

**SEQUENCE IVA VALVE TRAIN WEAR EVALUATION
FINAL REPORT COVER SHEET**

VERSION 20010418

CONDUCTED FOR

	V =VALID I =INVALID
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	NR = Non-reference Oil Test RO = Reference Oil Test
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Test Number					
Test Stand:	No. Tests Since Last Stand Calibration Test:			Laboratory Run Number:	
Lab Engine No.			Total Runs on Cylinder Head		
Lab Head Number			Lab Cam Number		
Date Completed			End of Test		
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 Research Report RR-D2-XXXX and the appropriate amendments through the Information Letter system. The remarks included in the report describe the anomalies associated with this test.</p>

SUBMITTED BY:

_____ Testing Laboratory

_____ Signature

_____ Typed Name

_____ Title

Form 2

Sequence IVA Valve Train Wear Test

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Sequence IVA Valve Train Wear Test

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, 2.389 (2.4) liter 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 shortblock is utilized for 12 tests; a cylinder head assembly for 6 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 (before tests 1 and 7).

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	25
Coolant Out Temperature	°C	50	55
Oil Cylinder Head	°C	49	59
Intake Air Temperature	°C	32	32
Intake Air Pressure	kPa	0.050	0.050
Intake Air Humidity	g/kg	11.5	11.5
Exhaust Pressure	kPa-abs	103.5	103.5
Coolant Flow	L/min	30	30
Fresh Airflow	SL/min	10	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 Test
Form 4
Results Summary**

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

Laboratory Oil	Fuel Batch	SAE Grade	
Date Started	Date Completed	Test Length	
Time Started	Time Completed	TMC Oil Code ^A	
Lab Engine			
Cam Lot Number	Head Lot	Rocker Arm Lot	

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	
Corr. Blowby, L/min @ hour 5	
Corr. Blowby, L/min @ hour 100	

Most Recent Stand Reference Oil Test History ^B

Test Number	- -		
Oilcode			
Date		TMC Oil Code	
Final Average Camshaft Wear,			

^A Reference Oil Tests Only

^B Non-reference Oil Tests Only

Sequence IVA Valve Train Wear Test

Form 5

Camshaft Lobe Wear

Laboratory:	Test Number:	Oil Code:
Formulation/Stand		

7-point measurement method

Position	Cylinder	Lobe Number	14° BTC Wear, μm	10° BTC Wear, μm	4° BTC Wear, μm	0° (Nose) Wear, μm	4° ATC Wear, μm	10° ATC Wear, μm	14° ATC Wear, μm	Lobe Wear, μm
Intake	1	1								
		3								
	2	4								
		6								
	3	7								
		9								
	4	10								
		12								
		Max. of Intake								
		Avg. of Intake								
Exhaust	1	2								
		5								
	3	8								
		11								
		Max. of Exhaust								
		Avg. of Exhaust								
		Over-all Maximum								
		Over-all Average								

Note: Plus direction is before top center of cam nose

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

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

Parameter	Units	Oil Threshold	EOT Oil	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	°C	0.000		50.0 55.0				
Humidity	g/kg	0.000		11.5				
Intake Air	°C	0.000		32				
Intake Air	kPa	0.000		0.05				
Exhaust - abs	kPa	0.000		103.5				
Engine Coolant	L/min	0.000		30.0				
Oil Cylinder Head	°C	0.000		49.0 59.0				
Fresh Air Flow	SL/min	0.000		10.0				
Controlled Parameters								
Parameter	Units	Typical Values		Average				
Oil Sump	°C	49 - 54	57 - 65					
Oil Gallery	°C	46.5 - 50.5	58.5 - 61.5					
Coolant In	°C	44 - 46	49 - 50					
Exhaust Gas	°C	306 - 332	414 - 434					
Fuel Rail	°C	15 - 30	15 - 30					
Oil Gallery	kPa	99.5 - 145.5	210.5 - 280.5					
Oil Cylinder Head	kPa	30 - 60	50 - 90					
Fuel	kPa	230 - 380	230 - 380					
Manifold Vacuum	°C	57.7 - 59.9	63.8 - 65.8					
Air-to-Fuel Ratio		14.1 - 14.7	14.1 - 14.7					
Crankcase	kPa	-0.1 - -0.4	-0.1 - -0.4					
Fuel Flow	kg/h	1.2 - 1.4	2.0 - 2.2					
Ignition Timing	°BTDC	9 - 11	22 - 26					
Ambient Temperature	°C	20 - 45	20 - 45					
Rocker Cover Gas	°C	47 - 49	52 - 55					
Rocker Cover Coolant	L/min	3.0 - 4.5	3.0 - 4.5					
Non-controlled Parameters								

^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 under range limits of the statistical measures.

