Report On
Sequence IIIG Evaluation

Version IIIG VERSION 20140324 Beta

Conducted For
TSTSPON1

TSTSPON2

LABVALID	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

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

Test Number					
Test Stand	STAND	Stand Test	STRUN	Lab Test	LABRUN
Oil Code	OILCODE				
Formulation/Stand	FORM				
Alternate Codes	ALTCODE1		ALTCODE2		ALTCODE3
EOT Date	DTCOMP		EOT Time		EOTTIME

In my opinion this test OPVALID 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.

Submitted By:

SUBLAB
Testing Laboratory

SUBSIGIM
Signature

SUBNAME
Typed Name

SUBTITLE
Title

Form 2

Sequence IIIG

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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 ^{o}C
Coolant Outlet Temperature	115 ^{o}C
Fuel Pressure	377.5 kPa
Intake Air Temperature	35 ^{o}C
Intake Air Pressure	0.05 kPa
Intake Air Dew Point	16.1 ^{o}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 ^{o}C

Sequence IIIG
Form 4

Test Result Summary

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Date Started	DTSTRT	Engine No.	ENGINENO
Time Started	STRTTIME	Fuel Batch	FUELBTID
Date Completed	DTCOMP	SAE Viscosity	SAEVISC
Time Completed	EOTTIME	TMC Oil Code[A]	IND
Test Length	TESTLEN		

Pass/Fail Results			
	Viscosity Increase at 100 Hours (%)	**Average Cam + Lifter Wear (µm)**	**Average Weighted Piston Deposits (merits)**
Original Units	PVIS	ACLW	WPD
Transformed Results[B]	TPVIS	TACLW	
Industry Correction Factor	PVIS_CF	ACLW_CF	WPD_CF
Corrected Transformed	PVIS_COR	ACLW_COR	
Severity Adjustment	PVIS_SA	ACLW_SA	WPD_SA
Final Transformed Result	TPVISFNL	TACLWFNL	
Final Original Unit Result	PVISFNL	ACLWFNL	WPDFNL

Additional Results			
Oil Consumption Hours, h [C]	OCONHRS	Total Oil Consumption, L	OILCON
Maximum Cam + Lifter Wear, µm	MCLW	Number of Cold-Stuck Rings	CSTUKT
Average Oil Ring Plugging, %	ORPAVG	Number of Hot-Stuck Ring	HSTUKT
Average Piston Varnish, merits	APV		

[A]Reference Oil Tests Only
[B]Viscosity Increase uses LN(PVIS), Average Cam + Lifter Wear uses LN(ACLW), Weighted Piston Deposits does not use a transformation
[C]Test Hours at which Oil Consumption was calculated

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Form 5

Operational Summary

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

	Parameter	Units	QI Threshold	EOT QI	Target	Average	Standard Deviation	Number of Samples	Number of BQD
Controlled Parameters	Speed	r/min	0.000	QRPM	3600	ARPM	SRPM	NRPM	BRPM
	Load	Nm	0.000	QLOAD	250	ALOAD	SLOAD	NLOAD	BLOAD
	Oil Filter Block	°C	0.000	QOTEMI	150.0	AOTEMP	SOTEMP	NOTEMP	BOTEMP
	Engine Coolant Out	°C	0.000	QCOLOU	115.0	ACOLOUT	SCOLOUT	NCOLOUT	BCOLOUT
	Condenser Coolant Out	°C	0.000	QCCOLO	40.0	ACCOLOUT	SCCOLOUT	NCCOLOUT	BCCOLOU
	Left Air-to-Fuel		0.000	QLAFR	15.0	ALAFR	SLAFR	NLAFR	BLAFR
	Right Air-to-Fuel		0.000	QRAFR	15.0	ARAFR	SRAFR	NRAFR	BRAFR
	Left Exhaust Back Pressure	kPa	0.000	QLEXBP	6.0	ALEXBP	SLEXBP	NLEXBP	BLEXBP
	Right Exhaust Back Pressure	kPa	0.000	QREXBP	6.0	AREXBP	SREXBP	NREXBP	BREXBP
	Intake Air	kPa	0.000	QINAIR	0.05	AINAIR	SINAIR	NINAIR	BINAIR
	Engine Coolant Flow	L/min	0.000	QCOLFL	160.0	ACOLFLO	SCOLFLO	NCOLFLO	BCOLFLO

