



**Sequence IX**  
**Form 2**  
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**Sequence IX**  
**Form 3**  
**Summary of Test Method**

The Pre-ignition test is a fired engine dynamometer lubricant test which evaluates the ability of a test lubricant to reduce pre-ignition events. The test method is a cyclic test.

The Pre-ignition test uses a Ford water cooled, 4 cycle, in-line cylinder, 2.0 liter ecotec engine as the test apparatus. The engine incorporates a dual overhead cam, four valves per cylinder (2 intake; 2 exhaust), and direct acting mechanical bucket lifter valve train design. The engine is monitored for pre-ignition events and total number of pre-ignition events. Results are tabulated at the end of test.

The test sequence is repeated for 4 test iterations. Each iteration is outlined in the table below:

<b>Parameters</b>	<b>Units</b>	<b>Iteration</b>			
		<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
Duration	cycles	175000	175000	175000	175000
Engine Speed	r/min	1750	1750	1750	1750
Torque	Nm	269	269	269	269
Equivalence Ratio	$\lambda$	1.00	1.00	1.00	1.00
Coolant Out Temperature	°C	95	95	95	95
Coolant Flow	L/min	55	55	55	55
Oil Gallery Temperature	°C	95	95	95	95
Inlet Air Temperature	°C	30	30	30	30
Air Charge Temperature	°C	43	43	43	43
Fuel Temperature	°C	30	30	30	30
Inlet Air Pressure	kPa	0.05	0.05	0.05	0.05
Exhaust Back Pressure	kPaA	104	104	104	104

**Sequence IX  
Form 4  
Test Results Summary**

Lab		Oil Code	
Stand		Test No.	
Laboratory Oil Code			
Formulation Stand Code			

<b>Summary of Valid Iterations</b>	
<b>Iteration</b>	<b>Number of Events*</b>
A	
B	
C	
D	
Total Number of Pre-ignitions, Valid Iterations	
Average of Valid Iterations	
Transformed Average of Valid Iterations	
Industry Correction Factor	
Corrected Transformed Average Pre-ignitions	
Severity Adjustment	
Final Transformed Result	
Final Original Unit Result	

<b>Iteration</b>	<b>Number of Events*</b>	<b>Number of Cycles (per cylinder) #</b>								<b>Iteration Validity</b>
		<b>Cylinder 1</b>		<b>Cylinder 2</b>		<b>Cylinder 3</b>		<b>Cylinder 4</b>		
		<b>Invalid</b>	<b>Valid</b>	<b>Invalid</b>	<b>Valid</b>	<b>Invalid</b>	<b>Valid</b>	<b>Invalid</b>	<b>Valid</b>	

\*Events are defined as the total number of pre-ignition events from all four cylinders during each iteration.

# A minimum of 170000 valid combustion cycles are required for a iteration to be considered valid

**Sequence IX**  
**Form 5**  
**Operational Summary – Iteration A**

Lab		Oil Code	
Stand		Test No.	
Laboratory Oil Code			
Formulation Stand Code			
Fuel Batch			

	Parameter	Units	QI Threshold	EOT QI	Target	Average	Standard Deviation	Number of	
								Samples	BQD
<b>Controlled Parameters</b>	Speed	r/min	0.000		1750				
	Torque	Nm	0.000		269				
	Coolant Out	°C	0.000		95				
	Oil Gallery	°C	0.000		95				
	Inlet Air	°C	0.000		30				
	Air Charge	°C	0.000		43				
	Fuel	°C	0.000		30				
	Inlet Air	kPaA	0.000		0.05				
	Exhaust Back	kPaA	0.000		104				
	Coolant	kPaG	0.000		70				
	Humidity	g/kg	0.000		11.4				
	Coolant Flow	L/min	0.000		55				

	Parameter	Units	Average	Standard Deviation	Number of	
					Samples	BQD
<b>Non-controlled Parameters</b>	Coolant In	°C				
	Oil Sump (optional)	°C				
	Exhaust	°C				
	Boost Pressure	kPaA				
	Intake Manifold	kPaA				
	Barometric	kPaA				
	Crankcase	kPaG				
	Fuel	kPaG				
	Fuel Flow	L/min				
	Power	kW				
	Equivalence Ratio	$\lambda$				

**Sequence IX**  
**Form 6**  
**Operational Summary – Iteration B**

Lab		Oil Code	
Stand		Test No.	
Laboratory Oil Code			
Formulation Stand Code			
Fuel Batch			

