

Report On
Sequence IIIG Evaluation

Version

Conducted For

| | |
|--|---|
| | V = Valid |
| | I = Invalid |
| | N = Results Cannot Be Interpreted As Representative Of Oil Performance (Non-Reference Oil) And Shall Not Be Used For Multiple Test Acceptance |

| | |
|--|-----------------------------|
| | NR = Non-Reference Oil Test |
| | RO = Reference Oil Test |

| Test Number | | | | | |
|-------------------|--|------------|----------|----------|--|
| Test Stand | | Stand Test | | Lab Test | |
| Oil Code | | | | | |
| Formulation/Stand | | | | | |
| Alternate Codes | | | | | |
| EOT Date | | | EOT Time | | |

| |
|---|
| <p>In my opinion this test _____ been conducted in a valid manner in accordance with ASTM Test Method D 7320 and the appropriate amendments through the information letter system. The remarks included in the report describe the anomalies associated with this test.</p> |
|---|

Submitted By: _____

Testing Laboratory

Signature

Typed Name

Title

Form 2

Sequence III G

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^A ACC Conformance Statement is required only for ACC registered tests

Sequence IIIG

Form 3

Summary of Test Method

The Sequence IIIG Test is a fired-engine, dynamometer lubricant test for evaluating automotive engine oils for certain high-temperature performance characteristics, including oil thickening, varnish deposition, oil consumption, and engine wear. Such oils include both single viscosity grade and multi-viscosity grade oils that are used in spark-ignition, gasoline-fueled engines, as well as diesel engines. The Sequence IIIG Test utilizes a 1996 General Motors Powertrain 3800 Series II, water-cooled, 4 cycle, V-6 engine as the test apparatus. The Sequence IIIG test engine is an overhead valve design (OHV) and uses a single camshaft operating both intake and exhaust valves via pushrods and hydraulic valve lifters in a sliding-follower arrangement. The engine uses one intake and one exhaust valve per cylinder. Induction is handled by a modified GM port fuel injection system setting the Air-to-Fuel ratio at 15:1. The test engine is overhauled prior to each test, during which critical engine dimensions are measured and rated or measured parts (pistons, camshaft, valve lifters, etc.) are replaced.

The Sequence IIIG Test consists of a 10-minute operational check, followed by 100 hours of engine operation at moderately high speed, load, and temperature conditions. The 100-hour segment is broken down into five 20-hour test segments. Following each 20-hour segment, and the 10-minute operational check, oil samples are drawn from the engine. The kinematic viscosities of the 20-hour segment samples are compared to the viscosity of the 10-minute sample to determine the viscosity increase of the test oil.

The Sequence IIIG Test is operated at the following test states during the 100-hour portion of the test:

| Parameter | Set Point |
|--------------------------------------|------------|
| Engine Speed | 3600 r/min |
| Engine Load | 250 N-m |
| Oil Filter Block Temperature | 150 °C |
| Coolant Outlet Temperature | 115 °C |
| Fuel Pressure | 377.5 kPa |
| Intake Air Temperature | 35 °C |
| Intake Air Pressure | 0.05 kPa |
| Intake Air Dew Point | 16.1 °C |
| Exhaust Back Pressure | 6 kPa |
| Engine Coolant Flow | 160 L/min |
| Breather Tube Coolant Flow | 10 L/min |
| Air-to-Fuel Ratio | 15.0:1 |
| Condenser Coolant Outlet Temperature | 40 °C |

**Sequence IIIG
Form 4**

Test Result Summary

| | | | |
|------------------------|--|----------|--|
| Lab | | Oil Code | |
| Stand | | Test No. | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |

| | | | |
|----------------|--|---------------------------|--|
| Date Started | | Engine No. | |
| Time Started | | Fuel Batch | |
| Date Completed | | SAE Viscosity | |
| Time Completed | | TMC Oil Code ^A | |
| Test Length | | | |

| Pass/Fail Results | | | |
|----------------------------------|-------------------------------|---------------------------------------|--|
| | Viscosity Increase (%) | Average Cam + Lifter Wear (µm) | Average Weighted Piston Deposits (merits) |
| Original Units | | | |
| Transformed Results ^B | | | |
| Industry Correction Factor | | | |
| Corrected Transformed | | | |
| Severity Adjustment | | | |
| Final Transformed Result | | | |
| Final Original Unit Result | | | |

| Additional Results | | | |
|---------------------------------------|--|----------------------------|--|
| Oil Consumption Hours, h ^C | | Oil Consumption, L | |
| Maximum Cam + Lifter Wear, µm | | Number of Cold-Stuck Rings | |
| Average Oil Ring Plugging, % | | Number of Hot-Stuck Ring | |
| Average Piston Varnish, merits | | | |

