

**Sequence IVA Valve Train Wear Evaluation  
Final Report Cover Sheet**

**Form 1**

Version:

Conducted For

	V = Valid
	I = Invalid

	NR = Non-reference oil
	RO = Reference oil

<b>Test Number</b>			
<b>Test Stand</b>	<b>Number of Runs on Stand Since Last Calibration Test</b>		<b>Total Runs on Stand</b>
Lab Engine Number		Total Runs on Engine	
Lab Head Number		Total Runs on Cylinder Head	
Lab Cam Number			
Date Completed		Completion Time	
Oil Code		Fuel Batch	
Formulation/Stand Code			
Alternate Codes:			

<p>In my opinion this test _____ been conducted in a valid manner in accordance with the ASTM Test Method D 6891 and the appropriate amendments through the Information Letter System. The remarks included in this report describe anomalies associated with this test.</p>
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Submitted By:

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

\_\_\_\_\_ Signature

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

\_\_\_\_\_ Title

**Sequence IVA Valve Train Wear  
Form 2**

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<sup>A</sup> ACC Conformance Statement is required for only ACC registered tests

**Sequence IVA Valve Train Wear  
Form 3**

**Summary of Test Method**

The Sequence IVA engine valve train wear test is a fired engine-dynamometer lubricant test which evaluates the ability of a test lubricant to reduce camshaft lobe wear. The test method is a low temperature cyclic test, with a total running duration of 100 hours.

A 1994 Nissan model KA24E water-cooled, 4 cycle, in-line cylinder, 2.4L engine is used as the test apparatus. The engine incorporates a single overhead cam (SOHC), three valves per cylinder (2 intake; 1 exhaust), and sliding follower valve train design. An engine short block is utilized for 20 tests; a cylinder head assembly for 10 tests; and the critical test parts (camshaft, rocker arms, rocker shafts) are replaced every test. A 95-minute break-in schedule is conducted whenever the long block or cylinder head is replaced.

The Sequence IVA test is a flush and run type of lubricant test. Each individual test consists of two 20-minute flushes, followed by the 100-hour cyclic test. The cyclic test is comprised of 100 hourly cycles. Each cycle consists of two stages. The idle speed Stage 1 duration is 50 minutes; the 1500 r/min stage 2 operates for 10 minutes. The stages of the test cycle are set at the following conditions:

<b>Parameter</b>	<b>Units</b>	<b>Stage 1</b>	<b>Stage 2</b>
Duration	Min	50	10
Engine Speed	r/min	800	1500
Engine Torque	N•m	25	
Coolant Out Temperature	°C	50	55
Oil Cylinder Head Temperature	°C	49	59
Intake Air Temperature	°C	32	
Intake Air Pressure	KPa	0.050	
Intake Air Humidity	G/kg	11.5	
Exhaust Pressure	kPa absolute	103.5	
Coolant Flow	L/min	30	
Fresh Air Flow	SL/min	10	

Upon test completion, the camshaft is removed from the engine and measured for individual lobe wear at seven prescribed locations (nose; 14 degrees before and after the nose; 10 degrees before and after the nose; 4 degrees before and after the nose). For each lobe, the seven locations are summed to determine the lobe wear. Then the twelve lobes are averaged to compute the final test result.

**Sequence IVA Valve Train Wear  
Form 4**

**Results Summary**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

Laboratory Oil			
Fuel Batch		SAE Grade	
Date Started	Date Completed	Test Length	
Time Started	Time Completed	TMC Oil Code <sup>A</sup>	
Lab Engine			

**Average Camshaft Wear**

Original Unit Result, $\mu\text{m}$	
Transformed Result	
Industry Correction Factor	
Corrected Transformed Result	
Severity Adjustment (non-reference oil tests only)	
Final Transformed Result	
Final Original Unit Result, $\mu\text{m}$	

**Additional Camshaft Lobe Wear Measurements**

Intake Lobe	Maximum, $\mu\text{m}$	
	Average, $\mu\text{m}$	
Exhaust Lobe	Maximum, $\mu\text{m}$	
	Average, $\mu\text{m}$	
Nose	Maximum, $\mu\text{m}$	
	Average, $\mu\text{m}$	

**Additional Information**

Total Oil Consumption @ EOT, g	
Fuel Dilution @ EOT, %	
Fuel Consumption @ EOT, kg	
Fe by ICP @ EOT, ppm	
Corrected Blowby, L/min @ hour 5	
Corrected Blowby, L/min @ hour 100	

