

Mack T-12 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. |
| | N = 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 | | | |

| |
|--|
| <p>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.</p> |
|--|

Submitted By:

Testing Laboratory

Signature

Typed Name

Title

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

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

The Mack T-12 EGR Engine Oil Test is a fuel engine-dynamometer test which evaluates the ability of a lubricant to minimize piston ring wear, cylinder liner wear, lead corrosion, oil consumption, and oxidation. This test is a two-phase, steady state test (constant speed and load), run with heavy EGR. The first phase is 100 h and is run with retarded fuel injection timing to produce elevated soot levels in the oil. The second phase is 200 h and is run under heavy load conditions to induce piston ring and cylinder liner wear.

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. A one h break-in is conducted prior to each test since a new engine build is used for each test.

Mack T-12 Test Conditions

| Parameter | Phase I | Phase II |
|---------------------------------------|--------------------------|---------------------------|
| Time, h | 100 | 200 |
| Injection Timing, °BTDC | Variable | 21 |
| Speed, r/min | 1800 | 1200 |
| Fuel Flow, kg/h | 59.2 | 63.5 |
| Intake CO₂, % | 3.09 | 1.42 |
| Exhaust CO₂, % | 9.25 | 9.78-10.08 typical |
| Inlet Manifold Temp., °C | 90 | 80 |
| Coolant Out Temp., °C | 66 | 108 |
| Fuel In Temp., °C | 40 | 40 |
| Oil Gallery Temp., °C | 88 | 116 |
| Intake Air Temp., °C | 25 | 25 |
| Intake Air Restriction, kPa | 3.5 – 4.0 | 3.5 – 4.0 |
| Inlet Manifold Pressure, kPa | 265 Nominal | 302-312 |
| Exhaust Back Pressure, kPa | 2.7 – 3.5 | 2.7 – 3.5 |
| Crankcase Pressure, kPa | 0.25 – 0.75 | 0.25 – 0.75 |
| Torque, Nm | Record | Record |
| Pre-Turbine Exhaust Temp., °C | Record | Record |
| Tailpipe Exhaust Temp., °C | Record | Record |
| Oil Sump Temp., °C | Record | Record |
| EGR Pre-Venturi Temp., °C | Record | Record |
| Inlet Air Dew Point, °C | Record | Record |
| EGR Pre-Venturi Press., kPa | Record | Record |
| Main Gallery Oil Pressure, kPa | Record | Record |
| Oil Filter Delta P, kPa | Not to exceed 138 | Not to exceed 138 |

**Mack T-12 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 | | | | | |
| Centrifugal Oil Filter Mass Gain, g | | | | | |
| Oil Filter Delta P, kPa (138 maximum) | | | | | |
| EOT TBN | | | | | |
| | Delta Pb@ EOT (ppm) | Avg Liner Wear (µm) | Avg Top Ring Weight Loss (mg) | Oil Consumption (g/h) | Delta Pb 250-300h (ppm) |
| Original Result | | | | | |
| Transformed Result ^B | | | | | |
| Correction Factor ^B | | | | | |
| Corrected Transformed Result ^B | | | | | |
| Severity Adjustment ^B | | | | | |
| Final Transformed Result ^B | | | | | |
| Final Original Unit Result | | | | | |
| Mack Merits ^C | | | | | |
| Total Mack Merits ^C | | | | | |

| Last Stand Reference Results | | | | | |
|--|--------------------------------|--------------------------------|--|--------------------------------------|--|
| Test Number: | | | | | |
| Oil Code: | | | | | |
| Test Length: | | | TMC Oil Code: | | |
| EOT Date: | | | EOT Time: | | |
| Number of Tests Since Stand Calibration^D | | | | | |
| Stand Calibration Expiration Date | | | | | |
| Average TGA Soot % at 100 h | | | | | |
| | Delta Pb@ EOT (ppm) | Avg Liner Wear (µm) | Avg Top Ring Weight Loss (mg) | Oil Consumption (g/h) | Delta Pb 250-300h (ppm) |
| Final Original Unit Result | | | | | |

^A Reference Tests only.

^B Transformed Units apply to Delta Pb @ EOT, Oil Consumption, and Delta Pb 250-300h only.

