

Sequence IX Aged Oil

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 Aged for multiple test acceptance |

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

| Test Number, Aging | | | | | | | |
|-----------------------------|--|----------------------------------|--|---------------------------------------|--|------------|--|
| Stand | | # of Runs since last Calibration | | Total runs on stand | | | |
| Test Number, LSPI | | | | | | | |
| Stand | | Stand Run | | Engine | | Engine Run | |
| Oil Code: | | | | # of runs since last calibration LSPI | | | |
| Formulation Stand Code | | | | | | | |
| Alternate Codes | | | | | | | |
| Date Started, Aging | | | | Time Started, Aging | | | |
| Date Started, LSPI | | | | Time Started, LSPI | | | |
| Date Completed, Aging | | | | Time Completed, Aging | | | |
| Date Completed, LSPI | | | | Time Completed, LSPI | | | |
| Test Length, Aging | | | | Total Downtime, Aging | | | |
| Test Length, LSPI | | | | Total Downtime, LSPI | | | |
| 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 D8291 and appropriate amendments. The remarks included in the report describe the anomalies associated with this test.

Submitted By: _____

Testing Laboratory

Signature

Typed Name

Title

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

The Sequence IX Aged Oil test is a fired engine dynamometer lubricant test which evaluates the ability of a test lubricant to reduce pre-ignition events on an aged oil. The test method consists of a cyclic test for aging and a steady state test for preignition.

The Pre-ignition test uses a Ford water cooled, 4 cycle, in-line cylinder, 2.0 liter EcoBoost 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 for aging is summarized below and runs for 72 hours.

| Parameter | Units | Quantity |
|-------------------------|-----------|----------|
| Duration | H | 72 |
| Engine Speed | r/min | 2500 |
| Engine Torque | N·m | 128 |
| Oil Gallery Temperature | °C | 100 |
| Coolant Out Temperature | °C | 85 |
| Coolant Flow | L/min | 70 |
| Intake Air Temperature | °C | 32 |
| Intake Air Pressure | kPa | 0.05 |
| Intake Air Humidity | g/kg | 11.4 |
| Coolant Pressure | kPa | 70 |
| Air Charge Temperature | °C | 30 |
| Air-Fuel Ratio | λ | 1.0 |
| Exhaust Backpressure | kPa | 107 |
| Blowby Flowrate | L/min | 65-75 |

The test sequence for LSPI is repeated for 4 test iterations. Each iteration is 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 |
| 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 Aged Oil
Form 4**

Test Result Summary, Aging

| | | | | |
|---------------------|--|----------|---------------|--|
| Lab | | Oil Code | | |
| Stand | | Test No. | | |
| Laboratory Oil Code | | | | |
| Engine No. | | | Fuel Batch | |
| SAE Viscosity | | | Reference Oil | |

Critical Oil Analysis Results

| Analysis Parameter | New Oil | End of Test |
|-----------------------------------|----------------|--------------------|
| Total Acid Number | | |
| Total Base Number | | |
| Kinematic Viscosity @ 40 °C | | |
| Kinematic Viscosity @ 100 °C | | |
| Soot Concentration | | |
| Oxidation, FTIR by D7414 | | |
| Nitration, FTIR by D7624 | | |
| Fuel dilution, D3525 | | |
| Weight of Oil Drain @ End of Test | | |

| Blowby | |
|----------------------|----------------------|
| Test Hours | Blowby, L/min |
| 23.5 to 23.75 | |
| 47.5 to 47.75 | |
| 71.5 to 71.75 | |
| Maximum | |
| Minimum | |
| Average | |

Sequence IX Aged Oil
Form 5
Test Results Summary, LSPI

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

| Summary of Valid Iterations | | |
|---|--------------------------|----------------|
| Iteration | Number of Events* | |
| A | | |
| B | | |
| C | | |
| D | | |
| Total Number of Pre-ignitions, Valid Iterations | | |
| Pass/Fail Parameters | | |
| | Average | Maximum |
| Results from Valid Iterations | | |
| Transformed results Valid Iterations | | |
| Industry Correction Factor | | |
| Corrected Transformed Pre-ignitions | | |
| Severity Adjustment | | |
| Final Transformed Result | | |
| Final Original Unit Result | | |

| Iteration | Number of Events* | Number of Cycles (per cylinder) # | | | | | | | | Iteration Validity |
|-----------|-------------------|-----------------------------------|-------|------------|-------|------------|-------|------------|-------|--------------------|
| | | Cylinder 1 | | Cylinder 2 | | Cylinder 3 | | Cylinder 4 | | |
| | | Invalid | Valid | Invalid | Valid | Invalid | Valid | Invalid | Valid | |
| | | | | | | | | | | |
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| | | | | | | | | | | |

