

# **Detroit DD13 Taskforce Agenda**

## **Meeting Minutes**

**Friday March 1, 2013**

### **Attendance**

Bob Campell, John Cruz, Mesfin Belay, Bob Salgueiro, Jim Gutzwiller, Pat Fetterman, Brad Carter, Chris Castanien, Jim Matasic, Allison Athey, Jim Rutherford, Mark Cooper, Addison Schweitzer, Andy Broff, Jim McCord, Scott Richards, Sean Moyer, Mark Sutherland, Jim Linden, Chris Cauley, Elisa Santos

### **Agenda**

Jim Matasic reviewed the agenda for the meeting.

### **Previous Test Review**

Jim reviewed information about the previous test completed by LZ. Discussion about the oil used, Non-coated vs. coated rings and the test cycle that was run. There was a question about whether there was evidence of oil breakdown and it was stated that there was no data yet. Noted that copper levels were somewhat higher and believed to be from the camshaft bushing area. Reviewed wear data and pictures of all 6 cylinder liners and scuffing of cylinder 4 liner.

### **Current Test Review**

Jim Matasic presented information on currently running test. Crankcase pressure comparison between previous test and current test presented. There was discussion about why the CCP was "jumping around" less during certain portions of the test. Attributed to throttle position during those test points. Question about controlling oil temp. LZ is not controlling oil temp during testing and has not noted a temp difference between tests. It was noted that difference in labs may drive control of oil temp. A question was asked about live thermostats and they are being used; however the coolant thermostat is blocked open.

The current test outline, cycle and operating conditions were reviewed.

There was a question about torque differences between tests due to engine build variations. There has not be a significant difference between the tests. The possibility of using throttle, torque or fuel control was put forward and will be discussed once the test has matured.

A question was asked about minimum oil pressure. The current test minimum oil pressure is 145kPa. The previous test minimum was 115 kPa but it was noted that that test only ran for 39 hours. Detroit was asked what the minimum oil pressure spec was. It wasn't known but will be provided. So far LZ has seen no engine fault codes due to low oil pressure and said that they intend to compare stand measured values to ECU reported values.

### **Hardware Update**

There was an update about new cylinder liners to be used in all tests going forward. Current liners are being phased out of production. The plan is to switch as soon as possible and lock the hardware in going forward. The only difference is that the new liners incorporate a carbon scraper ring. Liners are made of exact same material.

There was a question about availability of engines for other labs. The plan is still to have engines at other labs before the end of Q1.

### **General Discussion**

There was a question to clarify the poor and good 2.9 HTHS oils. The good 2.9 HTHS has improved wear characteristics over the poor 2.9 HTHS oil but does not necessarily represent a passing oil. The CJ4 15W-40 is a commercially available oil and the two 2.9 HTHS oils are both based on commercial oils but are internal formulations.

It was asked whether there has been any effort to obtain the bad 2.9 HTHS field oil. LZ indicated they are still working to get it from the supplier.

# *Lubrizol* DD13 Taskforce

3-1-13

## Topics

- Previous Test Information
- Analytical Data
- Wear Data
- Photos
- Current Test
- Test Outline
- Test Cycle
- Operating Conditions
- New hardware

## Previous Test Information

- Used LZ “Poor” 2.9HTHS oil
- Non-Coated Top Rings
- Used Detroit “Scuffing” MCM Calibration
- Ran Scuffing Test Cycle
- Test ran for 39 hours
  - Shutdown due to increase in Blowby Flow/ Crankcase Pressure
    - Began increasing at 25hrs when test went to 75% throttle
  - Found Cylinder #4 scuffed

# Analytical Data

- Only NEW and 20HR samples due to short test duration
- Future samples will be every 25hrs

	TGA	KIN_VISC	KIN_VISC	90 pass shear	Al	Cr	Cu	Fe	Na	Si	Sn	TBN	TAN
0	0.05	9.42	53.22	9.06	0	0	0	2	0	7	0	7.13	3
20	0.15	10.02	57.2		0	2	36	28	2	7	2	6.73	2.9

