

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:	Stand 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 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					
	Delta Pb@ EOT (ppm)	Avg Liner Wear (µm)	Avg Top Ring Weight Loss (mg)	Oil Consumption (g/h)	Delta Pb (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-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				
	Load	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				

Conrod Bearing Batch ID	
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**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 Bearing Batch ID	
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**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		
	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-13 EGR Engine Oil Test
Form 13
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 14
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-13 EGR Engine Oil Test
Form 17
Build-up and Hardware Information**

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

Hardware

Part	Part Number	Serial Number
Turbocharger		
Cylinder Head		
Pistons		
Injectors		
Top Ring		
2 nd Ring		
Oil Ring		
Main Bearings - Upper		
Main Bearings - Lower		
Rod Bearings - Upper		
Rod Bearings - Lower		
Camshaft Bearings		
Camshaft Thrust Bearings		
Liners		

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

**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:		
Date Rated:	Rater Initials:	Verified By:

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
Volvo Piston Rating Summary ^A**

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.

Piston Deposit Rating Summary							
Segment	Piston No.						Merit AVG
	1	2	3	4	5	6	
1st groove							
2nd groove							
3rd groove							
Crown Land							
2nd land							
3rd land							
2G / 2L average							
1G / 2G / 2L average							

^A Rating values determined per Volvo Rating Method

**Mack T-13 EGR Engine Oil Test
Form 20
Bore Polish and Ring Riding Summary**

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

Bore Polish Assessment (Visual Inspection)							
	Piston Number						
Bore Polish (cm ²):	1	2	3	4	5	6	Total
Primary (A)							
Secondary (B)							
Total							
Assessment Area (cm ²)	From the upper edge of the top ring position at TDC down to 150 mm from the top of the liner. Total area 617 cm ² .						

Ring-Riding (%)							
Totals	Piston No.						
	1	2	3	4	5	6	AVG
1st groove (%)							
2nd groove (%)							
3rd groove (%)							

**Mack T-13 EGR Engine Oil Test
Form 21
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% Residuuum, %	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-13 EGR Engine Oil Test
Form 22
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