^AReference Oil Tests Only

^BViscosity Increase uses LN(PVIS), Average Cam + Lifter Wear uses LN(ACLW), Weighted Piston Deposits does not use a transformation

^CTest Hours at which Oil Consumption was calculated

Sequence III G
Form 5
Operational Summary

| | | | |
|------------------------|--|----------|--|
| Lab | | Oil Code | |
| Stand | | Test No. | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |

| | Parameter | Units | QI Threshold | EOT QI | Target | Average | Standard Deviation | Number of | |
|-----------------------|-----------------------------|-------|--------------|--------|--------|---------|--------------------|-----------|-----|
| | | | | | | | | Samples | BQD |
| Controlled Parameters | Speed | r/min | 0.000 | | 3600 | | | | |
| | Load | Nm | 0.000 | | 250 | | | | |
| | Oil Filter Block | °C | 0.000 | | 150.0 | | | | |
| | Engine Coolant Out | °C | 0.000 | | 115.0 | | | | |
| | Condenser Coolant Out | °C | 0.000 | | 40.0 | | | | |
| | Left Air-to-Fuel | | 0.000 | | 15.0 | | | | |
| | Right Air-to-Fuel | | 0.000 | | 15.0 | | | | |
| | Left Exhaust Back Pressure | kPa | 0.000 | | 6.0 | | | | |
| | Right Exhaust Back Pressure | kPa | 0.000 | | 6.0 | | | | |
| | Intake Air | kPa | 0.000 | | 0.05 | | | | |
| Engine Coolant Flow | L/min | 0.000 | | 160.0 | | | | | |

| | Parameter | Units | Average | Standard Deviation | Number of | |
|---------------------------|----------------------|-------|---------|--------------------|-----------|-----|
| | | | | | Samples | BQD |
| Non-controlled Parameters | Oil Sump | °C | | | | |
| | Pump Outlet Pressure | kPa | | | | |
| | Gallery Pressure | kPa | | | | |
| | Engine Coolant In | °C | | | | |
| | Fuel Inlet | °C | | | | |
| | Intake Air | °C | | | | |
| | Intake Air Dew Point | °C | | | | |
| | Intake Vacuum | kPa | | | | |
| | Crankcase | kPa | | | | |
| | Fuel Pressure | kPa | | | | |

| Oil Consumption Data | | | | | | |
|------------------------|----------------|--|--|--|--|--|
| Hours | Initial Run-in | | | | | |
| Level (ml) low | | | | | | |
| Total Oil Consumed (L) | | | | | | |

| NO _x Measurement | | | |
|-----------------------------|--|--|--|
| Hours | | | |
| NO _x , ppm | | | |

Sequence III G

Form 6

Used Oil Analysis Results

| | | | |
|------------------------|--|----------|--|
| Lab | | Oil Code | |
| Stand | | Test No. | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |

| Viscosity Increase Data (cSt at 40°C) | | | |
|--|------------------------|--------|---------|
| Hours | Viscosity ^A | Change | Percent |
| New Oil | | | |
| Initial ^B | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| Results of ICP Analysis of Used Oil | | | |
|--|------|--------|------|
| Hours | Iron | Copper | Lead |
| Initial | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

^A 8000 cSt is maximum allowable viscosity

^B At end of leveling run

Sequence III G

Form 7

Valve Lifter and Camshaft Wear Results

| | | | |
|------------------------|--|----------|--|
| Lab | | Oil Code | |
| Stand | | Test No. | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |

| Number | Camshaft Lobe, µm | Valve Lifter, µm | Cam & Lifter Wear, µm |
|---------------|------------------------------|-------------------------|--------------------------------------|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| | | | |
| Maximum | | | |
| Minimum | | | |
| Average | | | |

Sequence III G

Form 8

Summary of Oil Ring Land Deposit Rating

| | | | |
|------------------------|--|-------------|--|
| Lab | | Oil Code | |
| Stand | | Test No. | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |
| Rater | | Rating Date | |

| Piston | Oil Ring Land Deposit, Merits | % Chipped |
|---------------|--------------------------------------|------------------|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| Average | | |

| Piston | % Oil Ring Plugging | Ring Sticking^A | |
|---------------|----------------------------|----------------------------------|-------------------------|
| | | Hot-Stuck Rings | Cold-Stuck Rings |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| Total | | | |
| Average | | | |

^A Possible values T = top compression ring
 B = bottom compression ring
 O = oil ring
 N = none

Sequence IIIG

Form 9

Summary of Piston Deposits

| | | | |
|------------------------|--|-------------|--|
| Lab | | Oil Code | |
| Stand | | Test No. | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |
| Rater | | Rating Date | |

