

**D 7484 - ISB
Lubricant Performance Test**

Report Packet Version No.

Method

Conducted For:

| | | |
|--|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | V = | Valid; The reference oil / non-reference oil was evaluated in accordance with the test procedure. |
| | I = | Invalid; The reference oil / non-reference oil was not evaluated in accordance with the test procedure. |
| | N = | Results cannot be interpreted as representative of oil performance (non-reference oil) and shall not be used in determining an average test result using multiple test criteria. |

| | |
|--|-----------------------------|
| | NR = Non-Reference Oil Test |
| | RO = Reference Oil Test |

| Test Number | | | |
|---------------------------|------------|-----------------------|---------------|
| Stand: | Stand Run: | Engine Serial Number: | Engine Hours: |
| End Of Test Date: | | End Of Test Time: | |
| Oil Code: | | | |
| Formulation / Stand Code: | | | |
| Alternate Codes | | | |

In my opinion the test _____ been conducted in a valid manner in accordance with Test Method D 7484 and the appropriate amendments through the information letter system. The remarks included in this report describe the anomalies associated with this test.

Submitted By: _____

Testing Laboratory

Signature

Typed Name

Title

D 7484 - ISB Lubricant Performance Test
Form 2
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D 7484 - ISB Lubricant Performance Test
Form 3
Summary Of Test Method

The ISB Lubricant Performance Test is an engine-dynamometer test which evaluates the ability of a lubricant to minimize valvetrain and camshaft wear. This test is a two-stage test. Stage A is 100 hours, steady state, and is run with retarded fuel injection timing to produce elevated soot levels in the oil. Stage B is 250 hours and is run under quick cyclic speed and load conditions to induce wear. The stages are run in sequence (Stage A followed by Stage B) for a total test length of 350 hours.

The test engine is a Cummins ISB diesel engine with EGR. It is an in-line six cylinder, four-stroke, turbocharged engine with electronically controlled fuel injection. The engine is re-used for multiple tests with new valvetrain parts for each test.

ISB Test Conditions

| Parameter | Stage A | Stage B^A |
|----------------------------------------|----------------|----------------------------|
| Time, h | 100 | 250 |
| Injection Timing, ° | -14 nominal | Varies |
| Speed, r/min | 1600 | Varies |
| Fuel Flow, kg/h | 20 | Varies |
| Inlet Manifold Temp., °C | 68 | Target 68 |
| Coolant Out Temp., °C | 99 | Target 99 |
| Fuel In Temp., °C | 40 | 40 |
| Oil Sump Temp., °C | 110 | Target 110 |
| Intake Air Temp., °C | Record | Record |
| Intake Air Pressure, kPa (vacuum) | 0 – 4 | Record |
| Intake Manifold Pressure, kPa absolute | Record | Record |
| Exhaust Back Pressure, kPa | 7 | Wide Open, Varies |
| Crankcase Pressure, kPa | Record | Record |
| Coolant System Pressure, kPa | 99 - 107 | 99 - 107 |
| Power, kW | Record | Record |
| Torque, Nm | Record | Record |
| Pre-turbine Exhaust Temp., °C | Record | Record |
| Tailpipe Exhaust Temp., °C | Record | Record |
| Oil Gallery Temp., °C | Record | Record |
| Inlet Air Dew Point, °C | Record | Record |
| Inlet Air Humidity, kg/kg | Record | Record |
| Oil Gallery Pressure, kPa | Record | Record |
| Oil Filter Delta P, kPa | Record | Record |
| Fuel Pressure @ Lift Pump, kPa | Record | Record |

^A Conditions indicated are 5 seconds into the peak power step of the transient cycle.

**D 7484 - ISB Lubricant Performance Test
Test Results Summary
Form 4**

| | | |
|-------------------------|-----------------|-----------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Formulation/Stand Code: | | |
| Oil Code: | Engine Kit S/N: | |

| | | | |
|------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------|-------------------------------------------------|
| Date Test Started | | | |
| Start Time | | | |
| Test Length | | | |
| TMC Oil Code ^A | | | |
| Number of Valid Tests Since Stand Calibration ^B | | | |
| Laboratory Oil Code | | | |
| SAE Viscosity | | | |
| TGA Soot % At 100 h | | | |
| Average TGA Soot % (25 – 350 h) | | | |
| | Average Camshaft Wear (μm) | Average Tappet Mass Loss (mg) | Average Crosshead Mass Loss (mg) |
| Original Result | | | |
| Transformed Result | | | |
| Correction Factor | | | |
| Corrected Transformed Result | | | |
| Severity Adjustment | | | |
| Final Transformed Result | | | |
| Final Result | | | |

