

**REPORT ON**  
**SEQUENCE IIIF 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
	RO = Reference oil

<b>Test Number</b>					
Test Stand		Stand Test Number		Lab Run Number	
Oil Code:					
Formulation/Stand Code					
Alternate Codes					
EOT Date			EOT Time		

In my opinion this test                      been conducted in a valid manner in accordance with the latest draft of the Sequence IIIF procedure and the appropriate amendments through the Information Letter System. The remarks included in this report describe anomalies associated with this test.
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SUBMITTED BY:

\_\_\_\_\_ Testing Laboratory

\_\_\_\_\_ Signature

\_\_\_\_\_ Typed Name

\_\_\_\_\_ Title

**SEQUENCE IIIF  
FORM 2**

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**SEQUENCE IIIF  
FORM 3**

Summary of Test Method

The Sequence IIIF 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 multiviscosity grade oils that are used in spark-ignition, gasoline-fueled engines, as well as diesel engines.

The Sequence IIIF Test utilizes a 1996 model Buick 3800 Series II, water-cooled, 4 cycle, V-6 engine as the test apparatus. The Sequence IIIF 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 IIIF Test consists of a 10-minute operational check, followed by 80 hours of engine operation at moderately high speed, load, and temperature conditions. The 80-hour segment is broken down into eight 10-hour test segments. Following each 10-hour segment, and the 10-minute operational check, oil samples are drawn from the engine. The kinematic viscosities of the 10-hour segment samples are compared to the viscosity of the 10-minute sample to determine the viscosity increase of the test oil.

The Sequence IIIF Test is operated at the following test states during the 80-hour portion of the test:

<b>Parameter</b>	<b>Set Point</b>
Engine Speed	3600 r/min
Engine Load	200 N·m
Oil Filter Block Temperature	155 °C
Coolant Outlet Temperature	122 °C
Fuel Pressure	365 kPa
Intake Air Temperature	27 °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
Condenser Coolant Flow	0 L/min
Air-to-Fuel Ratio	15.0:1
Condenser Coolant Outlet Temperature	°C

**SEQUENCE III F  
FORM 4**

**TEST RESULT SUMMARY**

LABORATORY		OILCODE	
TEST STAND NO.		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 <sup>A</sup>	
TEST LENGTH			

<b>Pass/Fail Results</b>						
	Viscosity Increase (%)	Screened Average Cam + Lifter Wear (µm)	Average Weighted Piston Deposits (merits)	Average Piston Skirt Varnish (merits)	Number of Hot Stuck Rings	Oil Consumption (L) <sup>B</sup>
Original Units						
Transformed Results						
Industry Correction Factor						
Corrected Transformed Result						
Severity Adjustment						
Final Transformed Result						
Final Original Unit Result						

<b>Additional Results</b>			
Oil Consumption Hours, h		Average Oil Ring Plugging, %	
Maximum Cam + Lifter Wear, µm		Number of Cold-Stuck Rings	
Average Cam + Lifter Wear, µm			

<b>Most Recent Stand Reference Oil Test History<sup>C</sup></b>			
Test Number		- -	
Oilcode			
Date Completed		TMC Oil Code	
Final Viscosity Increase, %		Fuel Batch	
Final Average Piston Skirt Varnish, merits			
Final Average Cam + Lifter Wear, µm			
Final Maximum Cam + Lifter Wear, µm			
Final Average Weighted Piston Deposit, merits			

<sup>A</sup> Reference Oil Tests Only

<sup>B</sup> Test Hours at which Oil Consumption was calculated

<sup>C</sup> Non-reference Oil Tests Only

**SEQUENCE III F  
FORM 5**

**OPERATIONAL SUMMARY**

LABORATORY		OIL CODE	
TEST STAND NO.		TEST NO.	— —
LABORATORY OIL CODE			
FORMULATION STAND CODE			

Controlled Parameters	Parameter	Units	QI Limit	EOT QI	Target	Average	Standard Deviation	Number of	
								Samples <sup>A</sup>	BQD <sup>B</sup>
Speed	r/min	0.000			3600				
Load	N·m	0.000			200				
Oil Filter Block	°C	0.000			155.0				
Engine Coolant Out	°C	0.000			122.0				
Condenser Coolant Out	°C	0.000			40.0				
Left Air-to-Fuel Ratio	-	0.000			15.0				
Right Air-to-Fuel Ratio	-	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				

Non-controlled Parameters	Parameter	Units	Average	Standard Deviation	Number of	
					Samples <sup>A</sup>	BQD <sup>B</sup>
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									

NO <sub>x</sub> Measurement			
Hours			
NO <sub>x</sub> , ppm			

**SEQUENCE III F  
FORM 6**

**USED OIL ANALYSIS RESULTS**

LABORATORY		OILCODE	
TEST STAND NO.		TEST NO.	-                          -
LABORATORY OIL CODE			
FORMULATION STAND CODE			

<b>VISCOSITY INCREASE DATA (cSt @ 40°C)</b>			
HOURS	VISCOSITY <sup>A</sup>	CHANGE	PERCENT
New Oil			
Initial <sup>B</sup>			

<sup>A</sup> 8000 cSt is maximum allowable viscosity

<sup>B</sup> At end of leveling run

<b>Results of ICP Analysis of Used Oil</b>										
Test Hours	Initial									
Iron										
Copper										
Lead										

