

Mack T-12A EGR Engine Oil Test

Report Packet Version No.

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. |
| | 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: | Engine Hours: |
| End Of Test Date: | | End Of Test Time: | |
| Oil Code: | | | |
| Formulation/Stand Code: | | | |
| Alternate Codes | | | |

In my opinion this test _____ been conducted in a valid manner in accordance with the Test Method D 7422 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**

**Mack T-12A EGR Engine Oil Test
Form 2**

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**Mack T-12A EGR Engine Oil Test
Form 3**

The Mack T-12A EGR Engine Oil Test is a fuel engine-dynamometer test which generates an oil sample to be used for MRV Viscosity requirements. This test is a one-phase, steady state test (constant speed and load), run with heavy EGR. The test is 100 h and is run with retarded fuel injection timing to produce elevated soot levels in the oil.

The test engine is a Mack E-TECH V-MAC III diesel engine with EGR. It is an in-line six-cylinder, four stroke, turbocharged engine. It has electronically controlled fuel injection with six individual electronic pumps.

Mack T-12A Test Conditions

| Parameter | Value |
|---------------------------------------|--------------------------|
| Time, h | 100 |
| Injection Timing, °BTDC | Variable |
| Speed, r/min | 1800 |
| Fuel Flow, kg/h | 59.2 |
| Intake CO₂, % | 3.09 |
| Exhaust CO₂, % | 9.25 |
| Inlet Manifold Temp., °C | 90 |
| Coolant Out Temp., °C | 66 |
| Fuel In Temp., °C | 40 |
| Oil Gallery Temp., °C | 88 |
| Intake Air Temp., °C | 25 |
| Intake Air Restriction, kPa | 3.5 – 4.0 |
| Inlet Manifold Pressure, kPa | 265 Nominal |
| Exhaust Back Pressure, kPa | 2.7 – 3.5 |
| Crankcase Pressure, kPa | 0.25 – 0.75 |
| Torque, Nm | Record |
| Pre-Turbine Exhaust Temp., °C | Record |
| Tailpipe Exhaust Temp., °C | Record |
| Oil Sump Temp., °C | Record |
| EGR Pre-Venturi Temp., °C | Record |
| Inlet Air Dew Point, °C | Record |
| EGR Pre-Venturi Press., kPa | Record |
| Main Gallery Oil Pressure, kPa | Record |
| Oil Filter Delta P, kPa | Not to exceed 138 |

**Mack T-12A EGR Engine Oil Test
Form 4
Test Results Summary**

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

| Test Results | | |
|--|----------------------|-----------------------|
| Date Test Started: | Start Time: | Test Length: |
| TMC Oil Code: ^A | Lab Oil Code: | SAE Viscosity: |
| Average TGA Soot % at 100 h | | |
| | | |
| | | |
| | | MRV @ 100h, cP |
| Original Result | | |
| Transformed Result ^B | | |
| Correction Factor ^B | | |
| Corrected Transformed Result ^B | | |
| Severity Adjustment ^B | | |
| Final Transformed Result ^B | | |
| Final Original Unit Result | | |

| Last Stand Reference Results | |
|---|----------------------|
| Test Number: | |
| Oil Code: | |
| Test Length: | TMC Oil Code: |
| EOT Date: | EOT Time: |
| Number of Tests Since Stand Calibration ^C | |
| Stand Calibration Expiration Date | |
| Average TGA Soot % at 100 h | |
| | |
| MRV @ 100h, cP | |
| Final Original Unit Result | |

^A Reference Tests only.

^B Transformed Units.

^C Operationally valid tests only, including current test.

**Mack T-12A EGR Engine Oil Test
Form 5
Operational Summary**

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

| Controlled Parameters | Parameter | Units | QI Threshold | EOT QI ^A | Target | Average | Samples ^B | BQD ^C | Over/Under Range ^D |
|---------------------------|---------------------------|---------|-----------------------------|---------------------|---------|---------|----------------------|------------------|-------------------------------|
| | Speed | r/min | 0.000 | | 1800 | | | | |
| Fuel Flow | kg/h | 0.000 | | 59.2 | | | | | |
| Inlet Manifold Temp. | °C | 0.000 | | 90 | | | | | |
| Coolant Out Temp. | °C | 0.000 | | 66 | | | | | |
| Fuel In Temp. | °C | 0.000 | | 40 | | | | | |
| Oil Gallery Temp. | °C | 0.000 | | 88 | | | | | |
| Inlet Air Temp. | °C | 0.000 | | 25 | | | | | |
| Inlet Air Restriction | kPa | | | 3.5 – 4.0 | | | | | |
| Inlet Man. Pressure | kPa | | | 265 Nominal | | | | | |
| Exh. Back Pressure | kPa | | | 2.7 – 3.5 | | | | | |
| Crankcase Pressure | kPa | | | 0.25 – 0.75 | | | | | |
| Intake CO ₂ | % | | | 3.09±0.05 | | | | | |
| Exhaust CO ₂ | % | | | 9.25±0.15 | | | | | |
| | | | | | | | | | |
| Non-Controlled Parameters | Parameter | Units | Typical Values ^E | | Average | | | | |
| | Torque | Nm | 1232-1397 | N/A | | | | | |
| | Brake Specific Fuel Cons. | g/kW-h | 212-263 | N/A | | | | | |
| | Pre-Turbine Temp. (Front) | °C | 482-605 | N/A | | | | | |
| | Pre-Turbine Temp. (Rear) | °C | 503-567 | N/A | | | | | |
| | Tailpipe Temp. | °C | 303-354 | N/A | | | | | |
| | Oil Sump Temp. | °C | 92-105 | N/A | | | | | |
| | EGR Pre-Venturi Temp. | °C | 138-201 | N/A | | | | | |
| | Blowby | L/min | 41-176 | N/A | | | | | |
| | Inlet Air Dew Point | °C | 6-22 | N/A | | | | | |
| | EGR Pre-Venturi Pressure | kPa | 235-336 | N/A | | | | | |
| Main Gallery Oil Pressure | kPa | 165-269 | N/A | | | | | | |