Sequence IVA Valve Train Wear Test

Form 7

Used Oil Analysis

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

Chemical Analysis: 0, 25, 50, 75 & 100 Hour Engine Oil

ASTM Method	Analysis Description	Units					
D 445	Kinematic Viscosity @ 40°C	cSt		---	---	---	
D 3525-M	Fuel Dilution, Gasoline	%	---	---	---	---	
D 5185 (ICP)	Fe by ICP	ppm	---				
D 5185 (ICP)	Cu by ICP	ppm	---				

Sequence IVA Valve Train Wear Test

Form 8

Camshaft Bore/Journal Measurements

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

Camshaft Bearing Bore Diameter (mm)

Bore Gauge Set: 33.000 mm

Diameter (Standard): 33.000 - 33.025 mm

Bore Number	X		V		Y		Maximum Run-Out	
	F	R	F	R	F	R	F	R
1								
2								
3								
4								
5								

Camshaft Bearing Journal Diameter (mm)

Diameter (Standard) 32.935 - 32.955 mm

Clearance (Limit) : 0.120 mm

Journal 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	
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End Play (Limit): 0.20 mm

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

Camshaft Run-Out (Bend), mm	
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Run-Out (Limit): 0.02 mm

Cylinder Compression (kPa)

Cylinder Number	1 (kPa)	2 (kPa)	3 (kPa)	4 (kPa)
Before Test				

Sequence IVA Valve Train Wear Test

Form 9

Special Maintenance Record

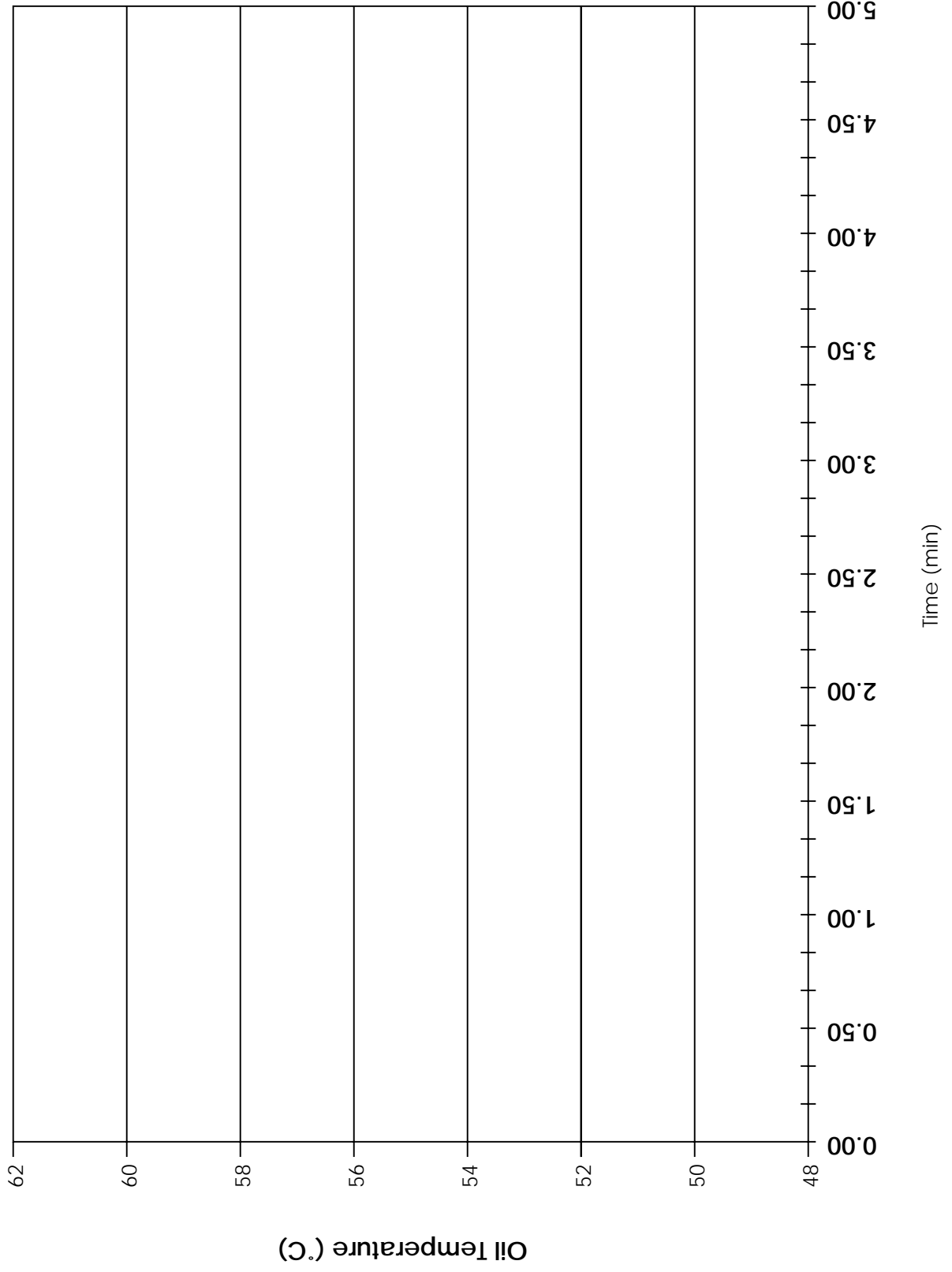
Laboratory:	Test Number: - -	Oil Code:
Formulation/Stand Code:		

