

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, Lambda	1.0	1.0	0.75
Blowby Flow Rate Avg, L/min	Record	60 - 70	-----
Air/Fuel Ratio	Stoichmetric	Stoichmetric	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.

**Sequence VG
Form 4
Test Result Summary
Non-Reference & Reference Oil Tests**

Laboratory: CC	Stand: CCCCC	Stand Runs: CCCC	Total Runs on Stand: CCCCC
Oilcode: CCC			
Formulation/Stand Code: CC-CCCCCCCCCC-C-C-C-C-C-C-C-C-C-C-C-C-C-C-C-C			

Date Started: YYYYMMDD	Time Started: HH:MM	SAE Viscosity: CCCCCC
Date Complete: YYYYMMDD	Time Complete: HH:MM	Lab Engine Number: CCCCC
Test Length: S1234		Fuel Batch: CCCCCCCCCCCCCC
Industry Oil Code: CCCCC		Nominal Piston Oversize: S1.123

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	S12.12	S12.12	S12.12	S12.12	S123	S1
Transformed Result					S1.1234	
Industry Correction Factor	S12.12	S12.12	S12.12	S12.12	S1.1234	S1
Corrected Transformed Result					S1.1234	
Severity Adjustment	S12.12	S12.12	S12.12	S12.12	S1.1234	S1
Final Transformed Result					S1.1234	
Final Original Unit Result	S12.12	S12.12	S12.12	S12.12	S12.12	S12.12

Clogging Information		Additional Information	
Oil Screen Debris, % Area	S123	Number of Cold Stuck Rings	S1
Oil Ring Clogging, % Area	S123	Average Blowby Stage II, L/min	S12.12
PCV Valve @ 25 kPa, %	S12.12	Oil Consumption, grams	S123456
PCV Valve @ 60 kPa, %	S12.12		

Last Reference Oil Test Calibrating Stand Information – Fill Out For Non-reference Oil Tests Only						
Stand: CCCCC			Total Runs on Test Stand CCCCC			
Oilcode: CCC						
Industry Oil Code: CCCCC		Engine Number: CCCCC		SAE Viscosity: CCCCCC		Date Completed: YYYYMMDD
Test Length: S1234		Fuel Batch: CCCCCCCCCCCCCC		Calibration Expiration Date: YYYYMMDD		
Clogging Information			Additional Information			
Oil Screen Debris, % Area	S123		Number of Cold Stuck Rings		S1	
Oil Ring Clogging, % Area	S123		Average Blowby Stage II, L/min		S12.12	
PCV Valve @ 25 kPa, %	S12.12		Oil Consumption, grams		S123456	
PCV Valve @ 60 kPa, %	S12.12					
	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	S12.12	S12.12	S12.12	S12.12	S123	S1

**Sequence VG
Form 5
Test Result Summary
Non-Reference & Reference Oil Tests**

Laboratory: CC	Stand: CCCCC	Stand Runs: CCCC	Total Runs on Stand: CCCCC
Oilcode: CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC			
Formulation/Stand Code: CC-CCCCCCCCC-C-C-CCCCC-CC-CC-CCCC			

Date Completed: YYYMMDD	Time Completed : HH:MM
Camshaft Serial Numbers	Cam, Left: CCCC Cam, Right: CCCC
Cylinder Head Serial Numbers	Head, Left: CCCCCCCCCC Head, Right: CCCCCCCCCC
Number of Runs	Block: S12 Left Head: S12 Right Head: S12

Sludge Deposits	
Area	Merit
Rocker Arm Cover, Left	S1.12
Rocker Arm Cover, Right	S1.12
Camshaft Baffle, Left	S1.12
Camshaft Baffle, Right	S1.12
Timing Chain Cover	S1.12
Oil Pan Baffle	S1.12
Oil Pan	S1.12
Valve Deck Area, Left	S1.12
Valve Deck Area, Right	S1.12
Average Engine Sludge	S12.12

Varnish Deposits	
Area	Merit
Piston Skirt, Thrust	S12.12
Cam Baffle, Left	S1.12
Cam Baffle, Right	S1.12
Average Engine Varnish	S12.12

Piston Varnish Deposits, Thrust Side	
Piston Number	Merit
1	S1.12
2	S1.12
3	S1.12
4	S1.12
5	S1.12
6	S1.12
7	S1.12
8	S1.12
Average	S12.12

**Sequence VG
Form 6
Operational Summary**

Laboratory: CC	Stand: CCCCC	Stand Runs: CCCC	Total Runs on Stand: CCCCC
Oilcode: CCC			
Formulation/Stand Code: CC-CCCCCCCCCCC-C-CCCCCCC-CC-CC-CCCCC			

