VG REPORT FORMS VERSION *20001214*

REPORT ON SEQUENCE VG EVALUATION

CONDUCTED FOR

TSTSPON1

TSTSPON2

LABVALID	V = VALID
	I = INVALID
	N = RESULTS CAN NOT BE INTERPRETED AS REPRESENTATIVE OF OIL PERFORMANCE (NON-REFERENCE OIL) AND SHALL NOT BE USED IN DETERMINING AN AVERAGE TEST RESULT USING MULTIPLE TEST ACCEPTANCE CRITERIA.

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

Test Number			
Test Stand: *STAND*	Runs Between Calibration Tests: *STRUN*	Total Runs on Test Stand: *TOTSRUN*	
Date Completed: *DTCOMP*		End of Test Time: *EOTTIME*	
Oil Code: *OILCODE*			
Formulation/Stand Code: *FORM*			
Alternate Codes:	*ALTCODE1*	*ALTCODE2*	*ALTCODE3*

In my opinion this test *OPVALID* been conducted in a valid manner in accordance with the VG Test Procedure (RR:) 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

FIG A7.1 Title Page

Form 2

Sequence VG

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Sequence VG Sludge and Varnish Deposit Test
Form 3

Summary of Test Method

The Sequence VG engine sludge and varnish deposit test is a fired engine-dynamometer test which evaluates the ability of a lubricant to minimize the formation of sludge and varnish deposits. This test method is a cyclic test, with a total running duration of 216 hours.

The test engine is a Ford 4.6L, spark ignition, four stroke, eight cylinder "V" configuration engine. Features of this engine include dual overhead camshafts, a cross-flow fast burn cylinder head design, two valves per cylinder and electronic port fuel injection. A 90 minute break-in schedule is conducted prior to each test, since a new engine build is used for each test.

The Sequence VG test requires a new engine for each test. Each test is run for 216 hours, consisting of 54 cycles of 4 hours each. Each cycle consists of 3 stages. The stages of the test cycle are set at the following conditions:

Condition	Stage I	Stage II	Stage III
Duration, minutes	120	75	45
Engine Speed, r/min	1200	2900	700
Engine Power, kW	Record	Record	1.10 - 1.50
Manifold Abs Press, kPa (abs)	69	66	Record
Engine Oil In, ˚C	68	100	45
Engine Coolant Out, ˚C	57	85	45
Engine Coolant Flow, L/min	48	Record	Record
Engine Coolant Pressure, kPa (gauge)	70	70	70
RAC Coolant In, ˚C	29	85	29
Rocker Cover Flow, L/min	15	15	15
Intake Air, ˚C	30	30	30
Intake Air Press, kPa (gauge)	0.05	0.05	0.05
Exhaust Gas Analysis			
O_2, Vol. %	1.0 Max	1.0 Max	3.0 Max
CO, Vol. %	1.0 Max	2.0 Max	8.5
CO_2, Vol. %	13.5 - 15.5	13.5 - 15.5	Record
Blowby Flow Rate Avg, L/min	Record	60 - 70	-----
Air/Fuel Ratio	Stoich	Stoich	11.5:1
Intake Air Humidity, g/kg	11.4	11.4	11.4
Exhaust Back Pressure, kPa abs	104	107	Record
Fuel Flow, kg/h	Record	Record	Record

Upon test completion, the engine is disassembled and rated for sludge and varnish. Average Engine Sludge and Average Engine Varnish are calculated.

FIG A7.3 Test Method Summary

SEQUENCE VG
FORM 4
TEST RESULT SUMMARY
NON-REFERENCE & REFERENCE OIL TESTS

Laboratory: *LAB*	Stand: *STAND*	Stand Runs: *STRUN*	Oil Code: *OILCODE*
Date Started: *DTSTRT*	Time Started: *STRTTIME*	Date Completed: *DTCOMP*	Time Completed: *EOTTIME*
Formulation/Stand Code: *FORM*			

Lab Engine Number: *ENGINE*	SAE Viscosity: *SAEVISC*
Test Length: *TESTLEN*	Fuel Batch: *FUELBTID*
Industry Oil Code: *IND*	