Number of Downtime Occurrences			
Test Hours	Date	Downtime	Reasons
			Total Downtime

Other Comments	
Number of Comment Lines	

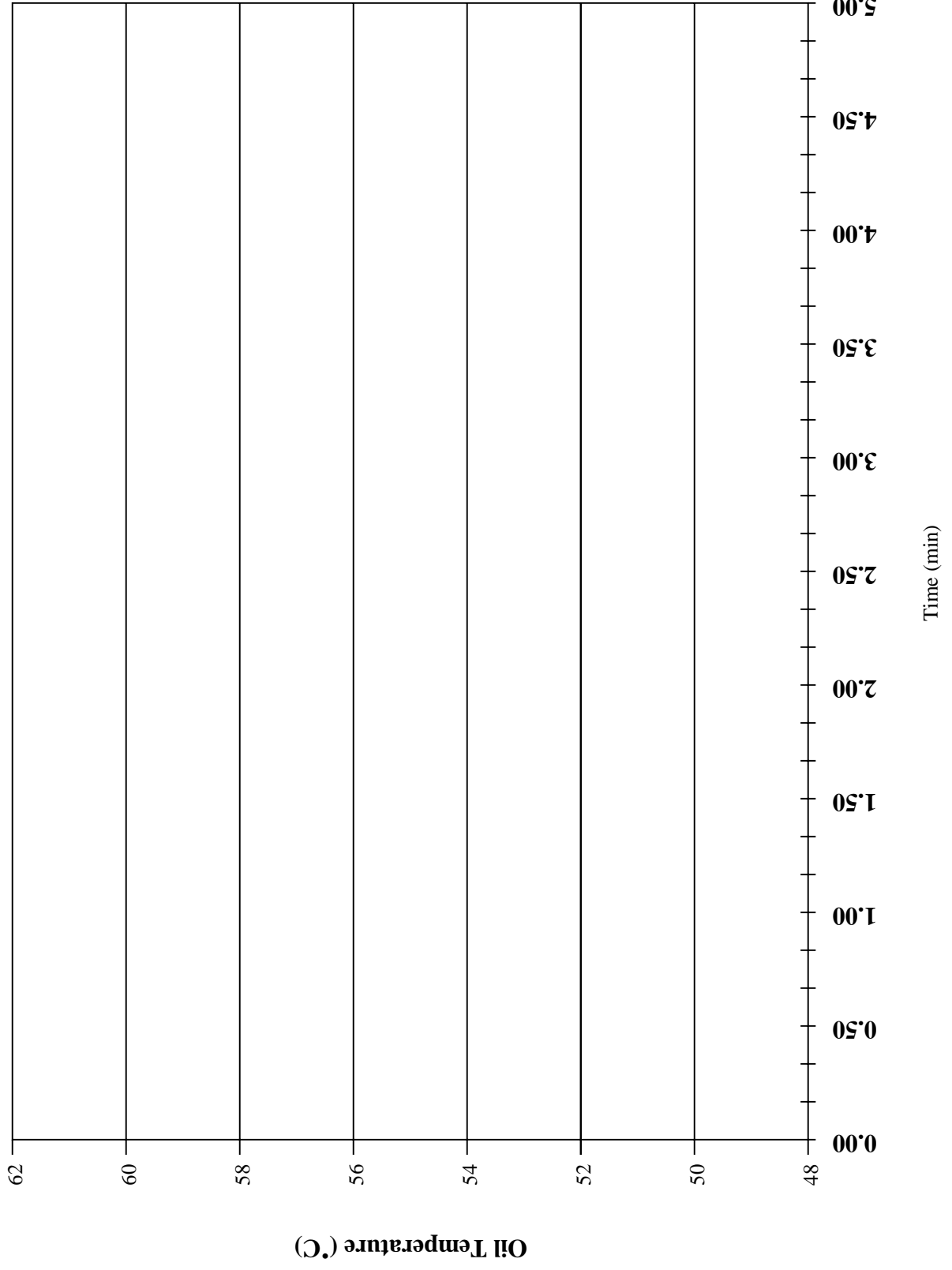
Sequence IVA Valve Train Wear Evaluation
Form 10
Stage 2 to 1 Transition: Oil Cylinder Head Temperature
Cycle 5