| Last Stand Reference Results | | | |
|-----------------------------------|----------------------------------------------------------|----------------------------------------------|-------------------------------------------------|
| Reference Test Number | | | |
| Oil Code | | | |
| Test Length | | | |
| TMC Oil Code | | | |
| EOT Date | | | |
| EOT Time | | | |
| Stand Calibration Expiration Date | | | |
| TGA Soot % AT 100 h | | | |
| Average TGA Soot % (25 – 350 h) | | | |
| | Average Camshaft Wear (μm) | Average Tappet Mass Loss (mg) | Average Crosshead Mass Loss (mg) |
| Final Result | | | |

^A Reference Tests Only

^B For Non-Reference Tests Only, includes current test if valid.

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Form 5

Operational Summary

| | | |
|-------------------------|-----------|-----------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Formulation/Stand Code: | | |
| Oil Code: | | |

| Controlled Parameters | Parameter | Units | Stage Target | | Stage Average | | Stage B Cycles ^A | System Response ^C |
|---------------------------|--------------------------|---------|-----------------------------|-------|-----------------|-----------------|-----------------------------|------------------------------|
| | | | A | B | A | B | | |
| | | | Speed | r/min | 1600 | Varies | | |
| Fuel Flow | kg/h | 20 | Varies | | | | | |
| Coolant Out | °C | 99 | 99 | | | | | |
| Fuel In | °C | 40 | 40 | | | | | |
| Oil Sump | °C | 110 | 110 | | | | | |
| Intake Air | °C | 25-35 | 25-35 | | | | | |
| Intake Manifold | °C | 68 | 68 | | | | | |
| Intake Air Restriction | kPa | 1-3 | 0-4 | | | | | |
| Exhaust | kPa | 6-8 | 4 max | | | | | |
| Coolant | kPa | 99-107 | 99-107 | | | | | |
| Non-controlled Parameters | Parameter | Units | Typical Values ^B | | Average Stage A | Average Stage B | | |
| | Torque | N-m | TBD | TBD | | | | |
| | Intake Manifold Pressure | kPa abs | TBD | TBD | | | | |
| | Crankcase Pressure | kPa | TBD | TBD | | | | |
| | Pre-Turbine Front | °C | TBD | TBD | | | | |
| | Pre-Turbine Rear | °C | TBD | TBD | | | | |
| | Tailpipe | °C | TBD | TBD | | | | |
| | Oil Gallery Temperature | °C | TBD | TBD | | | | |
| | Blowby | L/min | TBD | TBD | | | | |
| | Main Oil Gallery Press. | kPa | TBD | TBD | | | | |
| Fuel Pressure (lift pump) | kPa | TBD | TBD | | | | | |

^A Number of Stage B cycles. A minimum of 32,000 cycles is required.

^B Typical values determined from reference oil test database

^C Time for the output to reach 63.2% of final value for step change at input

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Form 6

Tappet Mass Loss Summary

| | | |
|---------------------------|-----------|-----------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Formulation / Stand Code: | | |
| Oil Code: | | |

| Tappet Wear | | | |
|--------------------|-------------------------|---------------------|-----------------------|
| Location | Pretest Mass (g) | EOT Mass (g) | Mass Loss (mg) |
| 1I | | | |
| 1E | | | |
| 2I | | | |
| 2E | | | |
| 3I | | | |
| 3E | | | |
| 4I | | | |
| 4E | | | |
| 5I | | | |
| 5E | | | |
| 6I | | | |
| 6E | | | |

| Tappet Mass Loss Intake / Exhaust Summary (mg) | Intake | | Exhaust | |
|-----------------------------------------------------------|--------------------|-------------------------|--------------------|-------------------------|
| | As Measured | Outlier Screened | As Measured | Outlier Screened |
| Average | | | | |
| Minimum | | | | |
| Maximum | | | | |
| Standard Deviation | | | | |
| Outlier Locations ^A | | | | |

^A Location Designation. Example: 3E

| Tappet Mass Loss Overall Summary (mg) | As Measured | Outlier Screened | Soot Adjusted |
|----------------------------------------------|--------------------|-------------------------|----------------------|
| Average | | | |
| Minimum | | | |
| Maximum | | | |
| Standard Deviation | | | |