	Parameter	Units	QI Threshold	EOT QI	Target	Average	Standard Deviation	Number of	
								Samples	BQD
<b>Controlled Parameters</b>	Speed	r/min	0.000		1750				
	Torque	Nm	0.000		269				
	Coolant Out	°C	0.000		95				
	Oil Gallery	°C	0.000		95				
	Inlet Air	°C	0.000		30				
	Air Charge	°C	0.000		43				
	Fuel	°C	0.000		30				
	Inlet Air	kPaA	0.000		0.05				
	Exhaust Back	kPaA	0.000		104				
	Coolant	kPaG	0.000		70				
	Humidity	g/kg	0.000		11.4				
	Coolant Flow	L/min	0.000		55				

	Parameter	Units	Average	Standard Deviation	Number of	
					Samples	BQD
<b>Non-controlled Parameters</b>	Coolant In	°C				
	Oil Sump (optional)	°C				
	Exhaust	°C				
	Boost Pressure	kPaA				
	Intake Manifold	kPaA				
	Barometric	kPaA				
	Crankcase	kPaG				
	Fuel	kPaG				
	Fuel Flow	L/min				
	Power	kW				
	Equivalence Ratio	$\lambda$				

**Sequence IX**  
**Form 7**  
**Operational Summary – Iteration C**

Lab		Oil Code	
Stand		Test No.	
Laboratory Oil Code			
Formulation Stand Code			
Fuel Batch			

	Parameter	Units	QI Threshold	EOT QI	Target	Average	Standard Deviation	Number of	
								Samples	BQD
<b>Controlled Parameters</b>	Speed	r/min	0.000		1750				
	Torque	Nm	0.000		269				
	Coolant Out	°C	0.000		95				
	Oil Gallery	°C	0.000		95				
	Inlet Air	°C	0.000		30				
	Air Charge	°C	0.000		43				
	Fuel	°C	0.000		30				
	Inlet Air	kPaA	0.000		0.05				
	Exhaust Back	kPaA	0.000		104				
	Coolant	kPaG	0.000		70				
	Humidity	g/kg	0.000		11.4				
	Coolant Flow	L/min	0.000		55				

	Parameter	Units	Average	Standard Deviation	Number of	
					Samples	BQD
<b>Non-controlled Parameters</b>	Coolant In	°C				
	Oil Sump (optional)	°C				
	Exhaust	°C				
	Boost Pressure	kPaA				
	Intake Manifold	kPaA				
	Barometric	kPaA				
	Crankcase	kPaG				
	Fuel	kPaG				
	Fuel Flow	L/min				
	Power	kW				
	Equivalence Ratio	$\lambda$				

**Sequence IX**  
**Form 8**  
**Operational Summary – Iteration D**

Lab		Oil Code	
Stand		Test No.	
Laboratory Oil Code			
Formulation Stand Code			
Fuel Batch			

	Parameter	Units	QI Threshold	EOT QI	Target	Average	Standard Deviation	Number of	
								Samples	BQD
<b>Controlled Parameters</b>	Speed	r/min	0.000		1750				
	Torque	Nm	0.000		269				
	Coolant Out	°C	0.000		95				
	Oil Gallery	°C	0.000		95				
	Inlet Air	°C	0.000		30				
	Air Charge	°C	0.000		43				
	Fuel	°C	0.000		30				
	Inlet Air	kPaA	0.000		0.05				
	Exhaust Back	kPaA	0.000		104				
	Coolant	kPaG	0.000		70				
	Humidity	g/kg	0.000		11.4				
	Coolant Flow	L/min	0.000		55				

	Parameter	Units	Average	Standard Deviation	Number of	
					Samples	BQD
<b>Non-controlled Parameters</b>	Coolant In	°C				
	Oil Sump (optional)	°C				
	Exhaust	°C				
	Boost Pressure	kPaA				
	Intake Manifold	kPaA				
	Barometric	kPaA				
	Crankcase	kPaG				
	Fuel	kPaG				
	Fuel Flow	L/min				
	Power	kW				
	Equivalence Ratio	$\lambda$				



**Sequence IX**  
**Form 9**  
**Operational Summary – CAN BUS, Iterations A and B**

Lab		Oil Code	
Stand		Test No.	
Laboratory Oil Code			
Formulation Stand Code			

PCM CAN BUS Channels	Iteration A	Units	Average	Standard Deviation	Number of		
					Samples	BQD	
	Ignition Timing Advance for #1 Cylinder	°					
	Absolute Throttle Position	%					
	Engine Coolant Temperature	°C					
	Intake Air Temperature	°C					
	Equivalence Ratio (Lambda)	$\lambda$					
	Absolute Load Value	%					
	Intake Manifold Absolute Pressure	kPaA					
	Fuel Rail Pressure	kPaA					
	Boost Absolute Pressure - Raw Value	kPaA					
	Turbocharger/Supercharger Wastegate	%					
	Actual Intake (A) Camshaft Position	°					
	Actual Exhaust (B) Camshaft Position	°					
	Intake (A) Camshaft Position Actuator Duty	%					
Exhaust (B) Camshaft Position Actuator Duty	%						
Charge Air Cooler Temperature	°C						