Note: CRC Manual 20 used for ALL Ratings

NOTE: These are un-weighted ratings

| | Grooves, merits | | | Lands, merits | | Undercrown, merits |
|----------|-----------------|------|------|---------------|------|--------------------|
| | 1 | 2 | 3 | 2 | 3 | |
| Piston 1 | | | | | | |
| Piston 2 | | | | | | |
| Piston 3 | | | | | | |
| Piston 4 | | | | | | |
| Piston 5 | | | | | | |
| Piston 6 | | | | | | |
| WF | 0.05 | 0.10 | 0.20 | 0.15 | 0.30 | 0.10 |

Note: These are un-weighted ratings

| | Piston Skirt Varnish, merits | | |
|----------|------------------------------|-------------|---------|
| | Thrust | Anti-Thrust | Average |
| Piston 1 | | | |
| Piston 2 | | | |
| Piston 3 | | | |
| Piston 4 | | | |
| Piston 5 | | | |
| Piston 6 | | | |
| Average | | | |
| WF | | | 0.10 |

PSVAV_x = (PSVT_x + PSVA_x)/2 where x = Number of Piston

PSVTAV = average of six Thrust Piston Skirt ratings.

PSVAAV = average of six Anti-Thrust Piston Skirt ratings.

APV = average of all 12 Piston Skirt ratings.

| | Total Weighted Deposits, merits |
|----------|---------------------------------|
| Piston 1 | |
| Piston 2 | |
| Piston 3 | |
| Piston 4 | |
| Piston 5 | |
| Piston 6 | |

$$WPD_x = (WF \cdot G1P_x) + (WF \cdot G2P_x) + (WF \cdot G3P_x) + (WF \cdot L2P_x) + (WF \cdot ORLD_x) + (WF \cdot UCP_x) + (WF \cdot PSVAV_x)$$

where: x = Number of Piston

WF = Appropriate Weighting Factor (WF) for part, from table.

| | |
|--|--|
| Average Weighted Piston Deposits, merits | |
|--|--|

$$WPD = (WPD_1 + WPD_2 + WPD_3 + WPD_4 + WPD_5 + WPD_6) / 6$$

**Sequence IIIG
Form 10
Blowby Values & Plot**

| | | | |
|------------------------|--|----------|--|
| Lab | | Oil Code | |
| Stand | | Test No. | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |

Blowby Plot



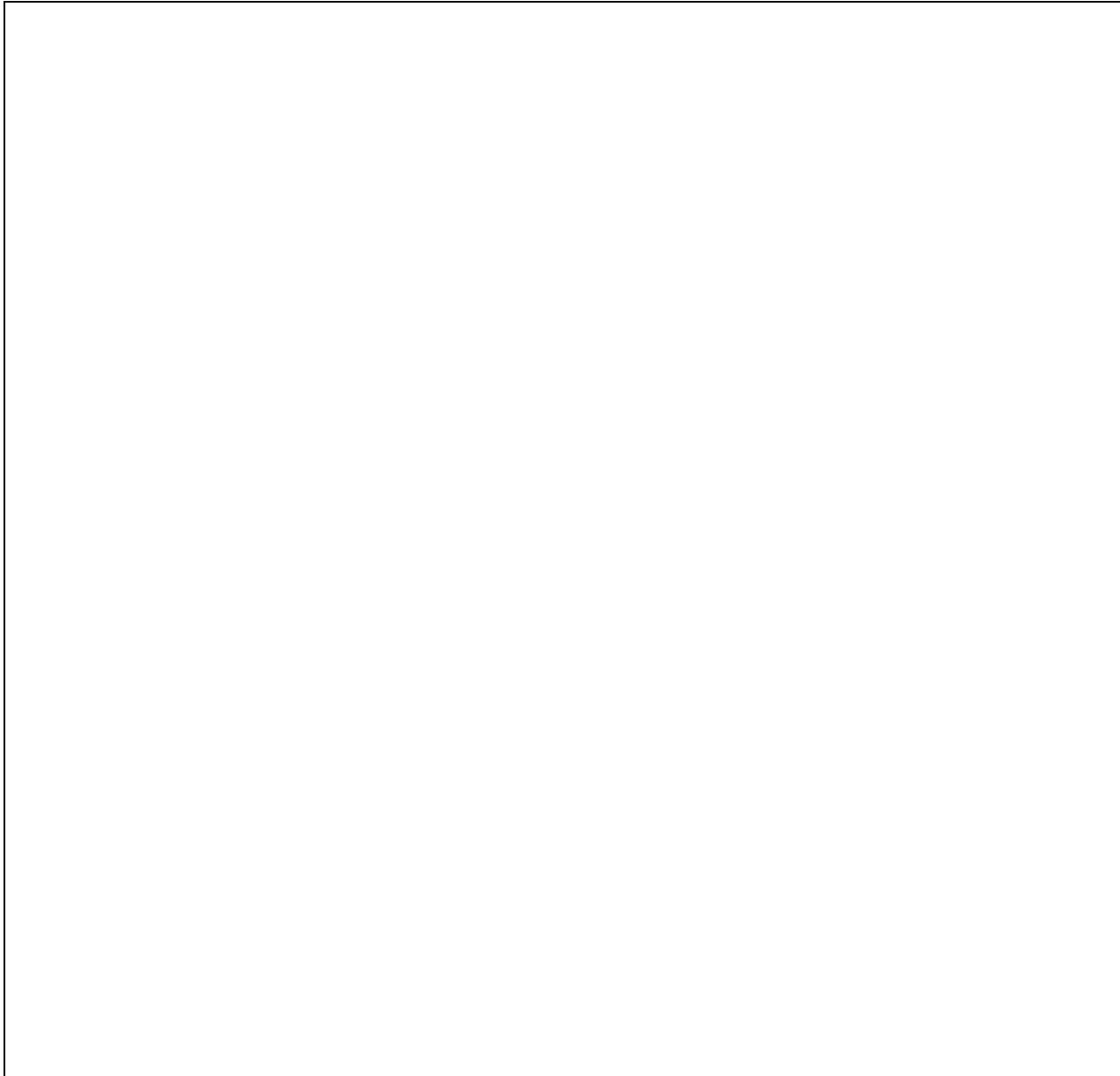
| | | | | | | | | | | |
|----------------|--|---------|--|--|--|--|--|--|--|--|
| Test Hours | | | | | | | | | | |
| Blowby, L/min. | | | | | | | | | | |
| Test Hours | | | | | | | | | | |
| Blowby, L/min. | | | | | | | | | | |
| Test Hours | | Average | | | | | | | | |
| Blowby, L/min. | | | | | | | | | | |