CRITICAL PARAMETERS

	Average Engine Sludge, merits	Rocker Cover Sludge, merits	Average Engine Varnish, merits	Average Piston Skirt Varnish, merits	Oil Screen Sludge, % Area	Number of Hot Stuck Rings
Original Result	*AES*	*RACS*	*AEV3*	*APV*	*OSCRNSLG*	*NHSCMPRG*
Transformed Result					*TRANOSCR*	
Industry Correction Factor	*AESCF*	*RACSCF*	*AEV3CF*	*APVCF*	*TOSCRCF*	*NHSRCF*
Corrected Transformed Result					*TOSCRCOR*	
Severity Adjustment	*AESSA*	*RACSSA*	*AEV3SA*	*APVSA*	*TOSCRSA*	*NHSRSA*
Final Transformed Result					*TOSCRFNL*	
Final Original Unit Result	*AESFNL*	*RACSFNL*	*AEV3FNL*	*APVFNL*	*OSCRFNL*	*NHSRFNL*

Clogging Information		**Additional Information**	
Oil Screen Debris, % Area	*OSCRNDEB*	Number of Cold Stuck Rings	*NCSCMPRG*
Oil Ring Clogging, % Area	*OILRING*	Average Blowby Stage II, L/min	*ACBLWRT2*
PCV Valve @ 25 kPa, %	*PCV25*	Oil Consumption, grams	*TOILCONS*
PCV Valve @ 60 kPa, %	*PCV60*		

Last Reference Oil Test Calibrating Stand Information - Fill Out For Non-reference Oil Tests Only

Stand: *RSTAND*	Total Runs on Test Stand: *RTOTSRUN*	Oilcode: *ROILCODE*	
Industry Oil Code: *RIND*	Engine Number: *RENGINE*	SAE Viscosity: *RSAEVISC*	Date Completed: *RDTCOMP*
Test Length: *RTESTLEN*	Fuel Batch: *RFUELBID*	Calibration Expiration Date: *RDTCALEX*	

Clogging Information		**Additional Information**	
Oil Screen Debris, % Area	*ROSCRDEB*	Number of Cold Stuck Rings	*RCSCMPRG*
Oil Ring Clogging, % Area	ROILRING	Average Blowby Stage II, L/min	*RACBLWR2*
PCV Valve @ 25 kPa, %	*RPCV25*	Oil Consumption, grams	*RTOILCON*
PCV Valve @ 60 kPa, %	*RPCV60*		

	Average Engine Sludge, merits	Average Rocker Cover Sludge, merits	Average Engine Varnish, merits	Average Piston Skirt Varnish, merits	Oil Screen Sludge, % Area	Number of Hot Stuck Rings
Final Original Unit Result	*RAESFNL*	*RRACSFNL*	*RAEV3FNL*	*RAPVFNL*	*ROSCRSLG*	*RHSCMPRG*

FIG A7.4 Test Result Summary

SEQUENCE VG
FORM 5
TEST RESULT SUMMARY
NON-REFERENCE & REFERENCE OIL TESTS

Laboratory: *LAB*	Stand: *STAND*	Stand Runs: *STRUN*	Oil Code: *OILCODE*
Date Started: *DTSTRT*	Time Started: *STRTTIME*	Date Completed: *DTCOMP*	Time Completed: *EOTTIME*
Formulation/Stand Code: *FORM*			

Hardware Identification	Production Number *PRODNUM*	Serial Number *SERNUM*	
Casting Numbers	Block *BLKCAST*	Cam, Left *CAMCASTL*	Cam, Right *CAMCASTR*
Piston Part Number *PISTPART*		Piston Ring Casting Number *PRINGNUM*	
Cylinder Head Casting Number	Left *CYLHCSTL*	Right *CYLHCSTR*	

Sludge Deposits	
Area	**Merit**
Rocker Arm Cover, Left	*RACLSRT*
Rocker Arm Cover, Right	*RACRSRT*
Camshaft Baffle, Left	*CAMBLSRT*
Camshaft Baffle, Right	*CAMBRSRT*
Timing Chain Cover	*TCCSRT*
Oil Pan Baffle	*OILPBSRT*
Oil Pan	*OILPNSRT*
Valve Deck Area, Left	*VLVDLSRT*
Valve Deck Area, Right	*VLVDRSRT*
Average Engine Sludge	*AES*

Varnish Deposits	
Area	**Merit**
Piston Skirt, Thrust	*APV*
Rocker Arm Cover, Left	*RACLVRT*
Rocker Arm Cover, Right	*RACRVRT*
Average Engine Varnish	*AEV3*

Wear Measurements		
Ring Wear	**Units**	**Value**
Follower Pin Wear, cyl #8, Intake.	µm	*CFPIN8I*
Follower Pin Wear, cyl #8, Exhaust.	µm	*CFPIN8E*
Cylinder Bore Wear, cyl #1 & #8 Max.	µm	*MXCYLB18*
Cylinder Bore Wear, cyl #1 & #8 Avg.	µm	*ACYLBW18*
Ring Gap Increase, cyl #1 & #8, Max	µm	*MXRGINC*
Ring Gap Increase, cyl #1 & #8, Avg	µm	*ARGINC*

