- Torque Check Speed
- Torque
- Corrected Torque at Torque Check Speed
- Inlet Fuel Pressure - abs
- Fuel Rate
- Corrected Specific Fuel Consumption
- Compressor Outlet Pressure - abs (turbocharged engines only)

Note: 3300, 3400 and 3500 gas engines only recorded torque check speed, torque and corrected torque at torque check speed.

Note: Generator set engines are not required to perform the torque check portion of the test since they are not designed to operate at speeds lower than rated speed.

High Idle Check

After the torque check, the dynamometer load is removed and the following data is recorded:

- Test High Idle Speed
- High Idle Stability

Low Idle Check

While operating at low idle speed, record the following data:

- Low Idle Speed
- Oil Pressure
- Low Idle Stability

Standard Packaged Generator Set Performance Testing

In addition to the standard engine test, all generator sets packaged at the factory also receive a standard test procedure.

Note: This information is for 3600 products only. See test information for other products below.

Data is recorded as the generator set runs for:

- 30 minutes at 50% load
- 30 minutes at 75% load
- 3 hours at 100% load (see note below)

Note: 3300, 3400 and 3500 gas engines and 3500 diesel engines will run a maximum of 1 hour during a standard package test.

Note: Standby and gas engine sets are only tested for 1 hour maximum at full load.

Unless the generator set has overload capability, in which case the generator set runs for:

- 30 minutes at 50% load
- 30 minutes at 75% load
- 2 hours at 100% load
- 1 hour at 110% load (see note below)

Note: Standby, continuous and gas engine sets will not be tested above 100% of advertised load.

The data collected includes the same engine data collected during the engine performance testing, in addition to the following generator data:

- Amperage
- Voltage
- Real Power
- Imaginary Power
- Power Factor
- Frequency
- Response Check Time

The transient frequency and voltage will be recorded on a strip chart. All load changes will be performed at 30 second intervals in the following load sequence:

Diesel Engine Packaged Generator Sets

1. ISO Test Loads to 100%
2. 100% - 0%
3. 0% - 25% - 50% - 75% - 100%
4. 100% - 75% - 50% - 25% - 0%
5. 0% - 50%
6. 50% - 0%

Gas Engine Packaged Generator Sets

1. 10% Load Step Test (10% load steps to 100%, then 100% - No Load)
or
2. 5% Load Step Test (5% load steps to 100%, then 5% load steps back down)
or
3. 100% Load Rejection Test (100% - No Load)

Note: Unless otherwise stated on the Engine Shipping Order (ESO), the 10% Load Step Test will be performed.

Optional Factory Testing

In addition to the standard factory testing previously described, many optional tests can be performed at the factory in order to satisfy specific customer requirements. The optional tests available for specific Caterpillar engine models and packaged generator sets are found in the Price List, and the following provides a general description of several of the more commonly requested tests.

Customer Witness Test

Customer Witness tests are available at the factory for engines and packaged generator sets, both diesel and gas. While they can be tailored to specific customer needs, they typically consist of the basic tests previously described. The customer should allocate at least one full day at the factory for the tests. All engines and packaged generator sets to be witness tested will have previously been through the standard factory testing.

Testing required in addition to the standard tests require written agreement at least four weeks prior to the scheduled test date.

Certified Dynamometer Test

This test provides fuel rate, boost, specific fuel consumption, and fuel rack position information at full load power (fuel stop). It is intended for applications requiring certified documentation of the standard dynamometer test procedure.

Standard Fuel Consumption Test

This test provides fuel rate and specific fuel consumption at 100%, 75% and 50% of advertised power at rated speed.

Fuel Consumption Test – Fuel Stop

This test provides fuel rate and specific fuel consumption at 100%, 75% and 50% of full load power (fuel stop) at rated speed.

Rated Speed Performance Test

This test provides fuel rate, specific fuel consumption, and various temperatures and pressures at 110%, 100%, 75%, 50% and 25% of full load power (fuel stop) at rated speed. Intended for generator set and marine constant speed controllable pitch propeller applications. Alternate loads and speeds may be customer specified.

Overload Test

This test provides fuel rate, boost, specific fuel consumption, and fuel rack position information at a customer specified temporarily increased power setting. Customer must specify test power. Engine is reset to the purchased power level at test completion.

Note: The overload test will be for more than 100% of the advertised rating if, and only if, that rating has the full 110% overload capability.



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