Sequence IIIG

Form 11

Viscosity Increase Plot

| | | | |
|------------------------|--|----------|--|
| Lab | | Oil Code | |
| Stand | | Test No. | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |



Sequence III G
Form 12
Hardware Information

| | | | |
|------------------------|--|----------|--|
| Lab | | Oil Code | |
| Stand | | Test No. | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |

| | | | | |
|------|---|--|------------------------------------|--|
| FIFO | Piston Ring Batch Code | | Build Completion Date | |
| FIFO | Oil Control (OC) Batch Code | | Piston Size (Grade) | |
| FIFO | Expander Ring (EXP) Batch Code | | Block Serial Number | |
| FIFO | Oil Filter Batch Code | | Crankshaft Serial Number | |
| FIFO | Camshaft Pour Code | | Camshaft Serial Number | |
| FIFO | Oil Cooler Batch Code | | Camshaft Phosphate Batch Code | |
| FIFO | Valve Springs Batch Code | | Cylinder Head Serial Number, Left | |
| FIFO | Intake Valve Seals Batch Code | | Cylinder Head Serial Number, Right | |
| FIFO | Exhaust Valve Seals Batch Code | | Top Ring Gap, mils | |
| FIFO | Main Bearings (M) Batch Code | | Bottom Ring Gap, mils | |
| FIFO | Connecting Rod Bearings (CR) Batch Code | | Bearing Kit Serial Number | |
| FIFO | Camshaft Bushing (CB) Batch Code | | | |
| FIFO | Lifter Engine Set Number (ESET) | | | |
| FIFO | Rocker Arm Batch Code | | | |
| FIFO | Piston Batch (Code) | | | |

Sequence III G
Form 14
American Chemistry Council Code Of Practice
Test Laboratory Conformance Statement

| | | | | | |
|--------------------------|--|------------|--|-----------|--|
| Test Laboratory | | | | | |
| Test Sponsor | | | | | |
| Formulation / Stand Code | | | | | |
| Test Number | | | | | |
| Start Date | | Start Time | | Time Zone | |

Declarations

No. 1 All requirements of the ACC Code of Practice for which the test laboratory is responsible were met in the conduct of this test. Yes _____ No _____*

No. 2 The laboratory ran this test for the full duration following all procedural requirements; and all operational validity requirements of the latest version of the applicable test procedure (ASTM or other), including all updates issued by the organization responsible for the test, were met. Yes _____ No _____*

If the response to this Declaration is “No”, does the test engineer consider the deviations from operational validity requirements that occurred to be beyond the control of the laboratory? Yes _____* No _____

No 3. A deviation occurred for one of the test parameters identified by the organization responsible for the test as being a special case. Yes _____* No _____ (This currently applies only to specific deviations identified in the ASTM Information Letter System)

| | |
|--|---|
| | Operational review of this test indicates that the results should be included in the Multiple Test Acceptance Criteria calculations. |
| | *Operational review of this test indicates that the results should not be included in the Multiple Test Acceptance Criteria calculations. |

Note: Supporting comments are required for all responses identified with an asterisk.

| Comments |
|----------|
| |
| |
| |
| |

Signature

Date

Typed Name

Title