#### ISM Lubricant Performance Test

# Report Packet Version No.

#### Method

# **Conducted For:**

	V =	Valid; The reference the test procedure.	ce oil / n	on-reference oil was ev	aluated in accordance with		
	I =	· · · · · · · · · · · · · · · · · · ·		non-reference oil was n	ot evaluated in accordance		
	1 -	with the test proced					
	Results cannot be interpreted as representative of oil performance (non- N = reference oil) and shall not be used in determining an average test result using						
	N = reference oil) and shall not be used in determining an average test result using multiple test criteria.						
		multiple test effecti	.a.				
	$\overline{NR = No}$	n-Reference Oil Test	t				
	RO = Ret	ference Oil Test					
			Test Nu	ımber			
Stand:		Engine:		Engi	ne Run No.:		
End Of Test Date	<b>e</b> :			End Of Test Time:			
Oil Code:							
Formulation/Stan	nd Code:						
Alternate Codes							
In many ominion th	44	haan a	معمدات معمدا	in a scalid mannan in a	accordance with Test Method		
In my opinion th					em. The remarks included in		
		nomalies associated v			em. The remarks included in		
uns report deserr	oc the an	omanes associated v	vitii tiiis	iost.			
	Sub	omitted By:					
					Testing Laboratory		
					Cianatura		
					Signature		
					Typed Name		

Title

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#### ISM Lubricant Performance Test Form 3 Summary Of Test Method

The ISM Lubricant Performance Test is an engine-dynamometer test which evaluates the ability of a lubricant to minimize crosshead wear, filter plugging and sludge build-up. This test is a two-stage, steady state test (constant speed and load). Stage A is 50 hours and is run with retarded fuel injection timing to produce elevated soot levels in the oil. Stage B is 50 hours and is run under heavy load conditions to induce wear. The stages are run in sequence (Stage A followed by Stage B) twice for a total test length of 200 hours.

The test engine is a Cummins ISM diesel engine with EGR. It is an in-line six cylinder, four-stroke, turbocharged engine with electronically controlled fuel injection. A two-h break-in is conducted prior to each test since a new engine build is used for each test.

#### **ISM Test Conditions**

Parameter	Stage A	Stage B
Time, h	50	50
Injection Timing, °BTDC	Variable	Variable
Speed, r/min	1800	1600
Fuel Flow, kg/h	58.0	64.4
Intake CO 2%	0.97 - 1.09	0.97 - 1.09
Inlet Manifold Temp., °C	80	65.5
Coolant Out Temp., °C	65.5	65.5
Fuel In Temp., °C	40	40
Oil Gallery Temp., °C	115	115
Intake Air Temp., °C	Record	Record
Intake Air Pressure, kPa absolute	Record	Record
Intake Manifold Pressure, kPa absolute	300 Minimum	320 Minimum
Exhaust Back Pressure, kPa absolute	107	107
Crankcase Pressure, kPa	Record	Record
Coolant System Pressure, kPa	99 - 107	99 - 107
Power, kW	Record	Record
Torque, Nm	Record	Record
Pre-turbine Exhaust Temp., °C	Record	Record
Tailpipe Exhaust Temp., °C	Record	Record
Oil Sump Temp., °C	Record	Record
Inlet Air Dew Point, °C	Record	Record
Inlet Air Humidity, kg/kg	Record	Record
Oil Gallery Pressure, kPa	Record	Record
Oil Filter Delta P, kPa	Record	Record