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Form 7

Crosshead Mass Loss Summary

| | | |
|---------------------------|-----------|-----------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Formulation / Stand Code: | | |
| Oil Code: | | |

| Location | Serial No. | Pretest Mass (g) | EOT Mass (g) | Mass Loss (mg) |
|----------|------------|------------------|--------------|----------------|
| 1I | | | | |
| 1E | | | | |
| 2I | | | | |
| 2E | | | | |
| 3I | | | | |
| 3E | | | | |
| 4I | | | | |
| 4E | | | | |
| 5I | | | | |
| 5E | | | | |
| 6I | | | | |
| 6E | | | | |

| Intake / Exhaust Crosshead Mass Loss Summary (mg) | Intake | | Exhaust | |
|---------------------------------------------------------|-------------|------------------|-------------|------------------|
| | As Measured | Outlier Screened | As Measured | Outlier Screened |
| Average | | | | |
| Minimum | | | | |
| Maximum | | | | |
| Standard Deviation | | | | |
| Outlier Locations ^A | | | | |

^A Location Designation. Example: 3E

| Crosshead Mass Loss Overall Summary (mg) | As Measured | Outlier Screened | Soot Adjusted |
|---------------------------------------------|-------------|------------------|---------------|
| Average | | | |
| Minimum | | | |
| Maximum | | | |
| Standard Deviation | | | |

**D 7484 - ISB Lubricant Performance Test
Form 8
Cam Shaft Wear Summary**

| | | |
|---------------------------|-----------|-----------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Formulation / Stand Code: | | |
| Oil Code: | | |

| Lobe Number | Intake/Exhaust | Cam Shaft Wear (μm) ^A |
|-------------|----------------|-----------------------------------------------|
| 1 | Intake | |
| 2 | Exhaust | |
| 3 | Intake | |
| 4 | Exhaust | |
| 5 | Intake | |
| 6 | Exhaust | |
| 7 | Intake | |
| 8 | Exhaust | |
| 9 | Intake | |
| 10 | Exhaust | |
| 11 | Intake | |
| 12 | Exhaust | |

^A Average wear at front, middle, and rear of cam lobe.

| Intake / Exhaust Cam Shaft Wear Summary (μm) | Intake | | Exhaust | |
|--------------------------------------------------------------|-------------|------------------|-------------|------------------|
| | As Measured | Outlier Screened | As Measured | Outlier Screened |
| Average | | | | |
| Minimum | | | | |
| Maximum | | | | |
| Standard Deviation | | | | |
| Outlier Locations ^B | | | | |

^B Lobe Number.

| Cam Shaft Wear Overall Summary (μm) | As Measured | Outlier Screened |
|-----------------------------------------------------|-------------|------------------|
| Average | | |
| Minimum | | |
| Maximum | | |
| Standard Deviation | | |

**D 7484 - ISB Lubricant Performance Test
Form 11
Test Fuel Analysis (Last Batch)**

| | | |
|---------------------------|-----------|-----------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Formulation / Stand Code: | | |
| Oil Code: | | |

| Fuel Supplier | | Fuel Batch Identifier | | |
|-----------------------------------|-----------------------|-----------------------|-----|---------------------|
| Measurement | Specs. | Analysis | | Test Method |
| | | New | EOT | |
| Total Sulfur, ppm | 7 – 15 | | | D 5453 |
| Gravity, °API | 34 – 37 | | | D 4052 |
| Hydrocarbon Composition | | | | |
| Aromatics % Wt. | 26 – 31.5 | | | D 5186 |
| Olefins % Vol. | Report | | | D 1319 |
| Cetane Index | Report | | | D 976 |
| Cetane No. | 43 – 47 | | | D 613 |
| Copper Strip Corrosion | 1 Maximum | | | D 130 |
| Flash Point, °C | 54 Minimum | | | D 93 |
| Pour Point, °C | -18 Maximum | | | D 97 |
| Carbon Residue on 10% Residuum, % | 0.35 Maximum | | | D 524 (10% Bottoms) |
| Water & Sediment, % Vol. | 0.05 Maximum | | | D 2709 |
| Viscosity, cSt @ 40°C | 2.0 – 2.6 | | | D 445 |
| Total Acid Number | 0.05 Maximum | | | D 664 |
| Strong Acid Number | 0.00 Maximum | | | D 664 |
| Accelerated Stability | 1.5 max | | | D 2274 |
| Ash, % Wt. | 0.005 max | | | D 482 |
| SLBOCLE, g | 3100 min ^A | | | D 6078 ^A |
| 90% Distillation, °C | 293 - 332 | | | D 86 |

^AMay be altered to be consistent with CARB or ASTM diesel fuel specifications.

**D 7484 - ISB Lubricant Performance Test
Form 12
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

| | |
|--|-------------------------------------------------------------------------------------------------------------------------------------------|
| | 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

Title