



Engine Oil Pressure Distribution Test - Transient

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. The objective of this test is to evaluate the peak high engine speed oil pressure and the minimum low speed oil pressure in the system, during a transient engine speed sweep. The test procedure provides a method of capturing the baseline values of the engine oil pressure at various oil temperatures in a short time frame.

1.2 Applicability. All global GM Global Propulsion Systems passenger car and truck engine applications.

1.3 Remarks. This procedure has been written to evaluate the engine oil pressure distribution system performance under pre-determined conditions to ensure maximum engine life under normal and adverse operating conditions. This procedure is one of the criteria used for development, verification, and quality audit testing of engine oil distribution system.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- Test engine build specifications, engine "as installed" in-vehicle configuration, engine idle speed, Fuel Cut Off (FCO) speed, engine oil type and level from the GM Design Release Engineer (DRE)
- Test request from the GM Test Engineer
- Pressurized Lubrication Requirements

3 Resources

3.1 Facilities. Engineering laboratory equipped with an engine dynamometer test facilities, i.e., a high speed, programmable speed motor to spin the camshaft(s) directly or indirectly (through a straight crankshaft) and the valvetrain and oil pump/oil pump drive to the limiting speed of the valvetrain. **Note:** If the camshaft(s) are directly driven, an external oil pump must supply system pressure to the test engine. The test facility shall be equipped with a means to measure barometric pressure.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Engine Speed Transducer. Accuracy ± 2 Revolution per Minute (RPM). Full scale 10 000 RPM. Optical encoders, motor drive speed, etc.

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3.2.2 Electric Oil Heater. Equivalent of 5 kW with temperature control to control the test engine oil sump temperature up to 140 °C.

3.2.3 Pressure Taps. Pressure transducer with a range of 1000 kPa $\pm$ 5 kPa to 2000 kPa $\pm$ 5 kPa (10 bar $\pm$ 0.05 bar to 20 bar $\pm$ 0.05 bar). Typically, 8 to 12 pressure taps/transducers are required for this testing. The exact number and location of taps/data channels are documented in 4.1.1.1 or will be detailed in the test request by the GM Test Engineer.

3.2.4. Thermocouples. Thermocouples Type K, precision 1 °C. Full scale 180 °C.

3.2.5 Turbocharger Speed Monitoring. If applicable. Speed accuracy $\pm$ 2 RPM. Full scale 250 000 RPM

3.2.6 Data Acquisition System. As required.

3.3 Test Vehicle/Test Piece. A test engine built to the specifications provided by the GM Design Release Engineer (DRE). **Note:** The test is to be performed on an engine that has completed development torque stabilization.

3.4 Test Time.

Calendar time: 2 d

Test Time: 8 h

Coordination Time: 8 h

3.5 Test Required Information. Test engine build specifications, engine "as installed" in-vehicle configuration, engine idle speed, Fuel Cut Off (FCO) speed, engine oil type and level from the GM DRE. Test request from the GM Test Engineer. Pressurized Lubrication Requirements (see 7.1). **Note:** The specific purpose of the test will be stated in the test request.

3.6 Personnel/Skills. Test technician familiar with dynamometer testing and data acquisition systems.

4 Procedure

4.1 Preparation.

4.1.1 Instrumentation Installation. Install oil pressure taps, thermocouples, turbocharger speed monitoring, if applicable in the test engine. The minimum required locations are as described in 4.1.1.1 through 4.1.1.3.

4.1.1.1 Oil Pressure Taps. Connect all the oil pressure transducers or pressure gauges at all the pressure locations. Optimally, the transducers must be mounted directly to the measurement location to optimize transient response, however, ensure that the transducers are isolated or physically separated from engine structures or other mechanical excitation sources. If it is not possible to mount the transducers to measurement location, the length and diameter of any hoses/tubes/lines used shall be as short, and unrestrictive as practical, typically 5 mm diameter, and constructed of suitably rigid material to minimize the resulting oil pressure pulse attenuation errors. All the air in the hoses/tubes/lines must be purged prior to making measurements. The pressure transducers must have a suitable frequency response and the appropriate sampling rate, typically a minimum of 10 Hz. **Note:** Deviations from this optimal setup will compromise resulting test data.