^C Non-reference Tests only.

^D Operationally valid tests only, including current test.

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

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

| | Parameter | Units | QI | | Target | | Average | | Samples ^B | BQD ^C | Over/Under Range ^D |
|----------------------------------|---------------------------|--------|-----------------------------|---------------------|----------------|-----------|---------|--|----------------------|------------------|-------------------------------|
| | | | Threshold | EOT QI ^A | | | | | | | |
| Controlled Parameters | Speed | r/min | 0.000 | | 1800 | 1200 | | | | | |
| | Fuel Flow | kg/h | 0.000 | | 59.2 | 63.5 | | | | | |
| | Inlet Manifold Temp. | °C | 0.000 | | 90 | 80 | | | | | |
| | Coolant Out Temp. | °C | 0.000 | | 66 | 108 | | | | | |
| | Fuel In Temp. | °C | 0.000 | | 40 | | | | | | |
| | Oil Gallery Temp. | °C | 0.000 | | 88 | 116 | | | | | |
| | Inlet Air Temp. | °C | 0.000 | | 25 | | | | | | |
| | Inlet Air Restriction | kPa | | | 3.5 – 4.0 | | | | | | |
| | Inlet Man. Pressure | kPa | | | 265 Nominal | 307±5 | | | | | |
| | Exh. Back Pressure | kPa | | | 2.7 – 3.5 | | | | | | |
| | Crankcase Pressure | kPa | | | 0.25 – 0.75 | | | | | | |
| | Intake CO ₂ | % | | | 3.09±0.05 | 1.42±0.05 | | | | | |
| | Exhaust CO ₂ | % | | | 9.25±0.15 | 9.93±0.15 | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Non-Controlled Parameters | Parameter | Units | Typical Values ^E | | Average | | | | | | |
| | Torque | Nm | 1232-1397 | 2434-2543 | | | | | | | |
| | Brake Specific Fuel Cons. | g/kW-h | 212-263 | 179-228 | | | | | | | |
| | Pre-Turbine Temp. (L) | °C | 482-605 | 504-759 | | | | | | | |
| | Pre-Turbine Temp. (R) | °C | 503-567 | 491-758 | | | | | | | |
| | Tailpipe Temp. | °C | 303-354 | 280-433 | | | | | | | |
| | Oil Sump Temp. | °C | 92-105 | 73-190 | | | | | | | |
| | EGR Pre-Venturi Temp. | °C | 138-201 | 107-126 | | | | | | | |
| | Blowby | L/min | 41-176 | 71-264 | | | | | | | |
| | Inlet Air Dew Point | °C | 6-22 | 6-22 | | | | | | | |
| | EGR Pre-Venturi Pressure | kPa | 226-331 | 235-336 | | | | | | | |
| | Main Gallery Oil Pressure | kPa | 394-502 | 165-269 | | | | | | | |

^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 3000

^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-12 EGR Engine Oil Test
Form 6
Rod Bearing Weight Loss**

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

| Cylinder # | Location | SOT Weight, g | EOT Weight, g | Weight Change, mg |
|------------|----------|---------------|---------------|-------------------|
| 1 | Upper | | | |
| 2 | Upper | | | |
| 3 | Upper | | | |
| 4 | Upper | | | |
| 5 | Upper | | | |
| 6 | Upper | | | |

| Summary | As Measured | Outlier Screened |
|---|-------------|------------------|
| Upper Bearing Average Weight Loss, mg | | |
| Upper Bearing Weight Loss Std. Dev., mg | | |
| Upper Bearing Minimum Weight Loss, mg | | |
| Upper Bearing Maximum Weight Loss, mg | | |
| Outlier Upper Rod Bearing ^A | | |

^A Cylinder number

| Cylinder # | Location | SOT Weight, g | EOT Weight, g | Weight Change, mg |
|---|----------|---------------|---------------|-------------------|
| 1 | Lower | | | |
| 2 | Lower | | | |
| 3 | Lower | | | |
| 4 | Lower | | | |
| 5 | Lower | | | |
| 6 | Lower | | | |
| Lower Bearing Average Weight Loss, mg | | | | |
| Lower Bearing Weight Loss Std. Dev., mg | | | | |
| Lower Bearing Minimum Weight Loss, mg | | | | |
| Lower Bearing Maximum Weight Loss, mg | | | | |