# Wear Data

		1	2	3	4	5	6
<b>TOP RING</b>	SOT , g	40.3138	40.3055	40.2272	40.2283	40.3059	40.2603
<b>WEIGHTS</b>	EOT , g	40.3086	40.3038	40.2206	31.6834	40.3041	40.2542
	Weight loss, mg	5.2	1.7	6.6	8544.9	1.8	6.1
		1	2	3	4	5	6
<b>2ND RING</b>	SOT , g	30.1777	30.3029	29.8849	30.0211	30.2041	30.1636
<b>WEIGHTS</b>	EOT , g	30.1775	30.3014	29.8841	29.9423	30.2030	30.1617
	Weight loss, mg	0.2	1.5	0.8	78.8	1.1	1.9
		1	2	3	4	5	6
<b>OIL RING</b>	SOT , g	18.5869	18.2541	18.2716	18.3234	18.2782	18.5097
<b>WEIGHTS</b>	EOT , g	18.5850	18.2521	18.2704	18.2732	18.2768	18.5063
	Weight loss, mg	1.9	2.0	1.2	50.2	1.4	3.4

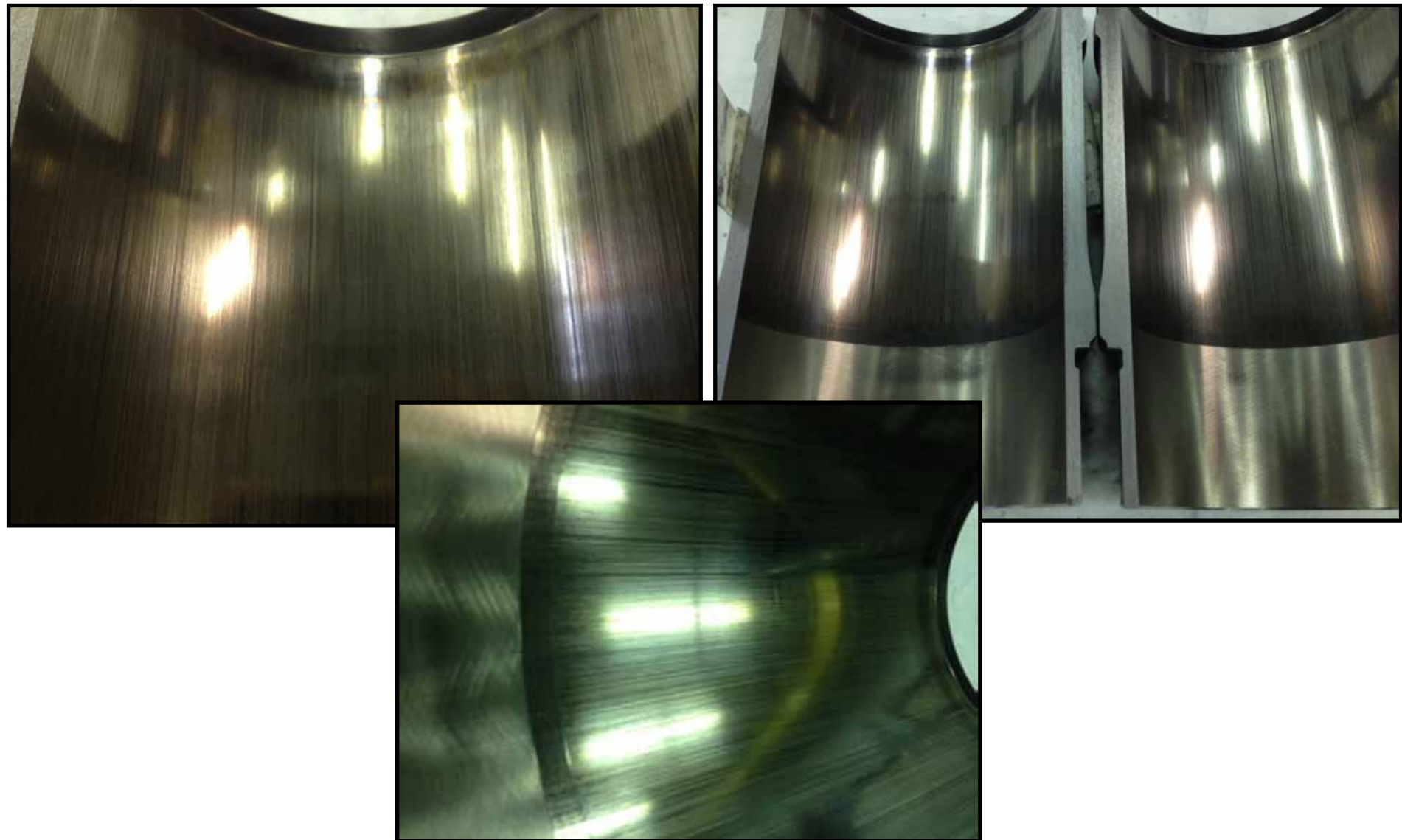
Due to low amount of test hours we did not get into any further measurements.