Parameter	Units	Threshold	EOT QI	Target			Average			Samples	BQD	Over/Under Range
				Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3			
Speed	r/min	0.000	S12.123	1200	2900	700	S1234	S1234	S1234	S12345	S12345	S12345
Manifold Abs Press	kPa	0.000	S12.123	69	66	Record	S12.1	S12.1	S12.1	S12345	S12345	S12345
Engine Oil, In	°C	0.000	S12.123	68	100	45	S123.1	S123.1	S123.1	S12345	S12345	S12345
Engine Coolant, Out	°C	0.000	S12.123	57	85	45	S12.1	S12.1	S12.1	S12345	S12345	S12345
Engine Coolant Flow	L/min	0.000	S12.123	48	Record	Record	S123.1	S123.1	S123.1	S12345	S12345	S12345
Engine Coolant Pressure	kPa	0.000	S12.123	70	70	70	S123.1	S123.1	S123.1	S12345	S12345	S12345
RAC Coolant, In	°C	0.000	S12.123	29	85	29	S12.1	S12.1	S12.1	S12345	S12345	S12345
RAC Flow	L/min	0.000	S12.123	15	15	15	S12.1	S12.1	S12.1	S12345	S12345	S12345
Intake Air	°C	0.000	S12.123	30	30	30	S12.1	S12.1	S12.1	S12345	S12345	S12345
Intake Air Pressure	kPa	0.000	S12.123	0.05	0.05	0.05	S1.123	S1.123	S1.123	S12345	S12345	S12345
Intake Air Humidity	g/kg	0.000	S12.123	11.4	11.4	11.4	S12.1	S12.1	S12.1	S12345	S12345	S12345
Exhaust Backpressure	kPa	0.000	S12.123	104	107	Record	S123.1	S123.1	S123.1	S12345	S12345	S12345
Parameter	Units	Specifications										
Fuel Flow	kg/h			Record	Record	Record	S12.1	S12.1	S12.1			
Blowby	L/min			Record	60-70			S12.12				
Power	kW			Record	Record	1.3 ± 0.2	S12.12	S12.12	S12.12			
Exhaust Gas												
Lambda, Left Bank	AFR			1.0	1.0	0.75	S1.12	S1.12	S1.12			
Lambda, Right Bank	AFR			1.0	1.0	0.75	S1.12	S1.12	S1.12			

Controlled Parameters

Non-

Sequence VG
Form 7
Oil Addition Record & Blowby Rates
Non-Reference & Reference Oil Tests

Laboratory: CC	Stand: CCCCC	Stand Runs: CCCC	Total Runs on Stand: CCCCC
Oilcode: CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC			
Formulation/Stand Code: CC-CCCCCCCCCC-C-C-C-C-C-C-C-C-C-C-C-C-C-C-C			

Cycle	Test Hour	Oil Added, g	Oil Consumed, g
S123	HHH:MM	S1234	S1234
S123	HHH:MM	S1234	S1234
S123	HHH:MM	S1234	S1234
S123	HHH:MM	S1234	S1234
S123	HHH:MM	S1234	S1234
S123	HHH:MM	S1234	S1234
S123	HHH:MM	S1234	S1234
S123	HHH:MM	S1234	S1234
S123	HHH:MM	S1234	S1234
S123	HHH:MM		S1234
Total, g		S123456	S123456

Stage II	
Test Hours	Blowby, L/min
CCCCCCC	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
HHH:MM	S12.12
Maximum	S12.12
Minimum	S12.12
Average Blowby, Hours 23 - 119	S12.12
Average	S12.12

**Sequence VG
Form 8
Analysis of Oil**

Laboratory: CC	Stand: CCCCC	Stand Runs: CCCC	Total Runs on Stand: CCCCC
Oilcode: CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC			
Formulation/Stand Code: CC-CCCCCCCCCC-C-C-CCCCCC-CC-CC-CCCCC			

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
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA			AAAA	S123.1	S123.12
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	S12.1		AAAA	S123.1	S123.12
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	S12.1	S1.12	AAAA	S123.1	S123.12
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	S12.1		AAAA	S123.1	S123.12
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	S12.1	S1.12	AAAA	S123.1	S123.12
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	S12.1		AAAA	S123.1	S123.12
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	S12.1	S1.12	AAAA	S123.1	S123.12
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	S12.1		AAAA	S123.1	S123.12
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	S12.1	S1.12	AAAA	S123.1	S123.12
CCC	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	AAAA	S12.1	S1.12	AAAA	S123.1	S123.12

^A Analyses not required by Test Method

**Sequence VG
Form 10
American Chemistry Council Code Of Practice
Test Laboratory Conformance Statement**

Test Laboratory	CC				
Test Sponsor	CC				
Formulation / Stand Code	CC-CCCCCCCCCC-C-C-CCCCCC-CC-CC-CCCC				
Test Number	CC				
Start Date	YYYYMMDD	Start Time	HH:MM	Time Zone	CCC

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 C No C *

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 C No C *

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 C * No C

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

Check the Appropriate Conclusion

C	Operational review of this test indicates that the results should be included in the Multiple Test Acceptance Criteria calculations.
C	*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	
	CC
	CC
	CC
	CC

Signature Image _____

YYYYMMDD _____

Signature

Date

CC

CC

Typed Name

Title