Report On
Sequence IIIG Evaluation

Version IIIG VERSION 20030707

Conducted For
TSTSPON1

TSTSPON2

LABVALID	**V** = Valid
	I = Invalid
	N = Results Cannot Be Interpreted As Representative Of Oil Perfromance (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 conducted in a valid manner in accordance with the latest draft of Sequence IIIG procedure 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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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	365 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
Breather Tube Coolant Outlet Temperature	40 ^{o}C

SEQUENCE IIIG
FORM 4

TEST RESULT SUMMARY

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	STAND -- STRUN -- LABRUN
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	IND
Test Length	TESTLEN		

Pass/Fail Results					
	Viscosity Increase (%)	**Average Cam + Lifter Wear (µm)**	**Average Weighted Piston Deposits (merits)**	**Average Piston Skirt Varnish (merits)**	**Mini Rotary Viscometer Viscosity (cP)**
Original Units	PVIS	ACLW	WPD	APV	MRV
Transformed Results	TPVIS	TACLW			TMRV
Industry Correction Factor	PVIS_CF	ACLW_CF	WPD_CF	APV_CF	MRV_CF
Corrected Transformed	PVIS_COR	ACLW_COR			MRV_COR
Severity Adjustment	PVIS_SA	ACLW_SA	WPD_SA	APV_SA	MRV_SA
Final Transformed Result	TPVISFNL	TACLWFNL			TMRVFNL
Final Original Unit Result	PVISFNL	ACLWFNL	WPDFNL	APVFNL	MRVFNL

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

Most Recent Stand Reference Oil Test History[C]			
Test Number	RSTAND - RSTRUN - RLABRUN		
Oil Code	ROILCODE		
Date Completed	RDTCOMP	TMC Oil	RIND
Final Viscosity Increase, %	RPVISFNL	Fuel Batch	RFUELBID
Final Average Piston Skirt Varnish, merits	RAPVFNL		
Final Average Cam + Lifter Wear, µm	RACLWFNL		
Final Maximum Cam + Lifter Wear, µm	RMCLWFNL		
Final Average Weighted Piston Deposit, merits	RWPDFNL		

[A]Reference Oil Tests Only
[B]Test Hours at which Oil Consumption was calculated
[C]Non-Reference Oil Tests Only

Sequence IIIG

Form 5

Operational Summary

Lab	LAB	Oil Code	OILCODE		
Stand	STAND	Test No.	--STAND	--STRUN	LABRUN
Laboratory Oil Code		LABOCODE			
Formulation Stand Code		FORM			

	Parameter	Units	QI Threshol	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**	QOTEMP	**150.0**	AOTEMP	SOTEMP	NOTEMP	BOTEMP
	Engine Coolant Out	°C	**0.000**	QCOLOUT	**115.0**	ACOLOUT	SCOLOUT	NCOLOUT	BCOLOUT
	Condenser Coolant Out	°C	**0.000**	QCCOLOU	**40.0**	ACCOLOUT	SCCOLOUT	NCCOLOUT	BCCOLOU
	Left Air-to-Fuel Ratio		**0.000**	QLAFR	**15.0**	ALAFR	SLAFR	NLAFR	BLAFR
	Right Air-to-Fuel Ratio		**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**	QCOLFLO	**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

Sequence IIIG

Form 6

Used Oil Analysis Results

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	STAND -- STRUN -- LABRUN
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

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

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

Cold Crank Simulator Results, D 5293	
Specified Temperature, °C	CCSTEMP
Cold-Crank Simulator Viscosity at Specified Temperature, cP	CCS

Mini-Rotary Viscometer Results, D 4684	
MRV Temperature, °C	MRVTEMP
MRV Result, cP	MRV
Yield Stress, cP	YSTRESS

Sequence IIIG

Form 7

Valve Lifter And Camshaft Wear Results

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	STAND -- STRUN -- LABRUN
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

Sequence IIIG

Form 8

Summary Of Oil Ring Land Deposit Rating

Lab	LAB	Oil Code	OILCODE		
Stand	STAND	Test No.	STAND -- STRUN		-- LABRUN
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

Sequence IIIG

Form 9

Summary Of Piston Deposits

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	STAND -- STRUN -- LABRUN
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

