



Dry Sump Scavenge Pump Sizing

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 main purpose of this test is to select the appropriate oil scavenge pump(s) flow capacity, using engine oil flow and oil drawdown data, to support a new program's Statement of Requirements (SOR) for the dry sump system.

1.2 Applicability. All General Motors Powertrain engines requiring a dry sump lubrication system.

1.3 Remarks. An oil scavenge pump, or series of scavenge pumps, is a required component for a dry sump lubrication system. Any area inside an engine where oil collects, or points where pressurized oil hemorrhages, is required to be scavenged for proper oil return to the reservoir. The flow capacity of the scavenge pump(s) must be appropriately sized to balance the rate of oil flow into the engine, and the oil flow return to the reservoir. Additionally, any dry sump applications intending to use the oil scavenge pump(s) to evacuate engine blow-by gas from the crankcase, must take the gas flow of the engine into account to allow the engine to be ventilated properly.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW16402 (ID) GMW16414 (ID)

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

2.3 Additional References.

- Anstalt für Verbrennungskraftmaschinen (AVL) Group, headquartered in Graz, Austria, www.avl.com
- Lubrication Subsystem Technical Specification (SSTS)
- Statement of Requirements (SOR)

3 Resources

3.1 Facilities. Engine dynamometer cell, with a dynamometer capable of sustaining maximum engine speed and engine power/torque output. The dynamometer should also be able to motor the test engine at speeds ≥ 1000 rpm.

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.

GM Confidential

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 1 of 7

3.2.1 Oil level sight tube(s), installed between the base and top of the oil reservoir. Alternatively, pressure sensors, mounted at the bottom and just above the column of oil in the reservoir, can be used (**Note:** this test method is still in development).

3.2.2 Video camera for monitoring oil level sight tube(s).

3.2.3 Electric or pneumatic Variable Drive Motor(s) (VDM), capable of delivering scavenge pump speed $>$ maximum engine speed. Alternatively, gear sets of varying sizes can be used to change the scavenge pump-to-engine drive ratio.

3.2.4 Electronic speed sensor for the VDM(s) and/or scavenge pump(s).

3.2.5 Oil scavenge lines, sized $\geq$ the inlet and outlet ports of the scavenge pump(s), respectively. These lines should be as short as possible to connect the scavenge pump ports to the pickup location(s) on the engine. These lines should also be free of high and low spots.

3.2.6 In-line oil filtration units, $\geq$ particle size filtration of engine oil filter, mounted in series with the oil scavenge line to the inlet of the scavenge pump(s).

3.2.7 Oil reservoir with appropriate capacity to allow ≥ 20 s of dwell time before complete evacuation, assuming no oil, at maximum engine oil flow rate (e.g., a 40 L/minute engine will require a reservoir tank with 13.34 L of oil volume, with additional volume for an air/oil separation system, if appropriate).

3.2.8 Centrifugal separator, in series with main oil scavenge return line to oil reservoir. Alternatively, a separation device in the oil reservoir can be used.

3.2.9 Stopwatch or equivalent (if taking data point without automatic sampling capability).

3.3 Test Vehicle/Test Piece.

3.3.1 The latest version of the test engine, for which the dry sump lubrication system is being developed. The test engine should include the latest oil pressure pump, and any oil-fed components (e.g., cam phaser, piston cooling jets, etc.)

3.3.2 A scavenge pump, or series of scavenge pumps, with flow capacity equivalent to a 3.5:1 scavenge flow-to-engine oil flow (or oil and blow-by gas flow for engines intending to use the scavenge pump(s) to evacuate the crankcase), at a 1:1 scavenge pump-to-engine speed ratio. Refer to 5.1 for an explanation of scavenge flow calculations. The scavenge pump(s) should include a driveshaft that can be operated by a VDM, or splined to accept pulleys of various sizes (if engine-driven). See Figure 1 and Figure 2 for examples of scavenge pump drive options.