# **ISM Lubricant Performance Test** Test Results Summary Form 4

Test Number	Laboratory:		EOT Date:			ЕОТ	Time	<del></del>	
Date Test Started			•						
Date Test Started Start Time Test Length TMC Oil Code A Laboratory Oil Code SAE Viscosity TGA Soot % At 50 h TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg) Criginal Result Transformed Result Test Number Oil Code Test Length TMC Oil Code Test Length TMC Oil Code TGA Soot % At 150 h Average Sludge Rating (merits) Test Number  Injector Adjustment Test Number Oil Code Test Length TMC Oil Code Test Length TMC Oil Code TGA Soot % At 50 h TGA Soot % At 50 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Tiller Plugging The Plugging Rating The Plugg	Formulation/	Stand Code:							
Start Time Test Length TMC Oil Code A Laboratory Oil Code SAE Viscosity TGA Soot % At 50 h TOGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg) Original Result Transformed Result B Corrected Transformed Result Filter Plugging Delta P (kPa)  Average Sludge Rating (mcrits)  Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Transformed Result Filter Plugging Delta P (kPa)  Average Sludge Rating (mcrits)  Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P (kPa)  Average Sludge Rating (mcrits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P (kPa)  Average Sludge Rating (mcrits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	Oil Code:			En	gine Kit	S/N:			
Start Time Test Length TMC Oil Code A Laboratory Oil Code SAE Viscosity TGA Soot % At 50 h TOGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg) Original Result Transformed Result B Corrected Transformed Result Filter Plugging Delta P (kPa)  Average Sludge Rating (mcrits)  Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Transformed Result Filter Plugging Delta P (kPa)  Average Sludge Rating (mcrits)  Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P (kPa)  Average Sludge Rating (mcrits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P (kPa)  Average Sludge Rating (mcrits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)				•					
Test Length TMC Oil Code A Laboratory Oil Code SAE Viscosity TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg) Original Result Transformed Result Transformed Result Transformed Result Transformed Result Test Number Oil Code Test Length TMC Oil Code EOT Date EOT Time Stand Calibration Expiration Date TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Tilter Plugging Delta P (kPa) Tilter Plugging Maverage Sludge Rating (merits)  Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Tilter Plugging Delta P (kPa) Tilter Plugging Maverage Sludge Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Total Oil Code Test Length TMC Oil Code TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Total Oil Consumption, kg  Tilter Plugging Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	Date Test Sta	arted							
TMC Oil Code   Laboratory Oil Code   SAE Viscosity   TGA Soot % At 50 h   TGA Soot % At 50 h   TGA Soot % At 150 h   Average TGA Soot % 0 - 200 h   Total Oil Consumption, kg   Tilter Plugging Delta P (kPa)   Average Sludge Rating (merits)   Average Sludge Screw Mass Loss Adjusted to 3.9% Soot (mg)   Average Sludge Rating (mg)   Average Sludge Rating (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)   Injecto	Start Time								
Laboratory Oil Code   SAE Viscosity   TGA Soot % At 50 h   TGGA Soot % At 150 h   Average TGA Soot % 0 - 200 h   Total Oil Consumption, kg   Crosshead Mass Loss Adjusted to 3.9% Soot (mg)   Consumption Result   B   Corrected Transformed Result   Corrected Transfor									
SAE Viscosity TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Original Result Transformed Result Transformed Result Transformed Result Tinal Tran	TMC Oil Co	de <sup>A</sup>							
TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Original Result  Transformed Result  Transformed Result  Tensformed Result  Final Transformed Result  Final Transformed Result  Final Transformed Result  Corrected Transformed Result  Final Transformed Result  Final Transformed Result  Corrected Transformed Result  Severity Adjustment  Final Transformed Result  Final Transformed Result  Corrected Transformed Result  Severity Adjustment  Final Transformed Result  Final Transformed Result  Corrected Transformed Result  Final Transformed Result  Injector Adjusting Screw Mass Loss Adjusted to 3,9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3,9% Soot (mg)	Laboratory C	Oil Code							
TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg    Crosshead Mass Loss Adjusted to 3.9% Soot (mg)	SAE Viscosi	ty							
Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Original Result  Transformed Result  Tensformed Result  Corrected Transformed Result  Final Result  Tensformed Result  Everative Adjustment  Everative Adjustmen	TGA Soot %	At 50 h							
Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Original Result  Transformed Result  Transformed Result  Torrection Factor  Corrected Transformed Result  Final Transformed Result  Final Result  Test Number Oil Code  Test Length  TMC Oil Code  EOT Date  EOT Date  EOT Date  EOT Time  Stand Calibration Expiration Date  TGA Soot % At 50 h  TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Filter Plugging (merits)  Filter Plugging (merits)  Filter Plugging (merits)  Average Sludge Rating (merits)  Average Sludge Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	TGA Soot %	At 150 h							
Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Original Result  Transformed Result  Transformed Result  Correction Factor  B Corrected Transformed Result  Severity Adjustment  Final Transformed Result  Final Result  Last Stand Reference Results  Test Number  Oil Code  Test Length TMC Oil Code  EOT Date EOT Date EOT Time Stand Calibration Expiration Date  TGA Soot % At 50 h TGA Soot % At 50 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P (kPa)  Filter Plugging Average Sludge Rating (merits)  Average Sludge Average Sludge Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)									_
Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Original Result  Transformed Result  Transformed Result  Correction Factor  Severity Adjustment  Final Transformed Result  Test Number Oil Code Test Length TMC Oil Code EOT Date EOT Time Stand Calibration Expiration Date  TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P (kPa)  Filter Plugging (merits)  Average Sludge Rating (merits)  Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)  Average Sludge Rating Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	Total Oil Con	nsumption, kg							
Original Result Transformed Resu			Loss Adjusted to 3.9% Soot	Delt	a P	]	Ratin	g	Adjusting Screw Mass Loss Adjusted to
Correction Factor B Corrected Transformed Result B Severity Adjustment B Final Transformed Result B Final Result  Last Stand Reference Results  Test Number Oil Code Test Length TMC Oil Code EOT Date EOT Time Stand Calibration Expiration Date TGA Soot % At 50 h TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Crosshead Pass of Soot (mg)  Correction Factor B Correction Factor B Corrected Transformed Result B Corrected T	Original Resi	ult		,		,			, <b>U</b>
Corrected Transformed Result B Severity Adjustment B Final Transformed Result B Final Result  Last Stand Reference Results  Test Number Oil Code Test Length TMC Oil Code EOT Date EOT Time Stand Calibration Expiration Date  TGA Soot % At 50 h TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)									
Severity Adjustment B Final Transformed Result B Final Result  Last Stand Reference Results  Test Number Oil Code Test Length TMC Oil Code EOT Date EOT Time Stand Calibration Expiration Date TGA Soot % At 50 h TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)		actor							
Final Transformed Result B  Final Result  Last Stand Reference Results  Test Number  Oil Code  Test Length  TMC Oil Code  EOT Date  EOT Time  Stand Calibration Expiration Date  TGA Soot % At 50 h  TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P (kPa)  Average Sludge Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	Corrected Tra	ansformed Result B							
Test Number Oil Code Test Length TMC Oil Code EOT Date EOT Time Stand Calibration Expiration Date TGA Soot % At 50 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Characteristics (Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Characteristics (Mass Loss Adjusted to 3.9% Soot (mg)									
Test Number Oil Code Test Length TMC Oil Code EOT Date EOT Time Stand Calibration Expiration Date TGA Soot % At 50 h TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Reference Results  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	Final Transfo	ormed Result B							
Test Number Oil Code  Test Length TMC Oil Code  EOT Date  EOT Time Stand Calibration Expiration Date  TGA Soot % At 50 h  TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  KPA)  Average Sludge Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	<b>Final Result</b>								
Test Number Oil Code  Test Length TMC Oil Code  EOT Date  EOT Time Stand Calibration Expiration Date  TGA Soot % At 50 h  TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  KPA)  Average Sludge Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)			Last Stand Re	ference F	Results				
Oil Code Test Length TMC Oil Code EOT Date EOT Time Stand Calibration Expiration Date TGA Soot % At 50 h TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	Test Number								
TMC Oil Code  EOT Date  EOT Time  Stand Calibration Expiration Date  TGA Soot % At 50 h  TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	Oil Code								
EOT Date EOT Time Stand Calibration Expiration Date TGA Soot % At 50 h TGA Soot % At 150 h Average TGA Soot % 0 - 200 h Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Average Sludge Rating (merits)  Average Sludge Screw Mass Loss Adjusted to 3.9% Soot (mg)	Test Length		•						
EOT Time Stand Calibration Expiration Date  TGA Soot % At 50 h  TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Average Sludge Rating (merits)  Average Sludge Rating (mg)	TMC Oil Cod	le							
Stand Calibration Expiration Date  TGA Soot % At 50 h  TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P Rating Adjusted to 3.9% Soot (mg)  (mg)  Average Sludge Rating Adjusted to 3.9% Soot (mg)	EOT Date								
TGA Soot % At 50 h  TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (mg)	EOT Time								
TGA Soot % At 150 h  Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P Rating (merits)  Average Sludge Rating Adjusted to 3.9% Soot (mg)	Stand Calibra	tion Expiration Date							
Average TGA Soot % 0 - 200 h  Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Delta P Rating (merits)  Average Sludge Rating Adjusted to 3.9% Soot (mg)									
Total Oil Consumption, kg  Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Average Sludge Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (merits)	TGA Soot %	At 150 h							
Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Average Sludge Rating (merits)  Injector Adjusting Screw Mass Loss Adjusted to 3.9% Soot (merits)	Average TGA	Soot % 0 - 200 h							
Crosshead Mass Loss Adjusted to 3.9% Soot (mg)  Filter Plugging Average Sludge Rating (merits)  Adjusted to 3.9% Soot (kPa)  Average Sludge Rating (merits)	Total Oil Con	sumption, kg							
	Final Result	Adjusted to 3.9% So	% Soot Delta P Rating			ating	lge	Sci	rew Mass Loss sted to 3.9% Soot