**Mack T-12 EGR Engine Oil Test
Form 7
Ring Weight Loss**

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

| Cylinder No. | Top Ring SOT Weight, g | Top Ring EOT Weight, g | Weight Loss, mg |
|--------------|------------------------|------------------------|-----------------|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |

| Summary | As Measured | Outlier Screened |
|------------------------------------|-------------|------------------|
| Top Ring Average Weight Loss, mg | | |
| Top Ring Weight Loss Std. Dev., mg | | |
| Top Ring Minimum Weight Loss, mg | | |
| Top Ring Maximum Weight Loss, mg | | |
| Outlier Ring ^B | | |

^A Results calculated without rings with plasma flanking.

^B Ring number wear results are not currently outlier screened.

| Cylinder No. | 2nd Ring SOT Weight, g | 2 nd Ring EOT Weight, g | Weight Loss, mg |
|--|------------------------|------------------------------------|-----------------|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 2 nd Ring Average Weight Loss, mg | | | |
| 2 nd Ring Weight Loss Std. Dev., mg | | | |
| 2 nd Ring Min. Weight Loss, mg | | | |
| 2 nd Ring Max. Weight Loss, mg | | | |

| Cylinder No. | Oil Ring SOT Weight, g | Oil Ring EOT Weight, g | Weight Loss, mg |
|------------------------------------|------------------------|------------------------|-----------------|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| Oil Ring Average Weight Loss, mg | | | |
| Oil Ring Weight Loss Std. Dev., mg | | | |
| Oil Ring Minimum Weight Loss, mg | | | |
| Oil Ring Maximum Weight Loss, mg | | | |

**MACK T-12 EGR Engine Oil Test
Form 8
Oil Analysis Summary**

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

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

| Summary | As Measured | Outlier Bearing Adjusted |
|--------------------------|-------------|--------------------------|
| Delta Pb @ EOT, ppm | | |
| Delta Pb @ 250-300h, ppm | | |
| MRV @ 100h, cP | | |
| MRV Yield Stress, Pa | | |

**Mack T-12 EGR Engine Oil Test
Form 9
Liner Surface Roughness & Bore Diameter**

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

| Liner No. | Location | Ra (µm) | Bore Diameter (mm) | | Ra (µm) | Dia. (mm) |
|-----------|------------------------|---------|--------------------|-----------|---------|-----------|
| 1 | Top Ring Travel @ 0° | | | Avg. | | |
| | Top Ring Travel @ 90° | | | Std. Dev. | | |
| | Top Ring Travel @ 180° | | | Min. | | |
| | Top Ring Travel @ 270° | | | Max. | | |
| 2 | Top Ring Travel @ 0° | | | Avg. | | |
| | Top Ring Travel @ 90° | | | Std.Dev. | | |
| | Top Ring Travel @ 180° | | | Min. | | |
| | Top Ring Travel @ 270° | | | Max. | | |
| 3 | Top Ring Travel @ 0° | | | Avg. | | |
| | Top Ring Travel @ 90° | | | Std. Dev. | | |
| | Top Ring Travel @ 180° | | | Min. | | |
| | Top Ring Travel @ 270° | | | Max. | | |
| 4 | Top Ring Travel @ 0° | | | Avg. | | |
| | Top Ring Travel @ 90° | | | Std.Dev. | | |
| | Top Ring Travel @ 180° | | | Min. | | |
| | Top Ring Travel @ 270° | | | Max. | | |
| 5 | Top Ring Travel @ 0° | | | Avg. | | |
| | Top Ring Travel @ 90° | | | Std. Dev. | | |
| | Top Ring Travel @ 180° | | | Min. | | |
| | Top Ring Travel @ 270° | | | Max. | | |
| 6 | Top Ring Travel @ 0° | | | Avg. | | |
| | Top Ring Travel @ 90° | | | Std. Dev. | | |
| | Top Ring Travel @ 180° | | | Min. | | |
| | Top Ring Travel @ 270° | | | Max. | | |

| | Ra (µm) | Bore Diameter (mm) |
|---|---------|--------------------|
| Average Surface Roughness & Bore Diameter | | |
| Standard Deviation Surface Roughness & Bore Diameter | | |
| Minimum Surface Roughness & Bore Diameter | | |
| Maximum Surface Roughness & Bore Diameter | | |

