

**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

Test Number			
Test Stand	Number of Runs on Stand Since Last Calibration Test		Total Runs on Stand
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>
--

Submitted By:

_____ Testing Laboratory

_____ Signature

_____ Typed Name

_____ Title

**Sequence IVA Valve Train Wear
Form 2**

Table of Contents

1.	Title / Validity Declaration Page	Form 1
2.	Table of Contents	Form 2
3.	Summary of Test Method	Form 3
4.	Results Summary	Form 4
5.	Camshaft Lobe Wear Table	Form 5
6.	Operational Data Summary	Form 6
7.	Used Oil Analysis	Form 7
8.	Camshaft Measurements	Form 8
9.	Special Maintenance Record	Form 9
10.	Cycle 5 Stage 2 to 1 Transition: Oil Gallery Temperature	Form 10
11.	Cycle 5 Stage 1 to 2 Transition: Oil Gallery Temperature	Form 11
12.	Cycle 5 Stage 2 to 1 Transition: Coolant Out Temperature	Form 12
13.	Cycle 5 Stage 1 to 2 Transition: Coolant Out Temperature	Form 13
14.	Cycle 5 Stage 2 to 1 Transition: Engine Torque	Form 14
15.	Cycle 5 Stage 1 to 2 Transition: Engine Torque	Form 15
16.	Cycle 5 Stage 2 to 1 Transition: Engine Speed	Form 16
17.	Cycle 5 Stage 1 to 2 Transition: Engine Speed	Form 17
18.	Hardware Information	Form 18
19.	ACC Conformance Statement ^A	Form 19

^A 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:

Parameter	Units	Stage 1	Stage 2
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 ^A	
Lab Engine			

Average Camshaft Wear

Original Unit Result, μm	
Transformed Result	
Industry Correction Factor	
Corrected Transformed Result	
Severity Adjustment (non-reference oil tests only)	
Final Transformed Result	
Final Original Unit Result, μm	

Additional Camshaft Lobe Wear Measurements

Intake Lobe	Maximum, μm	
	Average, μm	
Exhaust Lobe	Maximum, μm	
	Average, μm	
Nose	Maximum, μm	
	Average, μm	

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	

^A 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 ^A	BQD ^B	Over/Under Range ^C
	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						

^A Total number of data points taken as determined from test length and sampling rate

^B Number of Bad Quality Data points not used in the calculation of statistical measures

^C 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

Camshaft End Play, mm		End-play (Limit): 0.22mm
------------------------------	--	--------------------------

Camshaft Sprocket Run-out, mm		Run-out (Limit): 0.12mm
--------------------------------------	--	-------------------------

Camshaft Run-out (bend), mm		Run-out (Limit): 0.02mm
------------------------------------	--	-------------------------

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
			Total Downtime

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
			Total Downtime

Other Comments	
Number of Comment Lines	

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:	

--

**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

<input type="checkbox"/>	Operational review of this test indicates that the results should be included in the Multiple Test Acceptance Criteria calculations.
<input type="checkbox"/>	*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