- Oil pump inlet
- Oil pump outlet
- Oil filter inlet
- Oil filter outlet
- Oil cooler in
- Oil cooler out
- Block main gallery
- Oil supplying head
- Oil pressure switch location
- Intake and exhaust SHLA galleries (if applicable)
- Turbocharger oil inlet (if applicable)

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If an in-depth evaluation is requested, e.g., major block redesign or new engine program, additional required locations may include:

- Main bearing feeds
- Camshaft bearings
- Balance shaft bearings

4.1.1.2 Thermocouples.

- Ambient air
- Intake air
- Coolant out
- Engine oil: Main gallery
- Engine oil: Sump
- Oil cooler in/out in case an oil cooler is part of the oil circuit.

4.1.1.3 Turbocharger Speed Monitoring. If applicable.

Note: Additional measurements may be detailed in the test request by the GM Test Engineer.

4.1.2 Test Engine Installation. Install the test engine in the dynamometer test cell in "as installed" in-vehicle configuration with appropriate motoring speed monitoring, as required. Fill the crankcase with the oil type to the level specified by the GM DRE.

Note: Do not use an oil cooler unless the oil cooler is part of the oil circuit.

4.1.3 Equipment Preparation. Connect all the oil pressure taps, thermocouples, and the turbocharger speed monitoring to the appropriate signal conditioning and data acquisition instrumentation as required and check for proper function.

4.2 Conditions.

4.2.1 Environmental Conditions. Test at laboratory ambient conditions $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ with engine oil sump temperatures as described in 4.3, i.e., ambient ($25^{\circ}\text{C} \pm 5^{\circ}\text{C}$), 60°C (optional), 90°C (competitor data), 100°C , 120°C and 140°C ; verify with DRE.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Elevated Temperature Transient Speed Test. See Figure A1 in Appendix A. This test is used to evaluate the peak high speed and minimum low speed oil pressure in the system during an elevated temperature startup condition, i.e., oil temperatures at ambient ($25^{\circ}\text{C} \pm 5^{\circ}\text{C}$), 60°C (optional), 90°C (competitor data), 100°C , 120°C and 140°C ; verify with DRE

4.3.1.1 Warm up the engine by ramping the dynamometer to 2800 RPM, in 10 s, at 80% of peak Manifold Absolute Pressure (MAP); verify MAP setting with requestor before testing. Set the coolant temperature to 60°C for ambient and 60°C oil temperature conditions, 105°C for remaining oil temperature conditions.

4.3.1.2 Ramp the dynamometer speed to maximum engine speed, i.e., Fuel Cut Off (FCO) – 100 RPM, and 80% of peak MAP over 10 s to achieve the stabilized test temperatures.

4.3.1.3 Start the data acquisition system after sump oil temperature has been stabilized for 20 s at the desired test temperature.

Note: A specific sampling rate may be requested by the test engineer. See 4.1.1.1.

4.3.1.4 Ramp the dynamometer speed down to engine idle speed over 1 s and hold for 5 s.

4.3.1.5 Ramp the dynamometer speed up to engine speed of FCO – 100 RPM over 1 s, and hold peak speed for 3 s.

4.3.1.6 Ramp the dynamometer speed down to engine idle speed, over 10 s. Hold at idle for 20 s.

4.3.1.7 Stop the dynamometer and record data for 10 s to evaluate any transducer drift. Stop data acquisition.

Note: If the start of test temperature is greater than $\pm 3^{\circ}\text{C}$ from the end of test temperature, re-run the test. It may be necessary to use a test start temperature 3°C less than the desired test temperature.

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