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

**Sequence IX Aged Oil
Form 6
Operational Summary, Aging**

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

| Controlled Parameters | Parameter | Units | QI | EOT | Target | Average | Number of | |
|-----------------------|-------------------------|----------|-----------|-----|--------|---------|-----------|-----|
| | | | Threshold | OI | | | Samples | BQD |
| | Speed | r/min | 0.000 | | 2500 | | | |
| | Torque | N·m | 0.000 | | 128 | | | |
| | Oil Gallery Temperature | °C | 0.000 | | 100 | | | |
| | Coolant Out Temperature | °C | 0.000 | | 85 | | | |
| | Coolant System Pressure | kPa | 0.000 | | 70 | | | |
| | Engine Coolant Flow | L/min | 0.000 | | 70 | | | |
| | Intake Air Humidity | g/kg | 0.000 | | 11.4 | | | |
| | Intake Air Pressure | kPa | 0.000 | | 0.05 | | | |
| | Exhaust Back Pressure | kPa abs. | 0.000 | | 107 | | | |
| | Intake Air Temperature | °C | 0.000 | | 32 | | | |
| | Air Charge Temperature | °C | 0.000 | | 30 | | | |
| | Lambda | λ | 0.000 | | 1 | | | |
| | Blowby Flowrate | L/min | | | 65-75 | | | |

| Non Controlled | Parameter | Units | Average | Number of Samples | Number of BQD |
|----------------|----------------------------|--------------|---------|-------------------|---------------|
| | | Ambient Cell | °C | | |
| | Fuel Flow | kg/h | | | |
| | Ignition Voltage | V | | | |
| | Fuel Temperature | °C | | | |
| | Coolant In Temperature | °C | | | |
| | Oil Filter In Temperature | °C | | | |
| | Exhaust Temperature | °C | | | |
| | Manifold Absolute Pressure | kPa abs. | | | |
| | Boost Pressure | kPa abs. | | | |
| | Barometric Pressure | kPa abs. | | | |
| | Oil Gallery Pressure | kPa | | | |
| | Oil Head Pressure | kPa | | | |
| | Crankcase Pressure | kPa | | | |
| | Fuel Pressure | kPa | | | |
| | Pre-Intercooler Pressure | kPa abs. | | | |

**Sequence IX Aged Oil
Form 7
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 |
| Controlled Parameters | 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 | kPa | 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 |
| Non-controlled Parameters | Coolant In | °C | | | | |
| | Oil Sump (optional) | °C | | | | |
| | Exhaust | °C | | | | |
| | Boost Pressure | kPaA | | | | |
| | Intake Manifold | kPaA | | | | |
| | Barometric | kPaA | | | | |
| | Crankcase | kPa | | | | |
| | Fuel | kPa | | | | |
| | Fuel Flow | kg/h | | | | |
| | Power | kW | | | | |
| | Equivalence Ratio | λ | | | | |

**Sequence IX Aged Oil
Form 8
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 |
| Controlled Parameters | 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 | kPa | 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 |
| Non-controlled Parameters | Coolant In | °C | | | | |
| | Oil Sump (optional) | °C | | | | |
| | Exhaust | °C | | | | |
| | Boost Pressure | kPaA | | | | |
| | Intake Manifold | kPaA | | | | |
| | Barometric | kPaA | | | | |
| | Crankcase | kPa | | | | |
| | Fuel | kPa | | | | |
| | Fuel Flow | kg/h | | | | |
| | Power | kW | | | | |
| | Equivalence Ratio | λ | | | | |

**Sequence IX Aged Oil
Form 9
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 |
| Controlled Parameters | 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 | kPa | 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 |
| Non-controlled Parameters | Coolant In | °C | | | | |
| | Oil Sump (optional) | °C | | | | |
| | Exhaust | °C | | | | |
| | Boost Pressure | kPaA | | | | |
| | Intake Manifold | kPaA | | | | |
| | Barometric | kPaA | | | | |
| | Crankcase | kPa | | | | |
| | Fuel | kPa | | | | |
| | Fuel Flow | kg/h | | | | |
| | Power | kW | | | | |
| | Equivalence Ratio | λ | | | | |

