

**Low Speed Pre-Ignition Test
Form 1**

Version

Conducted For

| | |
|--|---|
| | V = Valid |
| | I = Invalid |
| | N = Results cannot be interpreted as representative of oil performance (Non-reference oil) and shall not be used for multiple test acceptance |

| | |
|--|------------------------|
| | NR = Non-reference oil |
| | RO = Reference oil |

| Test Number | | | | | | | |
|-----------------------------|--|-----------|--|----------------|------------------------|------------|--|
| Stand | | Stand Run | | Engine | | Engine Run | |
| Oil Code: | | | | | | | |
| Hours on Engine | | | | | Hours on Cylinder Head | | |
| Formulation Stand Code | | | | | | | |
| Alternate Codes | | | | | | | |
| Date Started | | | | Time Started | | | |
| Date Completed | | | | Time Completed | | | |
| Test Length | | | | Total Downtime | | | |
| Ref Oil Code ^A : | | | | | | | |
| SAE Viscosity | | | | | | | |

^A Reference Tests Only

| |
|--|
| In my opinion this test _____ been conducted in a valid manner in accordance with test Method DXXXX and appropriate amendments. The remarks included in the report describe the anomalies associated with this test. |
|--|

Submitted By: _____
Testing Laboratory

Signature

Typed Name

Title

**Pre-Ignition Test
Form 2
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**Pre-ignition Test
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 EcoTech 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 are tabulated at the end of test the end of test.

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

| Parameters | Units | Iteration | | | |
|-------------------------|--------------|------------------|----------|----------|----------|
| | | A | B | C | D |
| Duration | cycles | 175000 | 175000 | 175000 | 175000 |
| Engine Speed | r/min | 1750 | 1750 | 1750 | 1750 |
| Torque | Nm | 269 | 269 | 269 | 269 |
| Equivalence Ratio | λ | 1.00 | 1.00 | 1.00 | 1.00 |
| Coolant Out Temperature | °C | 95 | 95 | 95 | 95 |
| 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 |

**Pre-Ignition Test
Form 4
Test Results Summary**

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

| Summary of Valid Iterations | |
|---|--------------------------|
| Iteration | Number of Events* |
| A | |
| B | |
| C | |
| D | |
| Average of Valid Iterations | |
| Total Number of Pre-ignitions, Valid Iterations | |

| Summary of LSPI Events | | | | | | | |
|-------------------------------|--------------------------|-------------------------|--|----------|----------|----------|---------------------------|
| Iteration | Number of Events* | Number of Cycles | Number of Invalid Cycles (per cylinder) | | | | Iteration Validity |
| | | | 1 | 2 | 3 | 4 | |
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*Events are defined as the total number of pre-ignition events from all four cylinders during each iteration.

**Pre-Ignition Test
Form 5
Operational Summary – Iteration A**

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

| Controlled Parameters | Parameter | Units | QI Threshold | EOT QI | Target | Average | Standard Deviation | Number of | |
|-----------------------|-------------|-----------|--------------|--------|--------|---------|--------------------|-----------|-----|
| | | | | | | | | Samples | BQD |
| | Speed | r/min | 0.000 | | 1750 | | | | |
| | Torque | Nm | 0.000 | | 269 | | | | |
| | Equivalence | λ | 0.000 | | 1.00 | | | | |
| | Coolant Out | °C | 0.000 | | 95 | | | | |
| | Oil Gallery | °C | 0.000 | | 95 | | | | |
| | Inlet Air | °C | 0.000 | | 30 | | | | |
| | Air Charge | °C | 0.000 | | 35 | | | | |
| | Fuel | °C | 0.000 | | 30 | | | | |
| Inlet Air | kPaA | 0.000 | | 0.05 | | | | | |
| Exhaust Back | kPaA | 0.000 | | 104 | | | | | |

| Non-controlled Parameters | Parameter | Units | Average | Standard Deviation | Number of | |
|---------------------------|-----------------|-------|---------|--------------------|-----------|-----|
| | | | | | Samples | BQD |
| | Coolant In | °C | | | | |
| | Oil Sump | °C | | | | |
| | Exhaust | °C | | | | |
| | Boost Pressure | kPaA | | | | |
| | Intake Manifold | kPaA | | | | |
| | Barometric | kPaA | | | | |
| | Crankcase | kPaG | | | | |
| | Fuel | kPaG | | | | |
| | Coolant | kPaG | | | | |
| | Fuel Flow | L/min | | | | |
| Coolant Flow | L/min | | | | | |
| Power | kW | | | | | |