	Parameter	Units	Average	Standard Deviation	Number of Samples	Number of BQD
Non-controlled Parameters	Oil Sump	°C	AOSUMP	SOSUMP	NOSUMP	BOSUMP
	Pump Outlet Pressure	kPa	APOUTP	SPOUTP	NPOUTP	BPOUTP
	Gallery Pressure	kPa	AOILPRS	SOILPRS	NOILPRS	BOILPRS
	Engine Coolant In	°C	AECOLIN	SECOLIN	NECOLIN	BECOLIN
	Fuel Inlet	°C	AFUELIN	SFUELIN	NFUELIN	BFUELIN
	Intake Air	°C	AINAT	SINAT	NINAT	BINAT
	Intake Air Dew Point	°C	AINDEW	SINDEW	NINDEW	BINDEW
	Intake Vacuum	kPa	AINVAC	SINVAC	NINVAC	BINVAC
	Crankcase	kPa	ACCASEP	SCCASEP	NCCASEP	BCCASEP
	Fuel Pressure	kPa	APFUEL	SPFUEL	NPFUEL	BPFUEL

Oil Consumption Data						
Hours	Initial Run-in	OCONH020	OCONH040	OCONH060	OCONH080	OCONH100
Level (ml) low	OILLINI	OILLH020	OILLH040	OILLH060	OILLH080	OILLH100
Total Oil Consumed (L)		OILCH020	OILCH040	OILCH060	OILCH080	OILCH100

NO_x Measurement			
Hours	NOXHH019	NOXHH049	NOXHH099
$NO_{x,}$ ppm	NOX_H019	NOX_H049	NOX_H099

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Form 6

Used Oil Analysis Results

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Viscosity Increase Data (cSt at 40°C)			
Hours	Viscosity[A]	Change	Percent
New Oil	VNEW		
Initial[B]	VINI		
VISTH020	VIS_H020	DVISH020	PVISH020
VISTH040	VIS_H040	DVISH040	PVISH040
VISTH060	VIS_H060	DVISH060	PVISH060
VISTH080	VIS_H080	DVISH080	PVISH080
VISTH100	VIS_H100	DVISH100	PVISH100
TESTLEN	VISEOT	DVISEOT	PVIS

[A] 8000 cSt is maximum allowable viscosity
[B] At end of leveling run

Results of ICP Analysis of Used Oil			
Hours	Iron	Copper	Lead
Initial	FEWMINI	CUWMINI	PBWMINI
TST_H020	FEWMH020	CUWMH020	PBWMH020
TST_H040	FEWMH040	CUWMH040	PBWMH040
TST_H060	FEWMH060	CUWMH060	PBWMH060
TST_H080	FEWMH080	CUWMH080	PBWMH080
TST_H100	FEWMH100	CUWMH100	PBWMH100
TESTLEN	FEWMEOT	CUWMEOT	PBWMEOT

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Form 7

Valve Lifter and Camshaft Wear Results

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Number	Camshaft Lobe, µm	Valve Lifter, µm	Cam & Lifter Wear, µm
1	CAMW01	LFTW01	CLW01
2	CAMW02	LFTW02	CLW02
3	CAMW03	LFTW03	CLW03
4	CAMW04	LFTW04	CLW04
5	CAMW05	LFTW05	CLW05
6	CAMW06	LFTW06	CLW06
7	CAMW07	LFTW07	CLW07
8	CAMW08	LFTW08	CLW08
9	CAMW09	LFTW09	CLW09
10	CAMW10	LFTW10	CLW10
11	CAMW11	LFTW11	CLW11
12	CAMW12	LFTW12	CLW12
Maximum	MAXCW	MAXLFTW	MCLW
Minimum	MINCW	MINLFTW	MINCLW
Average	AVGCW	AVGLFTW	ACLW

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Form 8

Summary of Oil Ring Land Deposit Rating

Lab	LAB	Oil Code	OILCODE		
Stand	STAND	Test No.	TESTNUM		
Laboratory Oil Code		LABOCODE			
Formulation Stand Code		FORM			
Rater		RLDRATER		Rating Date	RLDRTDT

Piston	Oil Ring Land Deposit, Merits	% Chipped
1	ORLD1	ORCHIP1
2	ORLD2	ORCHIP2
3	ORLD3	ORCHIP3
4	ORLD4	ORCHIP4
5	ORLD5	ORCHIP5
6	ORLD6	ORCHIP6
Average	ORLD	AVGORCHP