PCM CAN BUS Channels	Iteration B	Units	Average	Standard Deviation	Number of		
					Samples	BQD	
	Ignition Timing Advance for #1 Cylinder	°					
	Absolute Throttle Position	%					
	Engine Coolant Temperature	°C					
	Intake Air Temperature	°C					
	Equivalence Ratio (Lambda)	$\lambda$					
	Absolute Load Value	%					
	Intake Manifold Absolute Pressure	kPaA					
	Fuel Rail Pressure	kPaA					
	Boost Absolute Pressure - Raw Value	kPaA					
	Turbocharger/Supercharger Wastegate	%					
	Actual Intake (A) Camshaft Position	°					
	Actual Exhaust (B) Camshaft Position	°					
	Intake (A) Camshaft Position Actuator Cycle	%					
Exhaust (B) Camshaft Position Actuator Duty	%						
Charge Air Cooler Temperature	°C						

**Sequence IX**  
**Form 10**  
**Operational Summary – CAN BUS, Iterations C and D**

Lab		Oil Code	
Stand		Test No.	
Laboratory Oil Code			
Formulation Stand Code			

PCM CAN BUS Channels	Iteration C	Units	Average	Standard Deviation	Number of	
					Samples	BQD
	Ignition Timing Advance for #1 Cylinder	°				
	Absolute Throttle Position	%				
	Engine Coolant Temperature	°C				
	Intake Air Temperature	°C				
	Equivalence Ratio (Lambda)	λ				
	Absolute Load Value	%				
	Intake Manifold Absolute Pressure	kPaA				
	Fuel Rail Pressure	kPaA				
	Boost Absolute Pressure - Raw Value	kPaA				
	Turbocharger/Supercharger Wastegate	%				
	Actual Intake (A) Camshaft Position	°				
	Actual Exhaust (B) Camshaft Position	°				
	Intake (A) Camshaft Position Actuator Duty	%				
	Exhaust (B) Camshaft Position Actuator	%				
	Charge Air Cooler Temperature	°C				

PCM CAN BUS Channels	Iteration D	Units	Average	Standard Deviation	Number of	
					Samples	BQD
	Ignition Timing Advance for #1 Cylinder	°				
	Absolute Throttle Position	%				
	Engine Coolant Temperature	°C				
	Intake Air Temperature	°C				
	Equivalence Ratio (Lambda)	λ				
	Absolute Load Value	%				
	Intake Manifold Absolute Pressure	kPaA				
	Fuel Rail Pressure	kPaA				
	Boost Absolute Pressure - Raw Value	kPaA				
	Turbocharger/Supercharger Wastegate	%				
	Actual Intake (A) Camshaft Position	°				
	Actual Exhaust (B) Camshaft Position	°				
	Intake (A) Camshaft Position Actuator Cycle	%				
	Exhaust (B) Camshaft Position Actuator	%				
	Charge Air Cooler Temperature	°C				

**Sequence IX**  
**Form 11**  
**Cycle Count and Type Summary**

Lab		Oil Code	
Stand		Test No.	
Laboratory Oil Code			
Formulation Stand Code			

Cylinder	Iteration A			Iteration B			Iteration C			Iteration D		
	PP Only	MFB2 Only	PP and MFB2	PP Only	MFB2 Only	PP and MFB2	PP Only	MFB2 Only	PP and MFB2	PP Only	MFB2 Only	PP and MFB2
1												
2												
3												
4												
All												

**Evaluation Criteria**

Parameter	Iteration A				Iteration B				Iteration C				Iteration D			
	Cyl 1	Cyl 2	Cyl 3	Cyl 4	Cyl 1	Cyl 2	Cyl 3	Cyl 4	Cyl 1	Cyl 2	Cyl 3	Cyl 4	Cyl 1	Cyl 2	Cyl 3	Cyl 4
PP Mean																
PP Std Dev																
PP F Value																
PP Thresh																
MFB2 Mean																
MFB2 Std Dev																
MFB2 F Value																
MFB2 Thresh																

**Legend:**

- PP**                    **Peak Pressure Only**
- MFB2**                **Mass Fraction Burn 2% Only**
- PP& MFB2**        **Both Peak Pressure and Mass Fraction Burn 2%**



















**Sequence IX**

**Form 20**

**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)

	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

\_\_\_\_\_