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



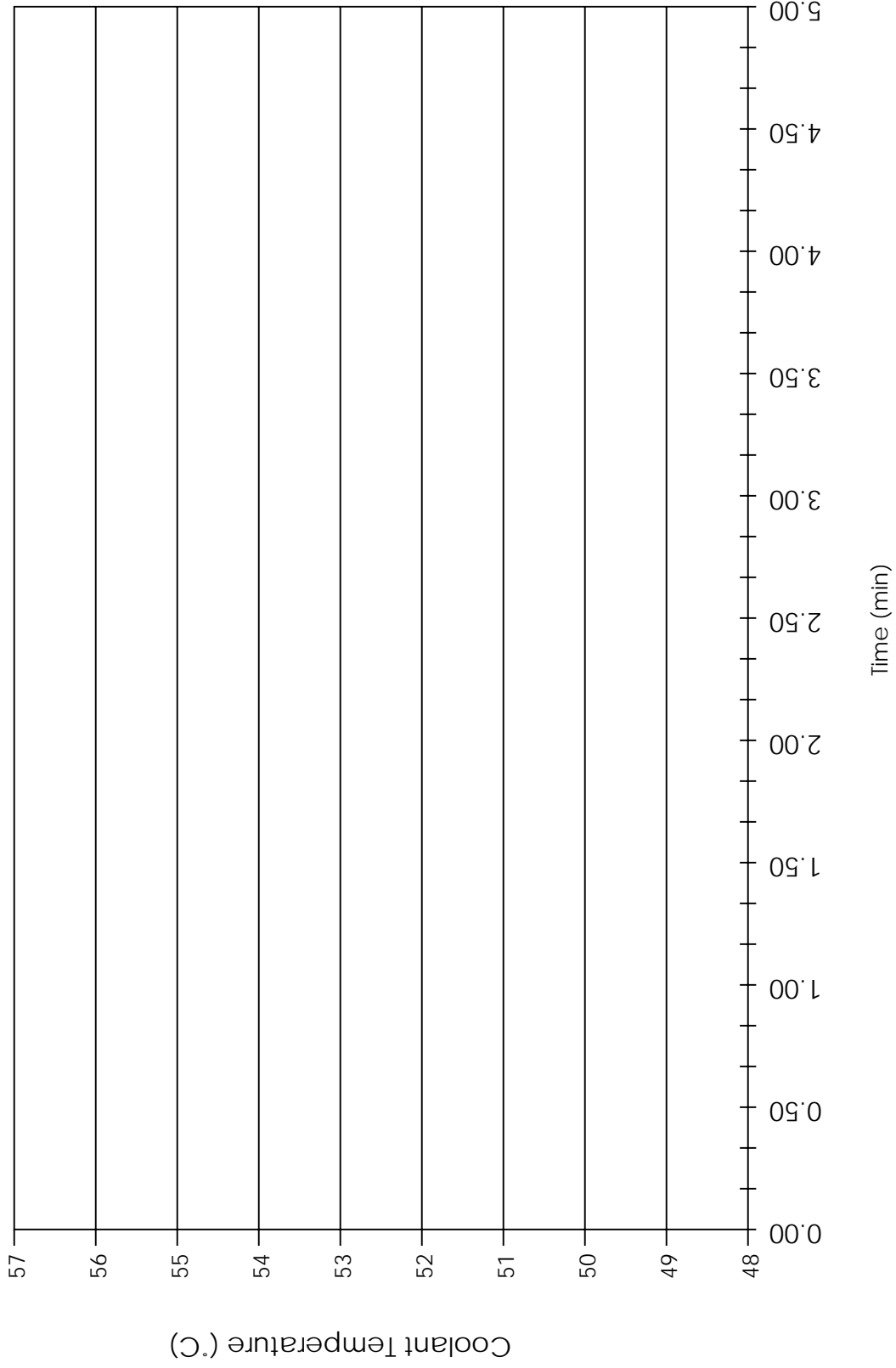
**Sequence IVA Valve Train Wear Evaluation
Form 11
Stage 1 to 2 Transition: Oil Cylinder Head Temperature
Cycle 5**