Piston Varnish Deposits, Thrust Side	
Piston Number	**Merit**
1	*PSVTH1*
2	*PSVTH2*
3	*PSVTH3*
4	*PSVTH4*
5	*PSVTH5*
6	*PSVTH6*
7	*PSVTH7*
8	*PSVTH8*
Average	*APV*

FIG A7.5 Deposit Breakdown

SEQUENCE VG
FORM 6
OPERATIONAL SUMMARY

Laboratory: *LAB*	Date Completed: *DTCOMP*	Time Completed: *EOTTIME*
Stand: *STAND*	Stand Runs: *STRUN*	Total Runs on Stand: *TOTSRUN*	Oil Code: *OILCODE*
Formulation/Stand Code: *FORM*		

	Parameter	Units	QI Threshold	EOT QI	Target			Average			Samples	BQD	Over/Under Range
					Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3			
Controlled Parameters	Speed	r/min	0.000	*QRPM*	1200	2900	700	*ARPM1*	*ARPM2*	*ARPM3*	*NRPM*	*BRPM*	*ORPM*
	Manifold Abs Press	kPa	0.000	*QMANABP*	69	66	Record	*AMANABP1*	*AMANABP2*	*AMANABP3*	*NMAP*	*BMAP*	*OMAP*
	Engine Oil, In	˚C	0.000	*QENGOIN*	68	100	45	*AENGOIN1*	*AENGOIN2*	*AENGOIN3*	*NEOIN*	*BEOIN*	*OEOIN*
	Engine Coolant,Out	˚C	0.000	*QCOLOUT*	57	85	45	*ACOLOUT1*	*ACOLOUT2*	*ACOLOUT3*	*NCOUT*	*BCOUT*	*OCOUT*
	Engine Coolant Flow	L/min	0.000	*QCOLFRT*	48	Record	Record	*ACOLFRT1*	*ACOLFRT2*	*ACOLFRT3*	*NCFRT*	*BCFRT*	*OCFRT*
	Engine Coolant Pressure	kPa	0.000	*QCOLPRE*	70	70	70	*ACOLPRE1*	*ACOLPRE2*	*ACOLPRE3*	*NCPRE*	*BCPRE*	*OCPRE*
	RAC Coolant, In	˚C	0.000	*QRACCTP*	29	85	29	*ARACCTP1*	*ARACCTP2*	*ARACCTP3*	*NRACC*	*BRACC*	*ORACC*
	RAC Flow	L/min	0.000	*QRACCFR*	15	15	15	*ARACCFR1*	*ARACCFR2*	*ARACCFR3*	*NRACF*	*BRACF*	*ORACF*
	Intake Air	˚C	0.000	*QINAIRT*	30	30	30	*AINAIRT1*	*AINAIRT2*	*AINAIRT3*	*NINAT*	*BINAT*	*OINAT*
	Intake Air Pressure	kPa	0.000	*QINAIRP*	0.05	0.05	0.05	*AINAIRP1*	*AINAIRP2*	*AINAIRP3*	*NINAP*	*BINAP*	*OINAP*
	Intake Air Humidity	g/kg	0.000	*QAIRHUM*	11.4	11.4	11.4	*AAIRHUM1*	*AAIRHUM2*	*AAIRHUM3*	*NAHUM*	*BAHUM*	*OAHUM*
	Exhaust Backpressure	kPa	0.000	*QEXBKPR*	104	107	Record	*AEXBKPR1*	*AEXBKPR2*	*AEXBKPR3*	*NEXBP*	*BEXBP*	*OEXBP*

	Parameter	Units		Specifications					
Non-controlled Parameters	Fuel Flow	kg/h		Record	Record	Record	*AFUELRT1*	*AFUELRT2*	*AFUELRT3*
	Blowby	L/min		Record	60-70			*ACBLWRT2*	
	Power	kW		Record	Record	1.3 ± 0.2	*APOWER1*	*APOWER2*	*APOWER3*
	Exhaust Gas								
	Left Manifold O_2	% Vol		1.0 Max	1.0 Max	3.0 Max	*ALEXGO1*	*ALEXGO2*	*ALEXGO3*
	Right Manifold O_2	% Vol		1.0 Max	1.0 Max	3.0 Max	*AREXGO1*	*AREXGO2*	*AREXGO3*
	Left Manifold CO	% Vol		1.0 Max	2.0 Max	8.5±1.5	*ALEXGCO1*	*ALEXGCO2*	*ALEXGCO3*
	Right Manifold CO	% Vol		1.0 Max	2.0 Max	8.5±1.5	*AREXGCO1*	*AREXGCO2*	*AREXGCO3*
	Left Manifold CO_2	% Vol		13.5-15.5	13.5-15.5	Record	*ALEXCO21*	*ALEXCO22*	*ALEXCO23*
	Right Manifold CO_2	% Vol		13.5-15.5	13.5-15.5	Record	*AREXCO21*	*AREXCO22*	*AREXCO23*
	Lambda	AFR		1.0	1.0	0.75	*AEXGNO2*	*ALEXGNO2*	*AREXGNO2*