**Mack T-12 EGR Engine Oil Test
Form 10
Liner Wear Summary**

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

| Position | Wear Step (µm) | | | | | |
|---------------------------|------------------------|----------|----------|----------|----------|----------|
| | Cylinder Number | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1:00 | | | | | | |
| 2:00 | | | | | | |
| 3:00 (Thrust) | | | | | | |
| 4:00 | | | | | | |
| 5:00 | | | | | | |
| 6:00 (Rear) | | | | | | |
| 7:00 | | | | | | |
| 8:00 | | | | | | |
| 9:00 (Anti-Thrust) | | | | | | |
| 10:00 | | | | | | |
| 11:00 | | | | | | |
| 12:00 (Front) | | | | | | |
| Average | | | | | | |

| Summary | As Measured | Outlier Screened |
|------------------------------------|--------------------|-------------------------|
| Average, µm | | |
| Std. Dev., µm | | |
| Minimum, µm | | |
| Maximum, µm | | |
| Outlier Liners ^A | | |

^A Cylinder Number.

**Mack T-12 EGR Engine Oil Test
Form 12
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 |
| HFRR, µm | 460 max^A | | | D 6079^A |
| 90% Distillation, °C | 293 - 332 | | | D 86 |

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

**Mack T-12 EGR Engine Oil Test
Form 13
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-12 EGR Engine Oil Test
Form 14
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 | |

| | |
|--------------------------------|--|
| Cylinder Liner Batch ID | |
| Ring Pack Batch ID | |
| Conrod Bearing Batch ID | |
| Main Bearing Batch ID | |
| Piston Crown Batch ID | |

**Mack T-12 EGR Engine Oil Test
Form 15
Rating Summary: Piston #1**

| | | |
|--------------------------------|------------------------|---------------------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Oil Code: | | |
| Formulation/Stand Code: | | |
| Date Rated: | Rater Initials: | Verified By: |

NOTE: Reporting of this information is NOT mandatory for T-12 Tests.

| Total Piston Ratings Summary | | | | | | | | | | | | | | | | | | | | |
|------------------------------|----------------|------------|------|-------|------|------------|------|-------|------|----------------------------|--------|------|-------|------------------------------|-------|------|----------------|------|----------------|------|
| C a r b o n | Dep. Factor | Grooves | | | | Lands | | | | Dep. Factor | Groove | | Lands | | | | Oil Cooling | | Under Crown | |
| | | No. 1 | | No. 2 | | No. 1 | | No. 2 | | | No. 3 | | No. 3 | | No. 4 | | A, % | Dem. | A, % | Dem. |
| | | A, % | Dem. | A, % | Dem. | A, % | Dem. | A, % | Dem. | | A, % | Dem. | A, % | Dem. | A, % | Dem. | | | | |
| | HC-1.0 | | | | | | | | | | | | | | | | | | | |
| | MC-0.5 | | | | | | | | | | | | | | | | | | | |
| | LC-.25 | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | |
| V a r i s h | 8 - 9 | | | | | | | | | 7.5 | | | | | | | | | | |
| | 7 - 7.9 | | | | | | | | | | | | | | | | | | | |
| | 6 - 6.9 | | | | | | | | | | | | | | | | | | | |
| | 5 - 5.9 | | | | | | | | | 4.5 | | | | | | | | | | |
| | 4 - 4.9 | | | | | | | | | | | | | | | | | | | |
| | 3 - 3.9 | | | | | | | | | | | | | | | | | | | |
| | 2 - 2.9 | | | | | | | | | 1.5 | | | | | | | | | | |
| | 1 - 1.9 | | | | | | | | | | | | | | | | | | | |
| | >0 - 0.9 | | | | | | | | | | | | | | | | | | | |
| Clean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Clean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total | | | | | | | | | | | | | | | | | | | | |
| Rating | | | | | | | | | | | | | | | | | | | | |
| Location Factor | 2 | 3 | 1 | 3 | | | | | 20 | 20 | 60 | 0.5 | 1 | | | | | | | |
| Ind Rating | | | | | | | | | | | | | | | | | | | | |
| WDP | | TGC | | | | TLC | | | | Unweighted Deposits | | | | T. L. Flaked Carbon % | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |

**Mack T-12 EGR Engine Oil Test
Form 16
Rating Summary: Piston #2**

| | | |
|--------------------------------|------------------------|---------------------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Oil Code: | | |
| Formulation/Stand Code: | | |
| Date Rated: | Rater Initials: | Verified By: |

NOTE: Reporting of this information is NOT mandatory for T-12 Tests.

| Total Piston Ratings Summary | | | | | | | | | | | | | | | | | | | | |
|------------------------------|----------------|------------|------|-------|------|------------|------|-------|------|----------------------------|--------|------|-------|------------------------------|-------|------|----------------|------|----------------|------|
| C a r b o n | Dep. Factor | Grooves | | | | Lands | | | | Dep. Factor | Groove | | Lands | | | | Oil Cooling | | Under Crown | |
| | | No. 1 | | No. 2 | | No. 1 | | No. 2 | | | No. 3 | | No. 3 | | No. 4 | | A, % | Dem. | A, % | Dem. |
| | | A, % | Dem. | A, % | Dem. | A, % | Dem. | A, % | Dem. | | A, % | Dem. | A, % | Dem. | A, % | Dem. | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | HC-1.0 | | | | | | | | | | | | | | | | | | | |
| | MC-0.5 | | | | | | | | | | | | | | | | | | | |
| | LC-.25 | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| V a r i s h | 8-9 | | | | | | | | | 7.5 | | | | | | | | | | |
| | 7-7.9 | | | | | | | | | | | | | | | | | | | |
| | 6-6.9 | | | | | | | | | | | | | | | | | | | |
| | 5-5.9 | | | | | | | | | 4.5 | | | | | | | | | | |
| | 4-4.9 | | | | | | | | | | | | | | | | | | | |
| | 3-3.9 | | | | | | | | | | | | | | | | | | | |
| | 2-2.9 | | | | | | | | | 1.5 | | | | | | | | | | |
| | 1-1.9 | | | | | | | | | | | | | | | | | | | |
| | >0-0.9 | | | | | | | | | | | | | | | | | | | |
| | Clean | | 0 | | 0 | | 0 | | 0 | Clean | | 0 | | 0 | | 0 | | 0 | | 0 |
| | Total | | | | | | | | | | | | | | | | | | | |
| Rating | | | | | | | | | | | | | | | | | | | | |
| Location Factor | | 2 | | 3 | | 1 | | 3 | | | 20 | | 20 | | 60 | | 0.5 | | 1 | |
| Ind Rating | | | | | | | | | | | | | | | | | | | | |
| WDP | | TGC | | | | TLC | | | | Unweighted Deposits | | | | T. L. Flaked Carbon % | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |

**Mack T-12 EGR Engine Oil Test
Form 17
Rating Summary: Piston #3**

| | | |
|--------------------------------|------------------------|---------------------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Oil Code: | | |
| Formulation/Stand Code: | | |
| Date Rated: | Rater Initials: | Verified By: |

NOTE: Reporting of this information is NOT mandatory for T-12 Tests.