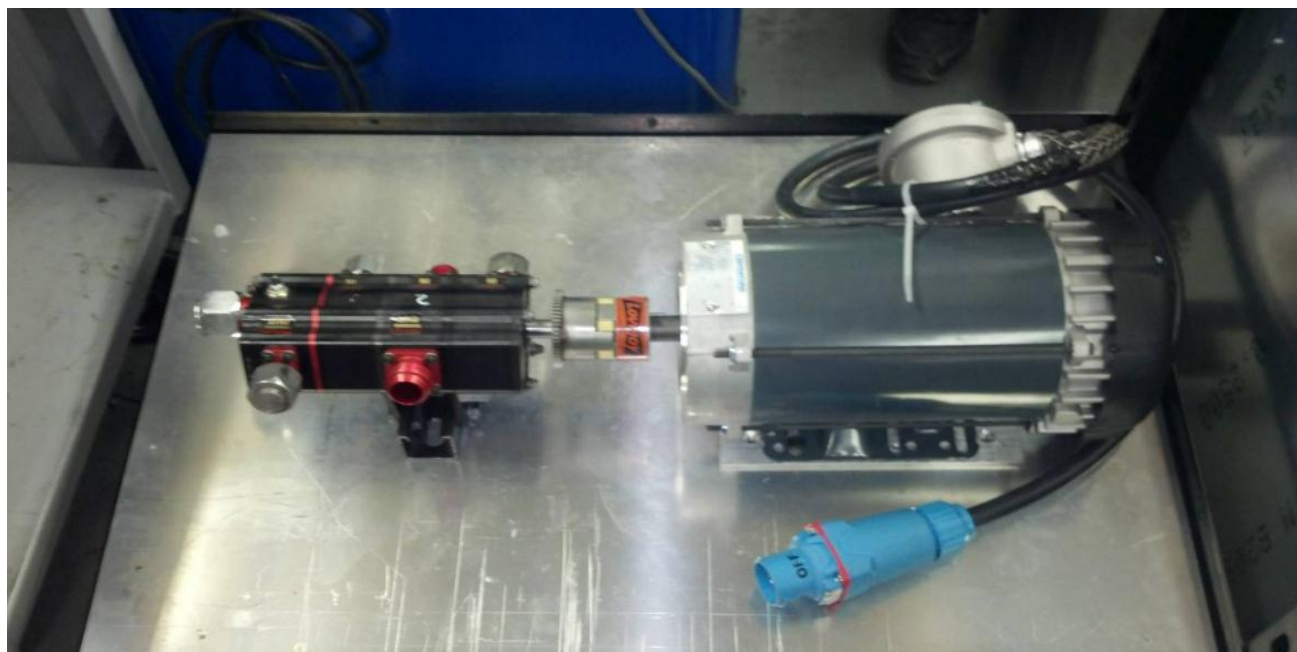


Figure 1: Variable Speed Drive Motor (VDM)