FIG A7.6 Operational Summary

SEQUENCE VG
FORM 6
OPERATIONAL SUMMARY

Laboratory: *LAB*	Date Completed: *DTCOMP*		Time Completed: *EOTTIME*
Stand: *STAND*	Stand Runs: *STRUN*	Total Runs on Stand: *TOTSRUN*	Oil Code: *OILCODE*
Formulation/Stand Code: *FORM*			

	Parameter	Units	QI Threshold	EOT QI	Target			Average			Samples	BQD	Over/Under Range
					Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3			
Controlled Parameters	Speed	r/min	0.000	*CUMEXNO2*	1200	2900	700						
	Manifold Abs Press	kPa	0.000		69	66	Record						
	Engine Oil, In	˚C	0.000		68	100	45						
	Engine Coolant,Out	˚C	0.000		57	85	45						
	Engine Coolant Flow	L/min	0.000		48	Record	Record						
	Engine Coolant Pressure	kPa	0.000		70	70	70						
	RAC Coolant, In	˚C	0.000		29	85	29						
	RAC Flow	L/min	0.000		15	15	15						
	Intake Air	˚C	0.000		30	30	30						
	Intake Air Pressure	kPa	0.000		0.05	0.05	0.05						
	Intake Air Humidity	g/kg	0.000		11.4	11.4	11.4						
	Exhaust Backpressure	kPa	0.000		104	107	Record						

	Parameter	Units		Specifications					
Non-controlled Parameters	Fuel Flow	kg/h		Record	Record	Record			
	Blowby	L/min		Record	60-70			*ACBLWRT2*	
	Power	kW		Record	Record	1.3 ± 0.2			
	Exhaust Gas								
	Left Manifold O_2	% Vol		1.0 Max	1.0 Max	3.0 Max			
	Right Manifold O_2	% Vol		1.0 Max	1.0 Max	3.0 Max			
	Left Manifold CO	% Vol		1.0 Max	2.0 Max	8.5±1.5			
	Right Manifold CO	% Vol		1.0 Max	2.0 Max	8.5±1.5			
	Left Manifold CO_2	% Vol		13.5-15.5	13.5-15.5	Record			
	Right Manifold CO_2	% Vol		13.5-15.5	13.5-15.5	Record			
	Lambda	AFR		1.0	1.0	0.75			

FIG A7.6 Operational Summary

SEQUENCE VG
FORM 7
OIL ADDITION RECORD & BLOWBY RATES
NON-REFERENCE & REFERENCE OIL TESTS

Laboratory: *LAB*	Stand: *STAND*	Stand Runs: *STRUN*	Oil Code: *OILCODE*
Date Started: *DTSTRT*	Time Started: *STRTTIME*	Date Completed: *DTCOMP*	Time Completed: *EOTTIME*
Formulation/Stand Code: *FORM*			

Cycle	Test Hour	Oil Added, g	Oil Consumed, g
6	23 h, 25 min	*OILAR006*	*OILCR006*
12	47 h, 25 min	*OILAR012*	*OILCR012*
18	71 h, 25 min	*OILAR018*	*OILCR018*
24	95 h, 25 min	*OILAR024*	*OILCR024*
30	119 h, 25 min	*OILAR030*	*OILCR030*
36	143 h, 25 min	*OILAR036*	*OILCR036*
42	167 h, 25 min	*OILAR042*	*OILCR042*
48	191 h, 25 min	*OILAR048*	*OILCR048*
54	215 h, 25 min		*OILCR054*
Total, g		*TOILADD*	*TOILCONS*

Stage II	
Test Hours	Blowby, L/min
Break-in	*BLBYH001*
23	*BLBYH023*
47	*BLBYH047*
71	*BLBYH071*
95	*BLBYH095*
119	*BLBYH119*
143	*BLBYH143*
167	*BLBYH167*
191	*BLBYH191*
215	*BLBYH215*
Maximum	*XCBLWRT2*
Minimum	*MCBLWRT2*
Average Blowby, Hours 23 - 119	*ABLW2120*
Average	*ACBLWRT2*