Sequence IIIG

Form 10

Blowby Values & Plot

Lab	LAB	Oil Code	OILCODE			
Stand	STAND	Test No.	STAND	-- STRUN	-- LABRUN	
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	BLWBH016	BLWBH021	BLWBH026	BLWBH031	BLWBH036	BLWBH041	BLWBH046
Test Hours	BBYTH051	BBYTH056	BBYTH061	BBYTH066	BBYTH071	BBYTH076	BBYTH081	BBYTH086	BBYTH091	BBYTH096
Blowby, L/min.	BLWBH051	BLWBH056	BLWBH061	BLWBH066	BLWBH071	BLWBH076	BLWBH081	BLWBH086	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.	STAND -- STRUN -- LABRUN
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

VISINIM

Sequence IIIG

Form 12

Hardware Information

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	STAND -- STRUN -- LABRUN
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Build Completion Date	BUILDDT	Piston Batch (Code)		PISTBAT
Block Serial Number	BLOCKSN	Piston Size (Grade)		PISTSIZE
Crankshaft Serial Number	CRANKSN	Piston Ring Batch Code		RINGCODE
Camshaft Serial Number	CAMSN	Oil Filter Batch Code		OILFIBAT
Camshaft Batch Code	CAMBAT	Oil Cooler Batch Code		OILCLBAT
Cylinder Head Serial Number, Left	LHEADSN	Valve Springs Batch Code		VALSPBAT
Cylinder Head Serial Number, Right	RHEADSN	Lifter Serial Number	1	LFTR1SN
Bearing Kit Serial Number	BRNGSN		2	LFTR2SN
Top Ring Gap, mils	TRINGGAP		3	LFTR3SN
Bottom Ring Gap, mils	BRINGGAP		4	LFTR4SN
Intake Valve Seals Batch Code	INVSLBAT		5	LFTR5SN
Exhaust Valve Seals Batch Code	EXVSLBAT		6	LFTR6SN
Rocker Arm Batch Code	RARMBAT		7	LFTR7SN
Connecting Rod Type (CAST or PM)	CRODTYPE		8	LFTR8SN
			9	LFTR9SN
			10	LFTR10SN
			11	LFTR11SN
			12	LFTR12SN

Sequence IIIG

Form 13

Downtime & Outlier Report Form

Lab	LAB	Oil Code	OILCODE
Stand	STAND	Test No.	STAND -- STRUN -- LABRUN
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Number of Downtime Occurrences		DWNOCR	
Test Hours	**Date**	**Downtime**	**Reasons**
DOWNR001	DDATR001	DTIMR001	DREAR001
DOWNR002	DDATR002	DTIMR002	DREAR002
DOWNR003	DDATR003	DTIMR003	DREAR003
DOWNR004	DDATR004	DTIMR004	DREAR004
DOWNR005	DDATR005	DTIMR005	DREAR005
DOWNR006	DDATR006	DTIMR006	DREAR006
DOWNR007	DDATR007	DTIMR007	DREAR007
DOWNR008	DDATR008	DTIMR008	DREAR008
DOWNR009	DDATR009	DTIMR009	DREAR009
DOWNR010	DDATR010	DTIMR010	DREAR010
DOWNR011	DDATR011	DTIMR011	DREAR011
DOWNR012	DDATR012	DTIMR012	DREAR012
DOWNR013	DDATR013	DTIMR013	DREAR013
DOWNR014	DDATR014	DTIMR014	DREAR014
DOWNR015	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.	STAND	--	STRUN	--	LABRUN
Laboratory Oil Code		LABOCODE					
Formulation Stand Code		FORM					

Number of Downtime Occurrences		DWNOCR	
Test Hours	**Date**	**Downtime**	**Reasons**
DOWNR016	DDATR016	DTIMR016	DREAR016
DOWNR017	DDATR017	DTIMR017	DREAR017
DOWNR018	DDATR018	DTIMR018	DREAR018
DOWNR019	DDATR019	DTIMR019	DREAR019
DOWNR020	DDATR020	DTIMR020	DREAR020
DOWNR021	DDATR021	DTIMR021	DREAR021
DOWNR022	DDATR022	DTIMR022	DREAR022
DOWNR023	DDATR023	DTIMR023	DREAR023
DOWNR024	DDATR024	DTIMR024	DREAR024
DOWNR025	DDATR025	DTIMR025	DREAR025
DOWNR026	DDATR026	DTIMR026	DREAR026
DOWNR027	DDATR027	DTIMR027	DREAR027
DOWNR028	DDATR028	DTIMR028	DREAR028
DOWNR029	DDATR029	DTIMR029	DREAR029
DOWNR030	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 ESRQME No NORQME *

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 YESNODEC * 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 _____ SUBDATE _____

Signature Date

SUBNAME _____ SUBTITLE _____

Typed Name Title