

Mack T-13 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 = | 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 Kit ID: |
| 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 XXXX 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-13 Engine Oil Test
Form 2**

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**Mack T-13 EGR Engine Oil Test
Form 3
Summary of Test Method**

The Mack T-13 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, oxidation and nitration. This test is a single phase, steady state test (constant speed and load), run with heavy EGR.

The test engine is an in-line six-cylinder, four stroke Mack MP8 diesel engine with EGR and VGT. It has electronically controlled fuel injection with six individual electronic pumps. A 20 minute break-in is conducted prior to each test since a new engine build is used for each test.

Mack T-13 Test Conditions

| Parameter | |
|------------------------------|-----|
| Time, h | TBD |
| Speed, r/min | TBD |
| Torque, Nm | TBD |
| Fuel Flow, kg/h | TBD |
| Intake CO ₂ , % | TBD |
| Exhaust CO ₂ , % | TBD |
| Inlet Manifold Temp., °C | TBD |
| Coolant Out Temp., °C | TBD |
| Fuel In Temp., °C | TBD |
| Oil Gallery Temp., °C | TBD |
| Intake Air Temp., °C | TBD |
| Intake Air Restriction, kPa | TBD |
| Inlet Manifold Pressure, kPa | TBD |
| Exhaust Back Pressure, kPa | TBD |
| Crankcase Pressure, kPa | TBD |
| EGR Temp., °C | TBD |

**Mack T-13 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: | | | |
| EOT TBN: | Number of Tests Since Stand Calibration ^D : | | | | |
| | Delta Pb@ EOT (ppm) | Avg Liner Wear (µm) | Avg Top Ring Weight Loss (mg) | Oil Consumption (g/h) | Delta Pb TBD-TBD (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: | | |
| Stand Calibration Expiration Date | | | | | |
| | Delta Pb@ EOT (ppm) | Avg Liner Wear (µm) | Avg Top Ring Weight Loss (mg) | Oil Consumption (g/h) | Delta Pb TBD-TBD (ppm) |
| Final Original Unit Result | | | | | |

^A Reference Tests only.

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

^C Non-reference Tests only.

^D Operationally valid tests only, including current test.

**Mack T-13 EGR Engine Oil Test
Form 5
Operational Summary
Controlled Parameters**

| | | |
|-------------------------|-----------|-----------|
| 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 | RPM | 0.000 | | 1500 | | | | |
| | Torque | Nm | 0.000 | | 2200 | | | | |
| | Coolant Out Temp. | °C | 0.000 | | 110 | | | | |
| | Oil Gallery Temp. | °C | 0.000 | | 130 | | | | |
| | Inlet Air Temp. | °C | 0.000 | | 30 | | | | |
| | Inlet Manifold Temp. | °C | 0.000 | | 78 | | | | |
| | EGR Gas Out Temp | °C | 0.000 | | 120 | | | | |
| | Fuel In Temp. | °C | 0.000 | | 35 | | | | |
| | Inlet Air Pressure | kPaA | 0.000 | | 94 | | | | |
| Exh. Back Pressure | kPaA | 0.000 | | 115.3 | | | | | |
| Inlet Man. Pressure | kPaG | 0.000 | | 232±5 | | | | | |
| Intake CO2 | % | 0.000 | | 2.06±0.05 | | | | | |

A Q1 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.

**Mack T-13 EGR Engine Oil Test
Form 6
Operational Summary
Non-Controlled Parameters**

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

| | Parameter | Units | Typical Values ^A | Average |
|----------------------------------|---------------------------|-------|-----------------------------|---------|
| Non-Controlled Parameters | Fuel Flow | kg/h | TBD | |
| | Exhaust CO2 | % | TBD | |
| | Coolant In Temp | °C | TBD | |
| | Crankcase Pressure | kPa | TBD | |
| | Pre-Turbine Temp. (F) | °C | TBD | |
| | Pre-Turbine Temp. (R) | °C | TBD | |
| | Tailpipe Temp. | °C | TBD | |
| | Main Gallery Oil Pressure | kPa | TBD | |
| | Oil Sump Temp. | °C | TBD | |
| | Oil Jet Temp. | °C | TBD | |
| | Oil Jet Pressure | kPa | TBD | |
| | Fuel Gallery Temp | °C | TBD | |
| | Fuel Gallery Pressure | kPa | TBD | |
| | Intercooler Out Temp | °C | TBD | |
| | Intercooler Out Pressure | kPa | TBD | |
| | Compressor Out Temp | °C | TBD | |
| | Compressor Out Pressure | kPa | TBD | |
| | Room Temp | °C | TBD | |
| | EGR Position | % | TBD | |
| | VGT Position | % | TBD | |
| Throttle Position | % | TBD | | |
| Blowby | L/min | TBD | | |
| Inlet Air Dew Point | °C | TBD | | |

^A Typical values determined from reference oil test database

**Mack T-13 EGR Engine Oil Test
Form 7
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 | | | | |

| | |
|-------------------------|--|
| Rod Bearings ID - Upper | |
| Rod Bearings ID - Lower | |

**Mack T-13 EGR Engine Oil Test
Form 8
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 | | | | |

| | |
|--------------------------|--|
| Main Bearings ID - Upper | |
| Main Bearings ID - Lower | |

**Mack T-13 EGR Engine Oil Test
Form 9
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-13 EGR Engine Oil Test
Form 10
Ring Gap Measurements**

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

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

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

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

| | |
|-------------------------|--|
| Top Ring ID | |
| 2 nd Ring ID | |
| Oil Ring ID | |

**MACK T-13 EGR Engine Oil Test
Form 12
Oil Analysis Summary - Continued**

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

| Hours | Metal Elements (ppm) | | | | | | | | |
|-------|----------------------|----|----|----|----|----|----|----|----|
| | Fe | Pb | Cu | Cr | Al | Si | Sn | Na | Ni |
| | | | | | | | | | |
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| | | | | | | | | | |
| | | | | | | | | | |

| Summary | As Measured | Outlier Bearing Adjusted |
|---------------------|-------------|--------------------------|
| Delta Pb @ EOT, ppm | | |
| Delta Pb ppm | | |

**Mack T-13 EGR Engine Oil Test
Form 14
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-13 EGR Engine Oil Test
Form 15
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.

| | |
|----------|--|
| Liner ID | |
|----------|--|

**Mack T-13 EGR Engine Oil Test
Form 16
Downtime Summary**

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

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

**Mack T-13 EGR Engine Oil Test
Form 18
Rating Summary
ASTM Deposit Ratings ^A**

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

NOTE: Reporting of this information is NOT mandatory for T-13 Tests.

| Piston No. | WDP | TGC | TLC | Unweighted Deposits | T. L. Flaked Carbon % |
|------------|-----|-----|-----|---------------------|--------------------------|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |

^A Rating values determined per ASTM Deposit Rating Manual 20

**Mack T-13 EGR Engine Oil Test
Form 19
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-13 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 | |
| | 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-13 EGR Engine Oil Test
Form 20
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-13 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-13 EGR Engine Oil Test
Form 21
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-13 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-13 EGR Engine Oil Test
Form 22
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-13 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-13 EGR Engine Oil Test
Form 23
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-13 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 | |
| | 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-13 EGR Engine Oil Test
Form 24
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-13 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-13 EGR Engine Oil Test
Form 25
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% Residuam, % | 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 | 460 | | | 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-13 EGR Engine Oil Test
Form 26
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