FIG A7.7 Blowby and Oil Additions

SEQUENCE VG
FORM 8
ANALYSIS OF OIL

Laboratory: *LAB*	Stand: *STAND*	Stand Runs: *STRUN*	Oil Code: *OILCODE*
Date Started: *DTSTRT*	Time Started: *STRTTIME*	Date Completed: *DTCOMP*	Time Completed: *EOTTIME*
Formulation/Stand Code: *FORM*			

Test Hours	Ag, ppm	Al, ppm	Cr, ppm	Cu, ppm	Fe, ppm	Pb, ppm	Si, ppm	Sn, ppm	Fuel Dilution by GC, Wt. % D3525	Pentane Insolubles, Wt. % D893B [A]	TBN D4739 [A]	Vis. @ 40˚C, cSt D445	Vis. @ 100˚C, cSt D445 [A]
TST_HNEW	*AGWMHNEW*	*ALWMHNEW*	*CRWMHNEW*	*CUWMHNEW*	*FEWMHNEW*	*PBWMHNEW*	*SIWMHNEW*	*SNWMHNEW*			*TBN_HNEW*	*V40_HNEW*	*V100HNEW*
TST_H024	*AGWMH024*	*ALWMH024*	*CRWMH024*	*CUWMH024*	*FEWMH024*	*PBWMH024*	*SIWMH024*	*SNWMH024*	*FUELH024*		*TBN_H024*	*V40_H024*	*V100H024*
TST_H048	*AGWMH048*	*ALWMH048*	*CRWMH048*	*CUWMH048*	*FEWMH048*	*PBWMH048*	*SIWMH048*	*SNWMH048*	*FUELH048*	*PEN_H048*	*TBN_H048*	*V40_H048*	*V100H048*
TST_H072	*AGWMH072*	*ALWMH072*	*CRWMH072*	*CUWMH072*	*FEWMH072*	*PBWMH072*	*SIWMH072*	*SNWMH072*	*FUELH072*		*TBN_H072*	*V40_H072*	*V100H072*
TST_H096	*AGWMH096*	*ALWMH096*	*CRWMH096*	*CUWMH096*	*FEWMH096*	*PBWMH096*	*SIWMH096*	*SNWMH096*	*FUELH096*	*PEN_H096*	*TBN_H096*	*V40_H096*	*V100H096*
TST_H120	*AGWMH120*	*ALWMH120*	*CRWMH120*	*CUWMH120*	*FEWMH120*	*PBWMH120*	*SIWMH120*	*SNWMH120*	*FUELH120*		*TBN_H120*	*V40_H120*	*V100H120*
TST_H144	*AGWMH144*	*ALWMH144*	*CRWMH144*	*CUWMH144*	*FEWMH144*	*PBWMH144*	*SIWMH144*	*SNWMH144*	*FUELH144*	*PEN_H144*	*TBN_H144*	*V40_H144*	*V100H144*
TST_H168	*AGWMH168*	*ALWMH168*	*CRWMH168*	*CUWMH168*	*FEWMH168*	*PBWMH168*	*SIWMH168*	*SNWMH168*	*FUELH168*		*TBN_H168*	*V40_H168*	*V100H168*
TST_H192	*AGWMH192*	*ALWMH192*	*CRWMH192*	*CUWMH192*	*FEWMH192*	*PBWMH192*	*SIWMH192*	*SNWMH192*	*FUELH192*	*PEN_H192*	*TBN_H192*	*V40_H192*	*V100H192*
TST_H216	*AGWMH216*	*ALWMH216*	*CRWMH216*	*CUWMH216*	*FEWMH216*	*PBWMH216*	*SIWMH216*	*SNWMH216*	*FUELH216*	*PEN_H216*	*TBN_H216*	*V40_H216*	*V100H216*

[A] Analyses not required by Test Method

FIG A7.8 Oil Analysis

SEQUENCE VG
FORM 9
DOWNTIME OCCURRENCES AND OTHER COMMENTS

Laboratory: *LAB*	Stand: *STAND*	Stand Runs: *STRUN*	Oil Code: *OILCODE*
Date Started: *DTSTRT*	Time Started: *STRTTIME*	Date Completed: *DTCOMP*	Time Completed: *EOTTIME*
Formulation/Stand Code: *FORM*			

Number of Downtime Occurrences		*DWNOCR*	
Test Hours	Date	Downtime	Reasons
DOWNR001	*DDATR001*	*DTIMR001*	*DREAR001*
		TOTLDOWN	Total Downtime

Other Comments		
Number of Comment Lines	*TOTCOM*	
OCOMR001		

FIG A7.9 Downtime