Piston	% Oil Ring Plugging	Ring Sticking[A]	
		Hot-Stuck Rings	Cold-Stuck Rings
1	ORP1	HSTUK1	CSTUK1
2	ORP2	HSTUK2	CSTUK2
3	ORP3	HSTUK3	CSTUK3
4	ORP4	HSTUK4	CSTUK4
5	ORP5	HSTUK5	CSTUK5
6	ORP6	HSTUK6	CSTUK6
Total		HSTUKT	CSTUKT
Average	ORPAVG		

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

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Form 9

Summary of Piston Deposits

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	
Rater	APVRATER	Rating Date	APVRTDT

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	G1P1	G2P1	G3P1	L2P1	ORLD1	UCP1
Piston 2	G1P2	G2P2	G3P2	L2P2	ORLD2	UCP2
Piston 3	G1P3	G2P3	G3P3	L2P3	ORLD3	UCP3
Piston 4	G1P4	G2P4	G3P4	L2P4	ORLD4	UCP4
Piston 5	G1P5	G2P5	G3P5	L2P5	ORLD5	UCP5
Piston 6	G1P6	G2P6	G3P6	L2P6	ORLD6	UCP6
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	PSVT1	PSVA1	PSVAV1
Piston 2	PSVT2	PSVA2	PSVAV2
Piston 3	PSVT3	PSVA3	PSVAV3
Piston 4	PSVT4	PSVA4	PSVAV4
Piston 5	PSVT5	PSVA5	PSVAV5
Piston 6	PSVT6	PSVA6	PSVAV6
Average	PSVTAV	PSVAAV	APV
WF			0.10

PSVAVx = (PSVTx + PSVAx)/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	WPD1
Piston 2	WPD2
Piston 3	WPD3
Piston 4	WPD4
Piston 5	WPD5
Piston 6	WPD6

WPDx = (WF*G1Px)+(WF*G2Px)+(WF*G3Px)+ (WF*L2Px)+ (WF*ORLDx)+(WF*UCPx)+(WF*PSVAVx)
where: x = Number of Piston
WF = Appropriate Weighting Factor (WF) for part, from table.

Average Weighted Piston Deposits, merits	WPD

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

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Form 10
Blowby Values & Plot

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Blowby Plot

BLOWBYIM

Test Hours	BBYTH001	BBYTH006	BBYTH011	BBYTH016	BBYTH021	BBYTH026	BBYTH031	BBYTH036	BBYTH041	BBYTH046
Blowby, L/min.	BLWBH001	BLWBH006	BLWBH011	BLWBH01(	BLWBH02	BLWBH02(	BLWBH031	BLWBH036	BLWBH041	BLWBH046
Test Hours	BBYTH051	BBYTH056	BBYTH061	BBYTH066	BBYTH071	BBYTH07(	BBYTH081	BBYTH086	BBYTH091	BBYTH096
Blowby, L/min.	BLWBH051	BLWBH056	BLWBH061	BLWBH06(	BLWBH07	BLWBH07(	BLWBH081	BLWBH08(	BLWBH091	BLWBH096
Test Hours	BBYTH099	Average								
Blowby, L/min.	BLWBH099	ABLOBY								

Sequence IIIG

Form 11

Viscosity Increase Plot

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

VISINIM

Sequence IIIG

Form 12

Hardware Information

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code			LABOCODE
Formulation Stand Code			FORM

FIFO	Piston Ring Batch Code	RINGCODE	Build Completion Date	BUILDDT
FIFO	Oil Control (OC) Batch Code	ORINGBAT	Piston Size (Grade)	PISTSIZE
FIFO	Expander Ring (EXP) Batch Code	ERINGBAT	Block Serial Number	BLOCKSN
FIFO	Oil Filter Batch Code	OILFIBAT	Crankshaft Serial Number	CRANKSN
FIFO	Camshaft Pour Code	CAMPOURC	Crankshaft Part Number	CRANKPN
FIFO	Oil Cooler Batch Code	OILCLBAT	Camshaft Serial Number	CAMSN
FIFO	Valve Springs Batch Code	VALSPBAT	Camshaft Phosphate Batch Code	CAMBAT
FIFO	Intake Valve Seals Batch Code	INVSLBAT	Cylinder Head Serial Number, Left	LHEADSN
FIFO	Exhaust Valve Seals Batch Code	EXVSLBAT	Cylinder Head Serial Number, Right	RHEADSN
FIFO	Main Bearings (M) Batch Code	MBRNGBAT	Top Ring Gap, mils	TRINGGAP
FIFO	Connecting Rod Bearings (CR) Batch Code	CBRNGBAT	Bottom Ring Gap, mils	BRINGGAP
FIFO	Camshaft Bushing (CB) Batch Code	CBUSHBAT	Bearing Kit Serial Number	BRNGSN
FIFO	Lifter Engine Set Number (ESET)	LFTSETNO	Cylinder Head Part Number, Left	CYLHPNLT
FIFO	Rocker Arm Batch Code	RARMBAT	Cylinder Head Part Number, Right	CYLHPNRT
FIFO	Piston Batch (Code)	PISTBAT		