| Total Piston Ratings Summary | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------|----------------|---------|------|------------|------|-------|------|------------|------|----------------|--------|----------------------------|-------|------|-------|------------------------------|----------------|------|----------------|------|--|--|
| C a r b o n | Dep. Factor | Grooves | | | | Lands | | | | Dep. Factor | Groove | | Lands | | | | Oil Cooling | | Under Crown | | | |
| | | No. 1 | | No. 2 | | No. 1 | | No. 2 | | | No. 3 | | No. 3 | | No. 4 | | A, % | Dem. | A, % | Dem. | | |
| | | A, % | Dem. | A, % | Dem. | A, % | Dem. | A, % | Dem. | | A, % | Dem. | A, % | Dem. | A, % | Dem. | | | | | | |
| | HC-1.0 | | | | | | | | | | | | | | | | | | | | | |
| | MC-0.5 | | | | | | | | | | | | | | | | | | | | | |
| | LC-.25 | | | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | | | |
| | 8-9 | | | | | | | | | 7.5 | | | | | | | | | | | | |
| V a r i s h | 7-7.9 | | | | | | | | | | 4.5 | | | | | | | | | | | |
| | 6-6.9 | | | | | | | | | 1.5 | | | | | | | | | | | | |
| | 5-5.9 | | | | | | | | | | | Clean | | | | | | | | | | |
| | 4-4.9 | | | | | | | | | | | | | | | | | | | | | |
| | 3-3.9 | | | | | | | | | | | | | | | | | | | | | |
| | 2-2.9 | | | | | | | | | | | | | | | | | | | | | |
| | 1-1.9 | | | | | | | | | | | | | | | | | | | | | |
| | >0-0.9 | | | | | | | | | | | | | | | | | | | | | |
| | Clean | | 0 | | 0 | | 0 | | 0 | Clean | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | Total | | | | | | | | | | | | | | | | | | | | | |
| Rating | | | | | | | | | | | | | | | | | | | | | | |
| Location Factor | | 2 | | 3 | | 1 | | 3 | | 20 | | 20 | | 60 | | 0.5 | | 1 | | | | |
| Ind Rating | | | | | | | | | | | | | | | | | | | | | | |
| WDP | | | | TGC | | | | TLC | | | | Unweighted Deposits | | | | T. L. Flaked Carbon % | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |

**Mack T-12 EGR Engine Oil Test
Form 18
Rating Summary: Piston #4**

| | | |
|--------------------------------|------------------------|---------------------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Oil Code: | | |
| Formulation/Stand Code: | | |
| Date Rated: | Rater Initials: | Verified By: |

NOTE: Reporting of this information is NOT mandatory for T-12 Tests.

| Total Piston Ratings Summary | | | | | | | | | | | | | | | | | | | | | |
|------------------------------|--------------------|---------|------|-------|------|-------|------|-------|------|----------------|--------|------|-------|------|-------|------|---------------------|------|----------------|------|-----------------------|
| C a r b o n | Dep. Factor | Grooves | | | | Lands | | | | Dep. Factor | Groove | | Lands | | | | Oil Cooling | | Under Crown | | |
| | | No. 1 | | No. 2 | | No. 1 | | No. 2 | | | No. 3 | | No. 3 | | No. 4 | | A, % | Dem. | A, % | Dem. | |
| | | A, % | Dem. | A, % | Dem. | A, % | Dem. | A, % | Dem. | | A, % | Dem. | A, % | Dem. | A, % | Dem. | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | HC-1.0 | | | | | | | | | | | | | | | | | | | | |
| | MC-0.5 | | | | | | | | | | | | | | | | | | | | |
| | LC-.25 | | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| V a r i s h | 8-9 | | | | | | | | | 7.5 | | | | | | | | | | | |
| | 7-7.9 | | | | | | | | | | | | | | | | | | | | |
| | 6-6.9 | | | | | | | | | | | | | | | | | | | | |
| | 5-5.9 | | | | | | | | | | | | | | | | | | | | |
| | 4-4.9 | | | | | | | | | 4.5 | | | | | | | | | | | |
| | 3-3.9 | | | | | | | | | | | | | | | | | | | | |
| | 2-2.9 | | | | | | | | | | | | | | | | | | | | |
| | 1-1.9 | | | | | | | | | 1.5 | | | | | | | | | | | |
| | >0-0.9 | | | | | | | | | | | | | | | | | | | | |
| | | Clean | | 0 | | 0 | | 0 | | 0 | Clean | | 0 | | 0 | | 0 | | 0 | | 0 |
| | Total | | | | | | | | | | | | | | | | | | | | |
| | Rating | | | | | | | | | | | | | | | | | | | | |
| | Location Factor | 2 | | 3 | | 1 | | 3 | | | 20 | | 20 | | 60 | | 0.5 | | 1 | | |
| | Ind Rating | | | | | | | | | | | | | | | | | | | | |
| | WDP | | | | | TGC | | | | TLC | | | | | | | Unweighted Deposits | | | | T. L. Flaked Carbon % |
| | | | | | | | | | | | | | | | | | | | | | |