GM Confidential

© Copyright 2014 General Motors Company All Rights Reserved

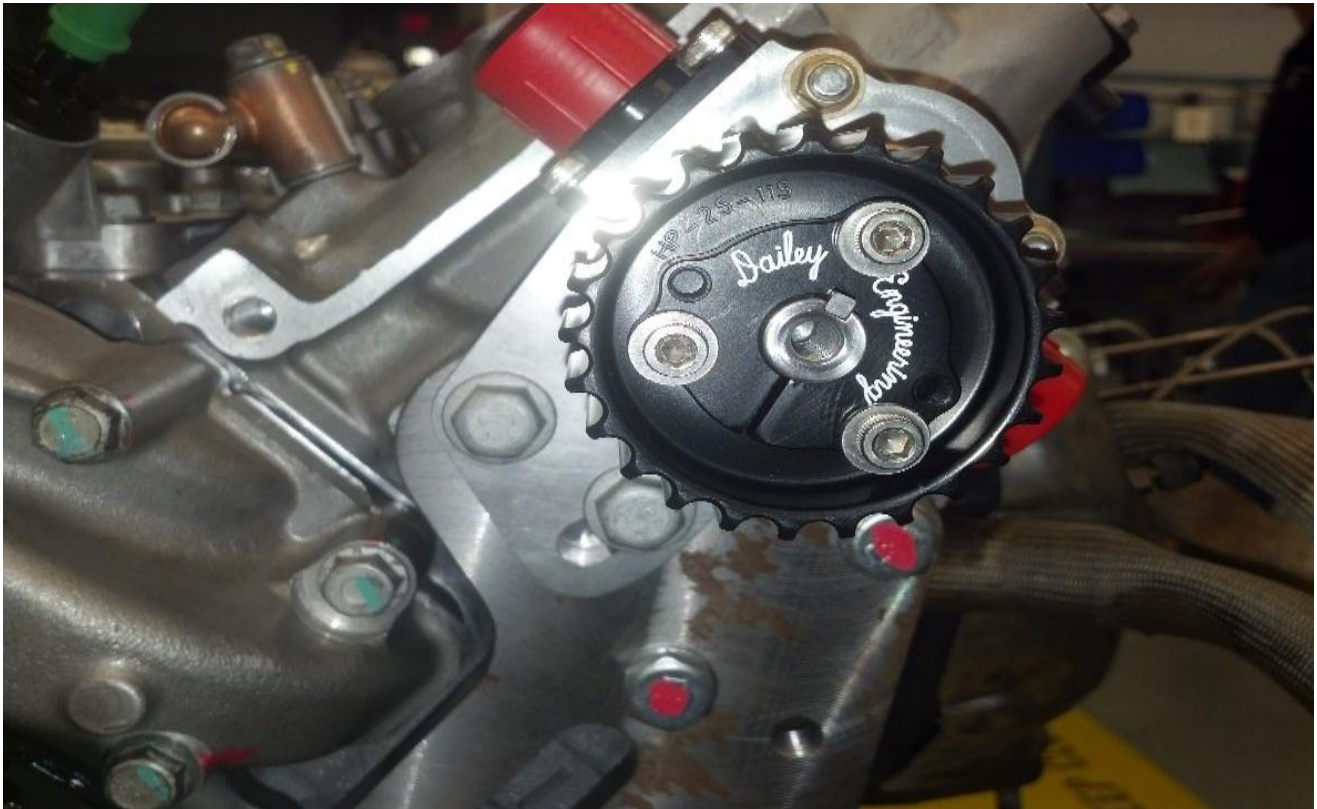


Figure 2: Crank-Driven Pulley

3.3.3 The latest design level oil pan and crankshaft oil scraper, or functionally representative parts.

Note: For engines intending to draw oil scavenge from locations other than the oil pan, the latest design level scavenge manifold, or functionally representative part(s), is required.

3.3.4 The latest ventilation hardware, or functionally representative hardware, for engines intending to use a crankcase ventilation system other than the scavenge pump(s).

Note: if a crankcase ventilation system is not intended to be used, the oil reservoir must still be ventilated to prevent over pressurization from the incoming scavenge flow.

3.4 Test Time.

Calendar time: 12 days
Test hours: 80 hours
Coordination hours: 16 hours

3.5 Test Required Information.

3.5.1 The engine oil flow rate for the test engine on which the scavenge pump size is being developed. If independent sections of the engine are to be scavenged, the oil flow rate for those sections should be measured, if possible. If this is not possible, the oil flow rate for each scavenged section should be quantified through analysis. Refer to GMW16402 for information pertaining to the engine oil flow rate test.

3.5.2 The engine blow-by gas flow rate for the test engine on which the scavenge pump size is being developed. Refer to GMW16414 for information pertaining to the engine blow-by mapping test. Additionally, if the engine program intends to introduce fresh make-up air into the crankcase, the estimated flow rate of fresh air must be added to the blow-by gas flow rate when calculating.

GM Confidential

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 3 of 7