<sup>&</sup>lt;sup>A</sup> Reference Tests Only <sup>B</sup> Filter Plugging Delta P Value in Transformed Units

#### **ISM Lubricant Performance Test** Form 5 **Operational Summary**

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

Controlled Parameters	Parameter	Units	QI Threshold	EOT QI <sup>A</sup>	Tar			Ave	erage	Samples B	<b>BQD</b> <i>C</i>	Over/Under Range D
lan	Speed	r/min	0.000		1800	1600						
Paı	Fuel Flow	kg/h	0.000		58.0	64.4						
led	Coolant Out	°C	0.000		65.							
rol	Fuel In	°C	0.000		4(	)						
ont	Oil Gallery	°C	0.000		11							
	Intake Manifold	°C	0.000		80.0	65.5						
	Exhaust	kPa	0.000		10	7						
	Parameter	Units	Typica	l Values <sup>E</sup>			Aver	age				
	Torque	N-m	TBD	TBD								
	Power	kW	TBD	TBD								
Ľ	Intake CO <sub>2</sub>	%	0.97 - 1.09	0.97 - 1.09								
Non-controlled Parameters	Blowby	L/min	Γ	TBD								
ran	Coolant In	°C	Γ	TBD								
Pa	Intake Air	°C	Γ	TBD								
lled	Pre-Turbine	°C	Γ	TBD								
tro	Tailpipe	°C	Γ	TBD								
con	Fuel	kPa	Γ	TBD								
on-	Oil Gallery	kPa	Т	TBD								
Z	Coolant	kPa	99	- 107								
	Intake Manifold	kPa	Γ	TBD								
	Crankcase	kPa	Γ	TBD								
	Intake Air	kPa	7	TBD					_			

A QI values above the threshold are acceptable by the Cummins Surveillance Panel. QI values below the threshold may not be considered acceptable based on an engineering review. See the comments section of this report.

Total number of data points taken

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

Number of points clipped by over/under range limits

Typical values determined from reference oil test database

## ISM Lubricant Performance Test Form 6 Crosshead Mass Loss Summary

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

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

	Inta	Intake		aust
Intake / Exhaust Summary	As Measured	Outlier Screened	As Measured	Outlier Screened
Average Crosshead Mass Loss (mg)				
Minimum Crosshead Mass Loss (mg)				
Maximum Crosshead Mass Loss (mg)				
Standard Deviation (mg)				
Outlier Crossheads Locations <sup>A</sup>				

<sup>&</sup>lt;sup>A</sup> Location Designation. Example: 3E

			Adjusted to 3.9%
Overall Summary	As Measured	Outlier Screened	Soot
Average Crosshead Mass Loss (mg)			
Minimum Crosshead Mass Loss (mg)			
Maximum Crosshead Mass Loss (mg)			
Standard Deviation (mg)			

#### ISM Lubricant Performance Test Form 7 Oil Filter Delta Pressure Plot

Laboratory:	EOT Date:	EOT Time:	
Test Numbe	er:	·	
Formulation	n/Stand Code:		
Oil Code:			
	OIL FILTER DELT	TA PRESSURE vs TEST HOURS	1
OIL FILTER DELTA P (kPa)			

**TEST HOURS** 

#### ISM Lubricant Performance Test Form 8 Sludge Rating Summary

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

# **Sludge Rating Summary**

Sludge Depth	Valve Cover % of Area	Valve Cover Volume Factor	Oil Pan % of Area	Oil Pan Volume Factor
1/4A				
1/2A				
3/4A				
A				
AB				
В				
BC				
С				
D				
Е				
F				
G				
Н				
I				
J				
	Total Volume Factor:		Total Volume Factor:	
	Merit Rating:		Merit Rating:	
			Average Sludge Ratio	ng:

# ISM Lubricant Performance Test Form 9 Ring Mass Loss Summary

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

		Top Ring		Second Ring			Oil Ring		
	Mas	s (g)	Mass Loss	Mas	s (g)	Mass Loss	Mas	s (g)	Mass Loss
Cylinder	Pretest	EOT	(mg)	Pretest	EOT	(mg)	Pretest	EOT	(mg)
1									
2									
3									
4									
5									
6									
				As Meası	ired Results				
Average M	ass Loss (mg)								
Std. Dev. M	lass Loss (mg)								
Maximum	Mass Loss (mg	)							
Minimum Mass Loss (mg)									
Outlier Top Ring (cylinder number)									
Outlier Screened Results									
Average Mass Loss (mg)									

#### ISM Lubricant Performance Test Form 10 Oil Analysis Summary

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

Test Hours	Viscosity @ 100°C, cSt	TGA % Soot	TBN D4739	TAN D664	Copper (ppm)	Iron (ppm)	Lead (ppm)	Aluminum (ppm)	Chromium (ppm)
NEW									