**Pre-Ignition Test
Form 6
Operational Summary – Iteration B**

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

| Controlled Parameters | Parameter | Units | QI Threshold | EOT QI | Target | Average | Standard Deviation | Number of | | |
|-----------------------|-------------|-----------|--------------|--------|--------|---------|--------------------|-----------|-----|--|
| | | | | | | | | Samples | BQD | |
| | Speed | r/min | 0.000 | | 1750 | | | | | |
| | Torque | Nm | 0.000 | | 269 | | | | | |
| | Equivalence | λ | 0.000 | | 1.00 | | | | | |
| | Coolant Out | °C | 0.000 | | 95 | | | | | |
| | Oil Gallery | °C | 0.000 | | 95 | | | | | |
| | Inlet Air | °C | 0.000 | | 30 | | | | | |
| | Air Charge | °C | 0.000 | | 35 | | | | | |
| | Fuel | °C | 0.000 | | 30 | | | | | |
| Inlet Air | kPaA | 0.000 | | 0.05 | | | | | | |
| Exhaust Back | kPaA | 0.000 | | 104 | | | | | | |

| Non-controlled Parameters | Parameter | Units | Average | Standard Deviation | Number of | |
|---------------------------|-----------------|-------|---------|--------------------|-----------|-----|
| | | | | | Samples | BQD |
| | Coolant In | °C | | | | |
| | Oil Sump | °C | | | | |
| | Exhaust | °C | | | | |
| | Boost Pressure | kPaA | | | | |
| | Intake Manifold | kPaA | | | | |
| | Barometric | kPaA | | | | |
| | Crankcase | kPaG | | | | |
| | Fuel | kPaG | | | | |
| | Coolant | kPaG | | | | |
| | Fuel Flow | L/min | | | | |
| Coolant Flow | L/min | | | | | |
| Power | kW | | | | | |

**Pre-Ignition Test
Form 7
Operational Summary – Iteration C**

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

| Controlled Parameters | Parameter | Units | QI Threshold | EOT QI | Target | Average | Standard Deviation | Number of | |
|-----------------------|--------------|-----------|--------------|--------|--------|---------|--------------------|-----------|-----|
| | | | | | | | | Samples | BQD |
| | Speed | r/min | 0.000 | | 1750 | | | | |
| | Torque | Nm | 0.000 | | 269 | | | | |
| | Equivalence | λ | 0.000 | | 1.00 | | | | |
| | Coolant Out | °C | 0.000 | | 95 | | | | |
| | Oil Gallery | °C | 0.000 | | 95 | | | | |
| | Inlet Air | °C | 0.000 | | 30 | | | | |
| | Air Charge | °C | 0.000 | | 35 | | | | |
| | Fuel | °C | 0.000 | | 30 | | | | |
| | Inlet Air | kPaA | 0.000 | | 0.05 | | | | |
| | Exhaust Back | kPaA | 0.000 | | 104 | | | | |

| Non-controlled Parameters | Parameter | Units | Average | Standard Deviation | Number of | |
|---------------------------|-----------------|-------|---------|--------------------|-----------|-----|
| | | | | | Samples | BQD |
| | Coolant In | °C | | | | |
| | Oil Sump | °C | | | | |
| | Exhaust | °C | | | | |
| | Boost Pressure | kPaA | | | | |
| | Intake Manifold | kPaA | | | | |
| | Barometric | kPaA | | | | |
| | Crankcase | kPaG | | | | |
| | Fuel | kPaG | | | | |
| | Coolant | kPaG | | | | |
| | Fuel Flow | L/min | | | | |
| | Coolant Flow | L/min | | | | |
| | Power | kW | | | | |