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Form 13

Downtime & Outlier Report Form

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Number of Downtime Occurrences		DWNOCR	
Test Hours	Date	Downtime	Reasons
DOWNR00	DDATR001	DTIMR001	DREAR001
DOWNR00	DDATR002	DTIMR002	DREAR002
DOWNR00	DDATR003	DTIMR003	DREAR003
DOWNR00	DDATR004	DTIMR004	DREAR004
DOWNR00	DDATR005	DTIMR005	DREAR005
DOWNR00	DDATR006	DTIMR006	DREAR006
DOWNR00	DDATR007	DTIMR007	DREAR007
DOWNR00	DDATR008	DTIMR008	DREAR008
DOWNR00	DDATR009	DTIMR009	DREAR009
DOWNR01	DDATR010	DTIMR010	DREAR010
DOWNR01	DDATR011	DTIMR011	DREAR011
DOWNR01	DDATR012	DTIMR012	DREAR012
DOWNR01	DDATR013	DTIMR013	DREAR013
DOWNR01	DDATR014	DTIMR014	DREAR014
DOWNR01	DDATR015	DTIMR015	DREAR015
		TOTLDOWN	Total Downtime (hours) – Maximum allowable downtime: 24 hours

Other Comments		
Number of Comment Lines	TOTCOM	
OCOMR001		
OCOMR002		
OCOMR003		
OCOMR004		
OCOMR005		
OCOMR006		
OCOMR007		
OCOMR008		
OCOMR009		
OCOMR010		
OCOMR011		
OCOMR012		
OCOMR013		
OCOMR014		
OCOMR015		

Sequence IIIG

Form 13A

Downtime & Outlier Report Form

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	TESTNUM
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Number of Downtime Occurrences		DWNOCR	
Test Hours	Date	Downtime	Reasons
DOWNR01	DDATR016	DTIMR016	DREAR016
DOWNR01	DDATR017	DTIMR017	DREAR017
DOWNR01	DDATR018	DTIMR018	DREAR018
DOWNR01	DDATR019	DTIMR019	DREAR019
DOWNR02	DDATR020	DTIMR020	DREAR020
DOWNR02	DDATR021	DTIMR021	DREAR021
DOWNR02	DDATR022	DTIMR022	DREAR022
DOWNR02	DDATR023	DTIMR023	DREAR023
DOWNR02	DDATR024	DTIMR024	DREAR024
DOWNR02	DDATR025	DTIMR025	DREAR025
DOWNR02	DDATR026	DTIMR026	DREAR026
DOWNR02	DDATR027	DTIMR027	DREAR027
DOWNR02	DDATR028	DTIMR028	DREAR028
DOWNR02	DDATR029	DTIMR029	DREAR029
DOWNR03	DDATR030	DTIMR030	DREAR030
		TOTLDOWN	Total Downtime (hours) – Maximum allowable downtime: 24 hours

Other Comments		
Number of Comment Lines	TOTCOM	
OCOMR016		
OCOMR017		
OCOMR018		
OCOMR019		
OCOMR020		
OCOMR021		
OCOMR022		
OCOMR023		
OCOMR024		
OCOMR025		
OCOMR026		
OCOMR027		
OCOMR028		
OCOMR029		
OCOMR030		

Sequence IIIG

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

Test Laboratory	SUBLAB				
Test Sponsor	TSTSPON1				
Formulation / Stand Code	FORM				
Test Number	TESTNUM				
Start Date	DTSTRT	Start Time	STRTTIME	Time Zone	TZONE

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 YESRQM No NORQMI*

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 YESFULL No NOFULL *

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 YESNODE* No NONODEC

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 YESDEV* No NODEV (This currently applies only to specific deviations identified in the ASTM Information Letter System)

INCLUDE	Operational review of this test indicates that the results should be included in the Multiple Test Acceptance Criteria calculations.
DONOTINC	*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
ACCCOMM1
ACCCOMM2
ACCCOMM3
ACCCOMM4

SUBSIGIM
Signature

SUBDATE
Date

SUBNAME
Typed Name

SUBTITLE
Title