^A QI values above the threshold are acceptable by the Mack Surveillance Panel. QI values below the threshold may not be considered acceptable based on an engineering review. Refer to Annex A5

^B Total number of data points taken. Minimum acceptable value is 1000

^C Number of Bad Quality Data points not used in the calculation of the statistical measures.

^D Number of points clipped by over/under range limits.

^E Typical values determined from reference oil test database

Fig A1.5 – Operational Summary

**MACK T-12A EGR Engine Oil Test
Form 6
Oil Analysis Summary**

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

| Hours | Soot % TGA | Viscosity At 100°C cSt | Viscosity Increase cSt | TBN | TAN | IR Oxidation | | Wear Metal Elements (ppm) | | | | | | | | | |
|-----------|------------|------------------------|------------------------|-----|-----|--------------|-------------|---------------------------|----|----|----|----|----|----|----|----|--|
| | | | | | | Inte-grated | Peak Height | Fe | Pb | Cu | Cr | Al | Si | Sn | Na | Ni | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 100 (2nd) | | | | | | | | | | | | | | | | | |
| 100 Avg. | | | | | | | | | | | | | | | | | |

| Summary | As Measured |
|----------------------|-------------|
| MRV @ 100h, cP | |
| MRV Yield Stress, Pa | |

**Mack T-12A EGR Engine Oil Test
Form 8
Test Fuel Analysis (Last Batch)**

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

| Measurement | Specs. | Analysis | | Test Method |
|--|-----------------------------|----------|-----|-----------------------------|
| | | New | EOT | |
| Total Sulfur, ppm | 7 - 15 | | | D 5453 or equivalent |
| 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.

**Mack T-12A EGR Engine Oil Test
Form 9
Characteristics of the Data Acquisition System**

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

| Parameter (1) | Sensing Device (2) | Calibration Frequency (3) | Record Device (4) | Observation Frequency (5) | Record Frequency (6) | Log Frequency (7) | System Response (8) |
|------------------------|--------------------------|---------------------------------|-------------------------|---------------------------------|----------------------------|-------------------------|---------------------------|
| Temperatures | | | | | | | |
| Oil @ Filt. | | | | | | | |
| Fuel In. | | | | | | | |
| Intake Air | | | | | | | |
| Intake Man. | | | | | | | |
| Pre-Turb. | | | | | | | |
| Cool. Out | | | | | | | |
| Other | | | | | | | |
| Fuel Flow | | | | | | | |
| Engine RPM | | | | | | | |
| Load | | | | | | | |
| Inlet Restr. | | | | | | | |
| Exh. Press. | | | | | | | |
| Oil Gal. Press. | | | | | | | |

Legend:

- (1) **Operating Parameter**
- (2) **The type of device used to measure temperature, pressure or flow**
- (3) **Frequency at which the measurement system is calibrated**
- (4) **The type of device where data is recorded**
 LG - Handlog Sheet
 DL - Automatic Data Logger
 SC - Strip Chart Recorder
 C/M - Computer, Using Manual Data Entry
 C/D - Computer, Using Direct I/O Entry
- (5) **Data are observed but only if recorded off spec.**
- (6) **Data are recorded but are not retained at EOT**
- (7) **Data are logged as permanent record, note specify if:**
 SS - Snapshot Taken at Specified Frequency
 AG/X - Average of X Data Points at Specified Frequency
- (8) **Time for the output to reach 63.2% of final value for step change at input**

**Mack T-12A EGR Engine Oil Test
Form 10
Build-up and Hardware Information**

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

Injection Timing

| Timing Hours | Timing (Deg) |
|-----------------------------|--------------|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| Total Timing Changes | |

Hardware

| Part | Part Number | Serial Number |
|------------------------------|-------------|---------------|
| Primary Turbocharger | | |
| Secondary Charger | | |
| Cylinder Head (front) | | |
| Cylinder Head (rear) | | |
| Pistons | | |
| Injection Nozzles | | |
| Rod Bearings | | |
| Liners | | |
| Ring Set | | |

| Cylinder Kit Location | CPD ID Number |
|-----------------------|---------------|
| Cylinder 1 | |
| Cylinder 2 | |
| Cylinder 3 | |
| Cylinder 4 | |
| Cylinder 5 | |
| Cylinder 6 | |

| Bearing Type | Batch ID |
|---------------|----------|
| Conrod | |
| Main | |