**Pre-Ignition Test
Form 8
Operational Summary – Iteration D**

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

| Controlled Parameters | Parameter | Units | QI Threshold | EOT QI | Target | Average | Standard Deviation | Number of | |
|-----------------------|-------------|-----------|--------------|--------|--------|---------|--------------------|-----------|-----|
| | | | | | | | | Samples | BQD |
| | Speed | r/min | 0.000 | | 1750 | | | | |
| | Torque | Nm | 0.000 | | 269 | | | | |
| | Equivalence | λ | 0.000 | | 1.00 | | | | |
| | Coolant Out | °C | 0.000 | | 95 | | | | |
| | Oil Gallery | °C | 0.000 | | 95 | | | | |
| | Inlet Air | °C | 0.000 | | 30 | | | | |
| | Air Charge | °C | 0.000 | | 35 | | | | |
| | Fuel | °C | 0.000 | | 30 | | | | |
| Inlet Air | kPaA | 0.000 | | 0.05 | | | | | |
| Exhaust Back | kPaA | 0.000 | | 104 | | | | | |

| Non-controlled Parameters | Parameter | Units | Average | Standard Deviation | Number of | |
|---------------------------|-----------------|-------|---------|--------------------|-----------|-----|
| | | | | | Samples | BQD |
| | Coolant In | °C | | | | |
| | Oil Sump | °C | | | | |
| | Exhaust | °C | | | | |
| | Boost Pressure | kPaA | | | | |
| | Intake Manifold | kPaA | | | | |
| | Barometric | kPaA | | | | |
| | Crankcase | kPaG | | | | |
| | Fuel | kPaG | | | | |
| | Coolant | kPaG | | | | |
| | Fuel Flow | L/min | | | | |
| Coolant Flow | L/min | | | | | |
| Power | kW | | | | | |

**Pre-Ignition Test
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) | 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 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) | 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 Duty | % | | | | | | |
| Charge Air Cooler Temperature | °C | | | | | | |

**Pre-Ignition Test
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 | | | | |

**Pre-Ignition Test
Form 11
LSPI 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%**

Pre-Ignition Test
Form 12
Summary of Preignition Events, Iteration A

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

| Cylinder | Cycle | Peak Pressure | MFB2 | Type |
|----------|-------|---------------|------|------|
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| Cylinder | Cycle | Peak Pressure | MFB2 | Type |
|----------|-------|---------------|------|------|
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Legend:
PP Peak Pressure Only
MFB2 Mass Fraction Burn @ 2% Only
PP&MFB2 Both Peak Pressure and Mass Fraction Burn @ 2%

**Pre-Ignition Test
Form 14
Summary of Preignition Events, Iteration C**

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

| Cylinder | Cycle | Peak Pressure | MFB2 | Type |
|----------|-------|---------------|------|------|
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| Cylinder | Cycle | Peak Pressure | MFB2 | Type |
|----------|-------|---------------|------|------|
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Legend:
PP **Peak Pressure Only**
MFB2 **Mass Fraction Burn 2% Only**
PP&MFB2 **Both Peak Pressure and Mass Fraction Burn 2%**

**Pre-Ignition Test
Form 15
Summary of Preignition Events, Iteration D**

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

| Cylinder | Cycle | Peak Pressure | MFB2 | Type |
|----------|-------|---------------|------|------|
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| Cylinder | Cycle | Peak Pressure | MFB2 | Type |
|----------|-------|---------------|------|------|
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Legend:
PP Peak Pressure Only
MFB2 Mass Fraction Burn 2% Only
PP&MFB2 Both Peak Pressure and Mass Fraction Burn 2%

**Pre-Ignition Test
Form 18
Downtime Record**

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

| Number of Downtime Occurrences | | | |
|--------------------------------|------|----------|-------------------------------|
| Test Hours | Date | Downtime | Reasons |
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| | | | Total Downtime (hours) |

LSPI
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 |
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Signature

Date

Typed Name