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



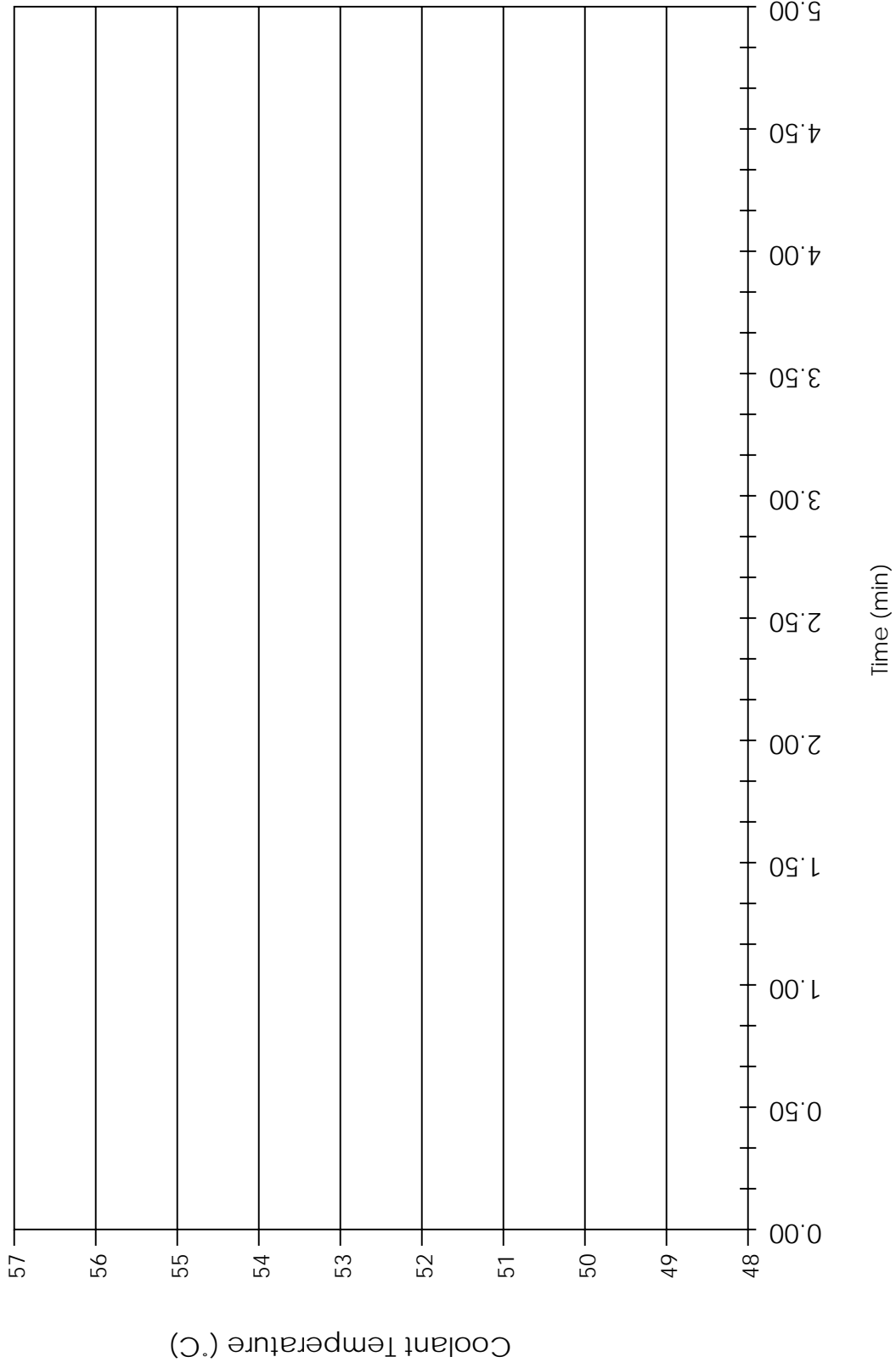
Sequence IVA Valve Train Wear Evaluation
Form 12
Stage 2 to 1 Transition: Coolant Out Temperature
Cycle 5