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



**Sequence IVA Valve Train Wear  
Form 6  
Operational Summary**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

Controlled Parameters	Parameter	Units	QI Limit	EOT QI	Target	Average		Samples <sup>A</sup>	BQD <sup>B</sup>	Over/Under Range <sup>C</sup>
	Speed	r/min	0.000		800	1500				
Torque	N·m	0.000		25.0						
Coolant Out Temperature	°C	0.000		50.0	55.0					
Humidity	g/kg	0.000		11.5						
Intake Air Temperature	°C	0.000		32						
Intake Air Pressure	kPa	0.000		0.05						
Exhaust Pressure, absolute	kPa	0.000		103.5						
Engine Coolant Flow	L/min	0.000		30						
Oil Cylinder Head Temperature	°C	0.000		49.0	59.0					
Rocker Cover Fresh Air Flow	SL/min	0.000		10.0						
Non-controlled Parameters	Parameter	Units	Typical Values		Average					
	Oil Sump Temperature	°C	53.5 ± 3		63.5 ± 3					
Oil Gallery Temperature	°C	50 ± 3		60 ± 3						
Coolant In Temperature	°C	45.5 ± 3		49 ± 3						
Exhaust Gas Temperature	°C	340 ± 50		450 ± 50						
Fuel Rail Temperature	°C	22.5 ± 10		22.5 ± 10						
Oil Gallery Pressure	kPa	130 ± 40		260 ± 80						
Oil Cylinder Head Pressure	kPa	40 ± 20		65 ± 30						
Fuel Pressure	kPa	238 ± 10		234 ± 10						
Manifold Vacuum	kPa	60 ± 5		65 ± 5						
Air-to-Fuel Ratio	-	14.1 – 14.7		14.1 – 14.7						
Crankcase Pressure	kPa	-0.3 ± 0.1		-0.3 ± 0.1						
Fuel Flow	kg/h	1.3 ± 0.3		2.15 ± 0.3						
Ignition Timing	°BTDC	9 – 11		22 – 26						
Ambient Temperature	°C	20 – 45		20 – 45						
Rocker Cover Gas Temperature	°C	47 – 49		52 – 55						
Rocker Cover Coolant Flow	L/min	3.0 – 4.5		3.0 – 4.5						
Coolant Pressure	kPa	70±5		70±5						
Rocker Cover Coolant In Temp.	°C	Record		Record						
Rocker Cover Coolant Out Temp.	°C	Record		Record						
Front Cover Fresh Air Flow	SL/min	Record		Record						

<sup>A</sup> Total number of data points taken as determined from test length and sampling rate

<sup>B</sup> Number of Bad Quality Data points not used in the calculation of statistical measures

<sup>C</sup> Number of points clipped by over or under range limits of the statistical measures

**Sequence IVA Valve Train Wear Evaluation  
Form 7**

**Used Oil Analysis**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

**Chemical Analysis of Used Engine Oil Samples**

Test Hours	Kinematic Viscosity @ 40°C D 445 cSt	Fuel Dilution D3525-M %	ICP D 5185 ppm	
			Fe	Cu
NEW				

**Sequence IVA Valve Train Wear  
Form 8**

**Camshaft Measurements**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

**Camshaft Bearing Journal Diameter (mm)**

Diameter (Standard): 32.935 – 32.955mm

Clearance (Limit): 0.120mm

Bore Number	V		H		Run-out		Clearance @ V	
	F	R	F	R	F	R	F	R
1								
2								
3								
4								
5								

Note: Calculate camshaft bearing clearance @ vertical bore diameter

<b>Camshaft End Play, mm</b>		End-play (Limit): 0.22mm
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<b>Camshaft Sprocket Run-out, mm</b>		Run-out (Limit): 0.12mm
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<b>Camshaft Run-out (bend), mm</b>		Run-out (Limit): 0.02mm
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**Cylinder Compression, kPa**

Cylinder Number	1	2	3	4
Before Test				





## Sequence IVA Valve Train Wear Evaluation

### Form 9A Special Maintenance Record

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

Number of Downtime Occurrences			
Test Hours	Date	Down Time	Reasons
			<b>Total Downtime</b>

Other Comments	
Number of Comment Lines	

## Sequence IVA Valve Train Wear Evaluation

### Form 9B

### Special Maintenance Record

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

Number of Downtime Occurrences			
Test Hours	Date	Down Time	Reasons
			<b>Total Downtime</b>

<b>Other Comments</b>	
<b>Number of Comment Lines</b>	

**Sequence IVA Valve Train Wear Evaluation**

**Form 10**

**Cycle 5 Stage 2 to 1 Transition: Oil Cylinder Head Temperature**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

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**Sequence IVA Valve Train Wear Evaluation  
Form 11**

**Cycle 5 Stage 1 to 2 Transition: Oil Cylinder Head Temperature**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

**Sequence IVA Valve Train Wear Evaluation  
Form 12**

**Cycle 5 Stage 2 to 1 Transition: Coolant Out Temperature**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

**Sequence IVA Valve Train Wear Evaluation  
Form 13**

**Cycle 5 Stage 1 to 2 Transition: Coolant Out Temperature**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

**Sequence IVA Valve Train Wear Evaluation  
Form 14**

**Cycle 5 Stage 2 to 1 Transition: Engine Torque**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	



**Sequence IVA Valve Train Wear Evaluation  
Form 15**

**Cycle 5 Stage 1 to 2 Transition: Engine Torque**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

**Sequence IVA Valve Train Wear Evaluation  
Form 16**

**Cycle 5 Stage 2 to 1 Transition: Engine Speed**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

**Sequence IVA Valve Train Wear Evaluation  
Form 17**

**Cycle 5 Stage 1 to 2 Transition: Engine Speed**

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	



## Sequence IVA Valve Train Wear Evaluation

### Form 18

### Hardware Information

Laboratory:	Test Number:
Oil Code:	
Formulation/Stand Code:	

	Position	Part Number	Lot Number
Rocker Arm	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	11		
	12		
Camshaft			
Cylinder Head			
Rocker Shaft, Exhaust			
Rocker Shaft, Intake			
Spark Plug			
Oil Filter			
Reground Camshaft s/n			

**Sequence IVA Valve Train Wear Evaluation**

**Form 19**

American Chemistry Council Code of Practice  
Test Laboratory Conformance Statement

Test Laboratory					
Test Sponsor					
Formulation / Stand Code					
Test Number					
Start Date		Start Time		Time Zone	

**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 \_\_\_\_\_ No \_\_\_\_\_ \*

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 \_\_\_\_\_ No \_\_\_\_\_ \*

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 \_\_\_\_\_ \* No \_\_\_\_\_

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

**Check The Appropriate Conclusion**

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

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

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

\_\_\_\_\_  
Title