# ISM Lubricant Performance Test Form 11 Test Fuel Applysis (Lest Ratch)

<b>Test Fuel</b>	<b>Analysis</b>	(Last Batch	)
		(	,

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

Fuel Supplier	Fuel Batch Identifier	

		Analysis			
Measurement	Specifications	New	EOT	Test Method	
Total Sulfur, % Weight	0.04 - 0.05			D 2662	
Gravity, °API	34.5 - 36.5			D 1298	
Hydrocarbon Composition					
Aromatics % Volume	28 - 33			D 1319	
Olefin	Report			D 1319	
Cetane Index	Report			D 4737	
Cetane Number	42 – 48			D 613	
Copper Strip Corrosion	1 Maximum			D 130	
Flash Point, °C	54 Maximum			D 93	
Pour Point, °C	-18 Maximum			D 97	
Carbon Residue on 10% Residuum, %	0.35 Maximum			D 524	
,	0.05 Maximum			(10% Bottoms) D 2709	
Water & Sediment, % Volume				1 11	
Viscosity, cSt @ 40 °C	2.4 - 3.0 0.05 Maximum			D 445	
Total Acid Number				D 664	
Strong Acid Number	0.00 Maximum			D 664	
Accelerated Stability	Tbd			D 2274	
Saturates, %	Report			D 1319	
Cloud Point, °C	Report			D 2500	
Distillation, °C					
IBP	Report			D 86	
10%	Report			D 86	
50%	Report			D 86	
90%	282 – 338			D 86	
EP	Report			D 86	

# ISM Lubricant Performance Test Form 12 Injector Adjusting Screw Mass Loss

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

Screw#	Pretest Mass, g	Post-Test Mass, g	Mass Loss, mg
1			
2			
3			
4			
5			
6			
		Total Mass Loss, mg	
Injector Adjusting Sc	rew Mass Loss Summary	As Measured	Outlier Screened
Average			
Standard Deviation			
Minimum			
Maximum			
Outlier Inj. Adj. Screw	A		
A	verage Adjusted to 3.9% S	oot	

<sup>&</sup>lt;sup>A</sup> Location Designation. Example: 3

# **ISM Lubricant Performance Test** Form 13

Unscheduled	<b>Downtime</b>	& Maintenance	Summary

Laboratory: EOT Date: EOT Time:							
Laboratory:		E	OT Date: EOT Time:				
Test Number:							
Formulation/Stand Code:							
Oil Code:							
Number of D	owntime Oc	currences					
Test Hours	Date	Downtime	Reasons				
Total Downtime (hours)							
Other	Comments						
	Comment L	ines					
		L.					

## ISM Lubricant Performance Test Form 13a Unscheduled Downtime & Maintenance Summary

Laboratory		E	OT Date: EOT Time:				
Test Number:							
Formulation/Stand Code:							
Oil Code:							
Number of <b>D</b>	Downtime Oc	currences					
Test Hours Date Downtime			Reasons				
Total Downtime (hours)							
Other	Comments						
Number of	f Comment L	ines					
		·					

## ISM Lubricant Performance Test Form 13b Unscheduled Downtime & Maintenance Summary

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

umber of Downtime Occurrences		ccurrences		
Test Hours	Date	Downtime	Reasons	
			Total Downtime (hours)	

Other Comments	
Number of Comment Lines	
	•

#### ISM Lubricant Performance Test Form 14 Characteristics Of The Data Acquisition System

Laboratory:	EOT Date:	EOT Time:			
Test Number:					
Formulation/Stand Code:					
Oil 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							
Pressure							
Inlet Air							
Exhaust							
Oil Gallery							
Other							
Fuel Flow							
Speed							
Load							

#### 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
  - DL Automatic data logger
  - C/D Computer, using direct I/O entry
- (5) Data are observed but only recorded if 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

#### ISM Lubricant Performance Test Form 15

# American Chemistry Council Code of Practice Test Laboratory Conformance Statement

Test Laboratory							
Test Sponsor							
Formulation/Stand Code							
Test Number							
Start Da	te	Start Time	Time Zo	ne			
		Declarations					
No. 1		the ACC Code of Practice uct of this test. Yes		tory	is responsible		
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 deviation 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 Co	onclusion				
		review of this test indicate Acceptance Criteria calcul		be i	ncluded in the		
*Operational review of this test indicates that the results should not be include Multiple Test Acceptance Criteria calculations.							
Note: Sup	oporting comments are	required for all responses	identified with an asterisk	•			
		Comments					
					_		
Signature	<del>,</del>		Date				
Typed Na	ame		Title				