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



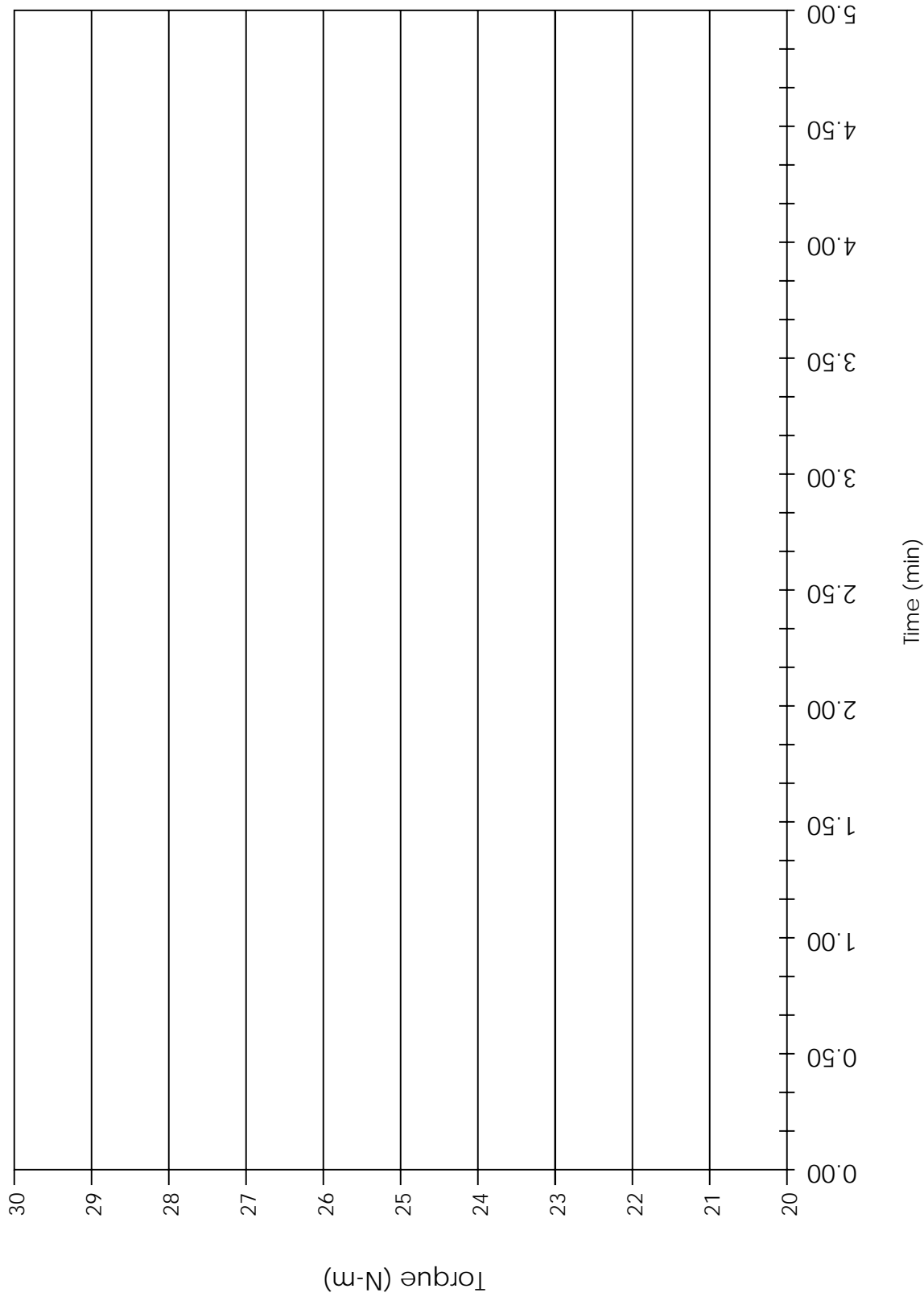
Sequence IVA Valve Train Wear Evaluation
Form 13
Stage 1 to 2 Transition: Coolant Out Temperature
Cycle 5