<b>Cold Crank Simulator Results, D5293</b>	
Final Temperature, °C	
Final Cold-Crank Simulator Viscosity, cP	

<b>Mini-Rotary Viscometer Results, D4684</b>	
MRV Temperature, °C	
MRV Result, cP	
Yield Stress, cP	

**SEQUENCE III F  
FORM 7**

**VALVE LIFTER AND CAMSHAFT WEAR RESULTS**

LABORATORY		OILCODE	
TEST STAND NO.		TEST NO.	- -
LABORATORY OIL CODE			
FORMULATION STAND CODE			

NUMBER	CAMSHAFT LOBE, $\mu\text{m}$	VALVE LIFTER, $\mu\text{m}$	CAM & LIFTER WEAR, $\mu\text{m}$
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
MAXIMUM			
MINIMUM			
AVERAGE			
SCREENED AVERAGE CAM + LIFTER WEAR <sup>A</sup>			

<sup>A</sup> Average Cam + Lifter Wear based on ten positions, excluding the minimum and maximum positions.

**SEQUENCE IIIF  
FORM 8**

**SUMMARY OF OIL RING LAND DEPOSIT RATINGS**

LABORATORY		OILCODE	
TEST STAND NO.		TEST NO.	- -
LABORATORY OIL CODE			
FORMULATION STAND CODE			
RATER		RATING DATE	

PISTON	OIL RING LAND DEPOSIT RATING, MERITS	% CHIPPED
1		
2		
3		
4		
5		
6		
Average		

PISTON	% OIL RING PLUGGING	RING STICKING <sup>A</sup>	
		HOT-STUCK RINGS	COLD-STUCK RINGS
1			
2			
3			
4			
5			
6			
Total			
Average			

<sup>A</sup> Possible values: T = top compression ring  
 B = bottom compression ring  
 O = oil ring  
 N = none



**SEQUENCE IIIF  
FORM 9**

**SUMMARY OF PISTON DEPOSITS**

LABORATORY		OILCODE	
TEST STAND NO.		TEST NO.	-                      -
LABORATORY OIL CODE			
FORMULATION STAND CODE			
RATER		RATING DATE	

**Note: CRC Manual 20 used for all ratings.**

Note: These are all unweighted 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 all unweighted 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

	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	
--	--

$$WPD = (WPD1 + WPD2 + WPD3 + WPD4 + WPD5 + WPD6) / 6$$



**SEQUENCE IIIF  
FORM 11**

**VISCOSITY INCREASE PLOT**

LABORATORY		OILCODE	
TEST STAND NO.		TEST NO.	- -
LABORATORY OIL CODE			
FORMULATION STAND CODE			

**SEQUENCE IIIF  
FORM 12**

**HARDWARE INFORMATION**

LABORATORY		OILCODE	
TEST STAND NO.		TEST NO.	- -
LABORATORY OIL CODE			
FORMULATION STAND CODE			

Build Completion Date		Piston Batch (Code)	
Block Serial Number		Piston Size (Grade)	
Crankshaft Serial Number		Piston Ring Batch Code	
Camshaft Serial Number		Oil Filter Batch Code	
Cylinder Head Serial Number, Left		Intake Valve Seals Batch Code	
Cylinder Head Serial Number, Right		Valve Springs Batch Code	
Bearing Kit Serial Number		Lifter Serial Number	Lifter Position 1
Top Ring Gap, mils			Lifter Position 2
Bottom Ring Gap, mils			Lifter Position 3
			Lifter Position 4
			Lifter Position 5
			Lifter Position 6
			Lifter Position 7
			Lifter Position 8
			Lifter Position 9
			Lifter Position 10
			Lifter Position 11
			Lifter Position 12

**SEQUENCE IIIF  
FORM 13**

**DOWNTIME & OUTLIER REPORT FORM**

LABORATORY		OILCODE	
TEST STAND NO.		TEST NO.	- -
LABORATORY OIL CODE			
FORMULATION STAND CODE			

Downtime Occurrences			
Test Hours	Date	Total Downtime	Reasons
<b>Total Downtime</b>			<b>MAXIMUM ALLOWABLE DOWNTIME: 24 HOURS</b>

<b>Other Comments &amp; Outliers</b>	
<b>Number of Comment Lines</b>	

# SEQUENCE III F EVALUATION

14 A

## DOWNTIME & OUTLIER REPORT FORM

LABORATORY		OILCODE	
TEST STAND NO.		TEST NO.	- -
LABORATORY OIL CODE			
FORMULATION STAND CODE			

Downtime Occurrences			
Test Hours	Date	Total Downtime	Reasons
<b>Total Downtime</b>			<b>MAXIMUM ALLOWABLE DOWNTIME: 24 HOURS</b>

<b>Other Comments &amp; Outliers</b>	
<b>Number of Comment Lines</b>	

**SEQUENCE IIIF  
FORM 14B**

**DOWNTIME & OUTLIER REPORT FORM**

LABORATORY		OILCODE	
TEST STAND NO.		TEST NO.	-                      -
LABORATORY OIL CODE			
FORMULATION STAND CODE			

Downtime Occurrences			
Test Hours	Date	Total Downtime	Reasons
<b>Total Downtime</b>			<b>MAXIMUM ALLOWABLE DOWNTIME: 24 HOURS</b>

<b>Other Comments &amp; Outliers</b>	
<b>Number of Comment Lines</b>	