**Mack T-12 EGR Engine Oil Test
Form 19
Rating Summary: Piston #5**

| | | |
|--------------------------------|------------------------|---------------------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Oil Code: | | |
| Formulation/Stand Code: | | |
| Date Rated: | Rater Initials: | Verified By: |

NOTE: Reporting of this information is NOT mandatory for T-12 Tests.

| Total Piston Ratings Summary | | | | | | | | | | | | | | | | | | | | |
|------------------------------|----------------|---------|------|------------|------|-------|------|------------|------|----------------|--------|----------------------------|-------|------|-------|------------------------------|----------------|------|----------------|------|
| C a r b o n | Dep. Factor | Grooves | | | | Lands | | | | Dep. Factor | Groove | | Lands | | | | Oil Cooling | | Under Crown | |
| | | No. 1 | | No. 2 | | No. 1 | | No. 2 | | | No. 3 | | No. 3 | | No. 4 | | A, % | Dem. | A, % | Dem. |
| | | A, % | Dem. | A, % | Dem. | A, % | Dem. | A, % | Dem. | | A, % | Dem. | A, % | Dem. | A, % | Dem. | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | HC-1.0 | | | | | | | | | | | | | | | | | | | |
| | MC-0.5 | | | | | | | | | | | | | | | | | | | |
| | LC-.25 | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| V a r i s h | 8-9 | | | | | | | | | 7.5 | | | | | | | | | | |
| | 7-7.9 | | | | | | | | | | | | | | | | | | | |
| | 6-6.9 | | | | | | | | | | | | | | | | | | | |
| | 5-5.9 | | | | | | | | | 4.5 | | | | | | | | | | |
| | 4-4.9 | | | | | | | | | | | | | | | | | | | |
| | 3-3.9 | | | | | | | | | | | | | | | | | | | |
| | 2-2.9 | | | | | | | | | 1.5 | | | | | | | | | | |
| | 1-1.9 | | | | | | | | | | | | | | | | | | | |
| | >0-0.9 | | | | | | | | | | | | | | | | | | | |
| | Clean | | 0 | | 0 | | 0 | | 0 | Clean | | 0 | | 0 | | 0 | | 0 | | 0 |
| | | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | |
| Rating | | | | | | | | | | | | | | | | | | | | |
| Location Factor | | 2 | | 3 | | 1 | | 3 | | 20 | | 20 | | 60 | | 0.5 | | 1 | | |
| Ind Rating | | | | | | | | | | | | | | | | | | | | |
| WDP | | | | TGC | | | | TLC | | | | Unweighted Deposits | | | | T. L. Flaked Carbon % | | | | |
| | | | | | | | | | | | | | | | | | | | | |

**Mack T-12 EGR Engine Oil Test
Form 20
Rating Summary: Piston #6**

| | | |
|--------------------------------|------------------------|---------------------|
| Laboratory: | EOT Date: | EOT Time: |
| Test Number: | | |
| Oil Code: | | |
| Formulation/Stand Code: | | |
| Date Rated: | Rater Initials: | Verified By: |

NOTE: Reporting of this information is NOT mandatory for T-12 Tests.