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



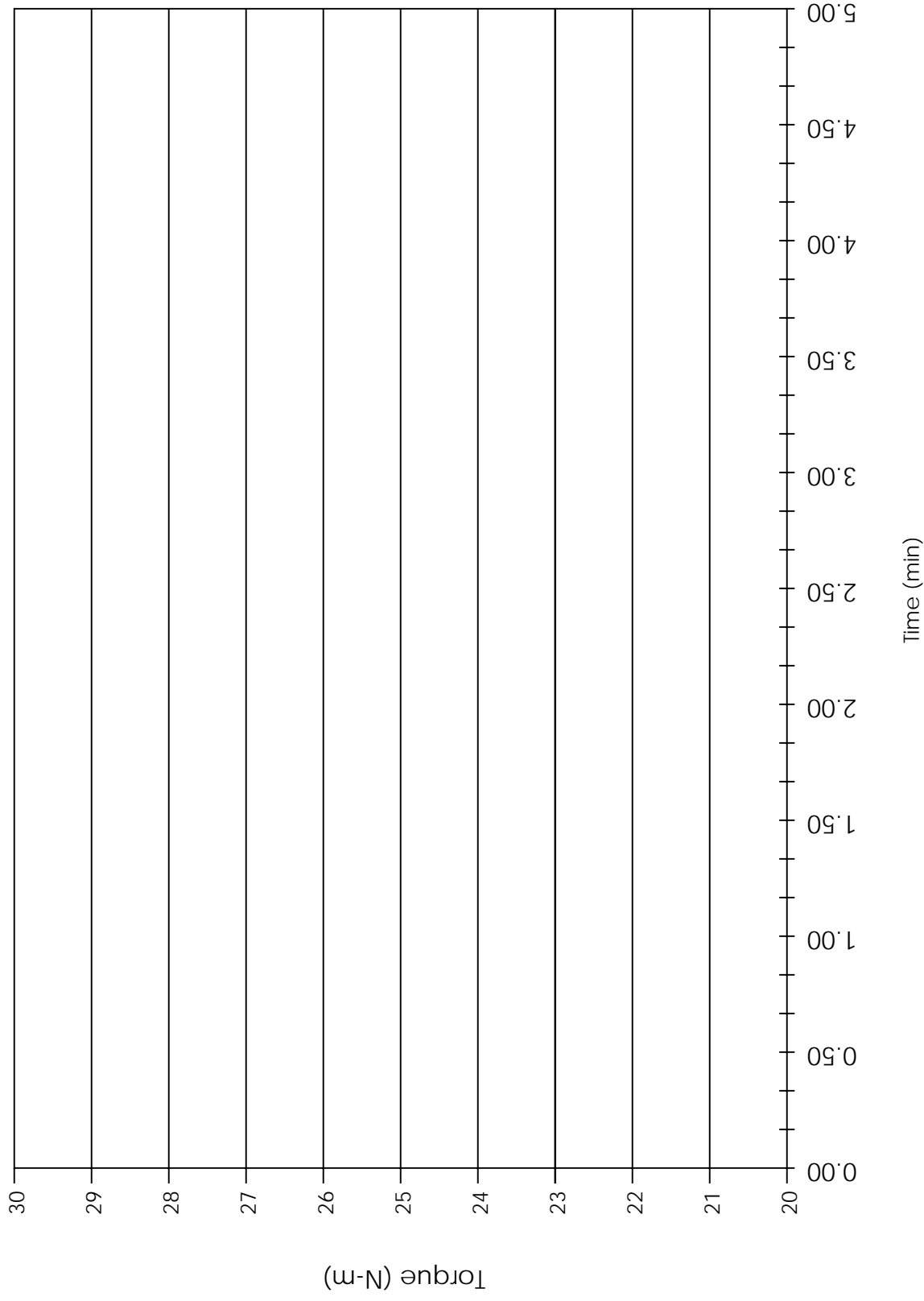
Sequence IVA Valve Train Wear Evaluation
Form 14
Stage 2 to 1 Transition: Engine Torque
Cycle 5