**Sequence IX Aged Oil
Form 10
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 |
| Controlled Parameters | 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 | kPa | 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 |
| Non-controlled Parameters | Coolant In | °C | | | | |
| | Oil Sump (optional) | °C | | | | |
| | Exhaust | °C | | | | |
| | Boost Pressure | kPaA | | | | |
| | Intake Manifold | kPaA | | | | |
| | Barometric | kPaA | | | | |
| | Crankcase | kPa | | | | |
| | Fuel | kPa | | | | |
| | Fuel Flow | kg/h | | | | |
| | Power | kW | | | | |
| | Equivalence Ratio | λ | | | | |

Sequence IX Aged Oil
Form 11
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 | kPa | | | | |
| | 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 | kPa | | | | |
| | 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 Aged Oil
Form 12
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 | kPa | | | | | |
| | 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 | kPa | | | | | |
| | 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 Aged Oil
Form 13
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 Aged Oil
Form 14
Summary of Pre-ignition 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%**

Sequence IX Aged Oil
Form 15
Summary of Pre-ignition Events, Iteration B

| | | | |
|------------------------|--|----------|--|
| 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%**

**Sequence IX Aged Oil
Form 16
Summary of Pre-ignition 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%**

**Sequence IX Aged Oil
Form 17
Summary of Pre-ignition 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%**

**Sequence IX Aged Oil
Form 19
Chemical Analyses**

| | | | | | | | | |
|-------------------------------|----------------|-----------------|-----------------|--------------------|--------------------|--------------------|--------------------|--|
| Lab | | Oil Code | | | | | | |
| Stand, Aging | | Test No. Aging | | | | | | |
| Stand LSPI | | Test No. LSPI | | | | | | |
| Laboratory Oil Code | | | | | | | | |
| Formulation Stand Code | | | | | | | | |
| Analytical Measurement | New Oil | Aged Oil | New LSPI | Iteration A | Iteration B | Iteration C | Iteration D | |
| Aluminum (Al) by D5185 | | | | | | | | |
| Boron (B) by D5185 | | | | | | | | |
| Calcium (Ca) by D5185 | | | | | | | | |
| Chromium (Cr) by D5185 | | | | | | | | |
| Copper (Cu) by D5185 | | | | | | | | |
| Iron (Fe) by D5185 | | | | | | | | |
| Lead (Pb) by D5185 | | | | | | | | |
| Magnesium (Mg) by D5185 | | | | | | | | |
| Manganese (Mn) by D5185 | | | | | | | | |
| Molybdenum (Mo) by D5185 | | | | | | | | |
| Potassium (K) by D5185 | | | | | | | | |
| Phosphorus (P) by D5185 | | | | | | | | |
| Silicone (Si) by D5185 | | | | | | | | |
| Sodium (Na) by D5185 | | | | | | | | |
| Tin (Sn) by D5185 | | | | | | | | |
| Titanium (Ti) by D5185 | | | | | | | | |
| Zinc (Zn) by D5185 | | | | | | | | |
| Total Acid Number | | | | | | | | |
| Total Base Number | | | | | | | | |
| Kinematic Viscosity @ 40 °C | | | | | | | | |
| Kinematic Viscosity @ 100 °C | | | | | | | | |
| Soot Concentration | | | | | | | | |
| Oxidation, FTIR by D7414 | | | | | | | | |
| Nitration, FTIR by D7624 | | | | | | | | |
| Fuel Dilution by GC D3525 | | | | | | | | |

**Sequence IX Aged Oil
Form 20
Downtime Record, Aging**

| | | | |
|------------------------|--|----------------|--|
| Lab | | Oil Code | |
| Stand, Aging | | Test No. Aging | |
| Stand LSPI | | Test No. LSPI | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |

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

**Sequence IX Aged Oil
Form 20a
Downtime Record, LSPI**

| | | | |
|------------------------|--|----------------|--|
| Lab | | Oil Code | |
| Stand, Aging | | Test No. Aging | |
| Stand LSPI | | Test No. LSPI | |
| Laboratory Oil Code | | | |
| Formulation Stand Code | | | |

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

**Sequence IX Aged Oil
Form 22
American Chemistry Council Code of Practice
Test Laboratory Conformance Statement**

| | | | | | |
|--------------------------|--|------------|--|-----------|--|
| Test Laboratory | | | | | |
| Test Sponsor | | | | | |
| Formulation / Stand Code | | | | | |
| Test Number, Aging | | | | | |
| Test Number, LSPI | | | | | |
| 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.

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| Comments |
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Signature

Date

Typed Name