| Total Piston Ratings Summary | | | | | | | | | | | | | | | | | | | | |
|------------------------------|----------------|---------|------|-------|------|-------|------|-------|------|---------------------|--------|------|-------|-----------------------|-------|------|----------------|------|----------------|------|
| C a r b o n | Dep. Factor | Grooves | | | | Lands | | | | Dep. Factor | Groove | | Lands | | | | Oil Cooling | | Under Crown | |
| | | No. 1 | | No. 2 | | No. 1 | | No. 2 | | | No. 3 | | No. 3 | | No. 4 | | A, % | Dem. | A, % | Dem. |
| | | A, % | Dem. | A, % | Dem. | A, % | Dem. | A, % | Dem. | | A, % | Dem. | A, % | Dem. | A, % | Dem. | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | HC-1.0 | | | | | | | | | | | | | | | | | | | |
| | MC-0.5 | | | | | | | | | | | | | | | | | | | |
| | LC-.25 | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| V a r i s h | 8-9 | | | | | | | | | 7.5 | | | | | | | | | | |
| | 7-7.9 | | | | | | | | | | | | | | | | | | | |
| | 6-6.9 | | | | | | | | | | | | | | | | | | | |
| | 5-5.9 | | | | | | | | | 4.5 | | | | | | | | | | |
| | 4-4.9 | | | | | | | | | | | | | | | | | | | |
| | 3-3.9 | | | | | | | | | | | | | | | | | | | |
| | 2-2.9 | | | | | | | | | 1.5 | | | | | | | | | | |
| | 1-1.9 | | | | | | | | | | | | | | | | | | | |
| | >0-0.9 | | | | | | | | | | | | | | | | | | | |
| | Clean | | 0 | | 0 | | 0 | | 0 | Clean | | 0 | | 0 | | 0 | | 0 | | 0 |
| | | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | |
| Rating | | | | | | | | | | | | | | | | | | | | |
| Location Factor | | 2 | | 3 | | 1 | | 3 | | | 20 | | 20 | | 60 | | 0.5 | | 1 | |
| Ind Rating | | | | | | | | | | | | | | | | | | | | |
| WDP | | TGC | | | | TLC | | | | Unweighted Deposits | | | | T. L. Flaked Carbon % | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |

**Mack T-12 EGR Engine Oil Test
Form 21
Main Bearing Weight Loss**

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

| Position No. | Location | SOT Weight, g | EOT Weight, g | Weight Change, mg |
|--|----------|---------------|---------------|-------------------|
| 1 | Upper | | | |
| 2 | Upper | | | |
| 3 | Upper | | | |
| 4 | Upper | | | |
| 5 | Upper | | | |
| 6 | Upper | | | |
| 7 | Upper | | | |
| Upper Bearing Average Weight Loss, mg | | | | |
| Upper Bearing Weight Loss Std. Dev., mg | | | | |
| Upper Bearing Minimum Weight Loss, mg | | | | |
| Upper Bearing Maximum Weight Loss, mg | | | | |

| Position No. | Location | SOT Weight, g | EOT Weight, g | Weight Change, mg |
|--|----------|---------------|---------------|-------------------|
| 1 | Lower | | | |
| 2 | Lower | | | |
| 3 | Lower | | | |
| 4 | Lower | | | |
| 5 | Lower | | | |
| 6 | Lower | | | |
| 7 | Lower | | | |
| Lower Bearing Average Weight Loss, mg | | | | |
| Lower Bearing Weight Loss Std. Dev., mg | | | | |
| Lower Bearing Minimum Weight Loss, mg | | | | |
| Lower Bearing Maximum Weight Loss, mg | | | | |

**Mack T-12 EGR Engine Oil Test
Form 22
Ring Gap Measurements**

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

| Cylinder No. | Top Ring Gap, mm | | |
|----------------|------------------|-----|-----------------|
| | SOT | EOT | Delta (EOT-SOT) |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| Average | | | |

| Cylinder No. | 2 nd Ring Gap, mm | | |
|----------------|------------------------------|-----|-----------------|
| | SOT | EOT | Delta (EOT-SOT) |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| Average | | | |

| Cylinder No. | Oil Ring Gap, mm | | |
|----------------|------------------|-----|-----------------|
| | SOT | EOT | Delta (EOT-SOT) |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| Average | | | |

**Mack T-12 EGR Engine Oil Test
Form 23
T-10 Merits Calculated with T-12 Results**

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

| | Delta Pb@ EOT (ppm) | Avg Liner Wear (µm) | Avg Top Ring Weight Loss (mg) | Oil Consumption (g/h) | Delta Pb 250-300h (ppm) |
|--|--------------------------------|--------------------------------|--|--------------------------------------|--|
| T-12 Final Original Unit Result | | | | | |
| T-10 Mack Merits ^A | | | | | |
| Total T-10 Mack Merits ^A | | | | | |

^A Non-reference Tests only.

**Mack T-12 EGR Engine Oil Test
Form 24
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

Typed Name

Date

Title