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



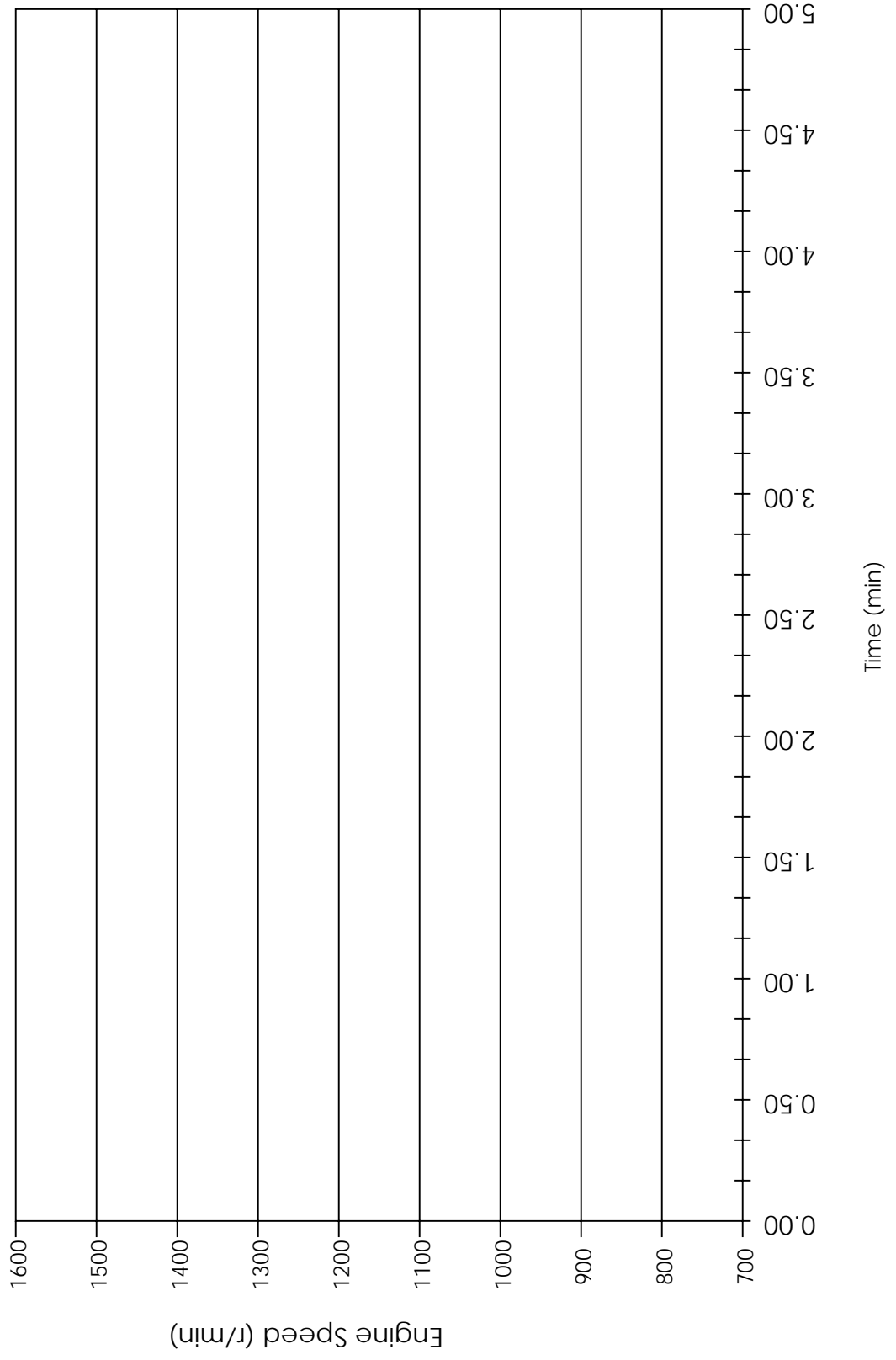
Sequence IVA Valve Train Wear Evaluation
Form 15
Stage 1 to 2 Transition: Engine Torque
Cycle 5

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



Sequence IVA Valve Train Wear Evaluation
Form 16
Stage 2 to 1 Transition: Engine Speed
Cycle 5

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



Sequence IVA Valve Train Wear Evaluation
Form 17
Stage 1 to 2 Transition: Engine Speed
Cycle 5

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