<b>Upper Rod Bearing</b>	1	2	3	4	5	6
SOT-pretest, g	108.7389	108.8794	108.8053	108.9391	108.8181	108.9078
EOT-post test, g	108.7311	108.8730	108.7979	108.9324	108.8122	108.9006
Weight loss, mg	7.8	6.4	7.4	6.7	5.9	7.2
<b>Lower Rod Bearing</b>	1	2	3	4	5	6
SOT-pretest, g	97.2446	95.6114	96.1166	96.1267	96.2391	96.4725
EOT-post test, g	97.2443	95.6113	96.1159	96.1261	96.2383	96.4721
Weight loss, mg	0.3	0.1	0.7	0.6	0.8	0.4

### Cylinder Liner Wear Step

Cylinder #4 was 200 microns. All others were less than 1 micron.

# Cylinder #4

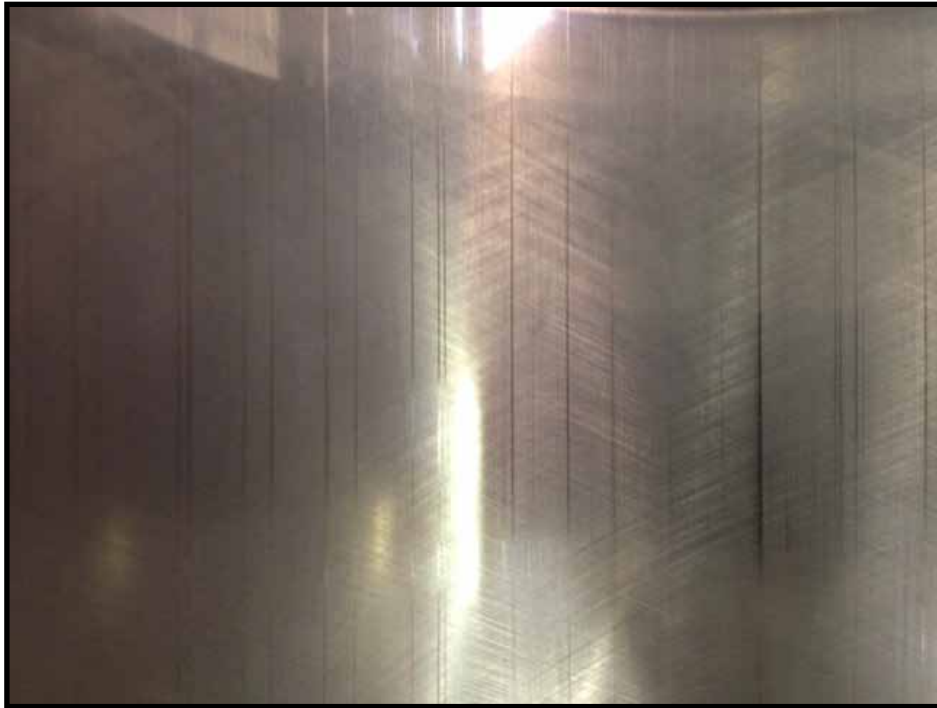




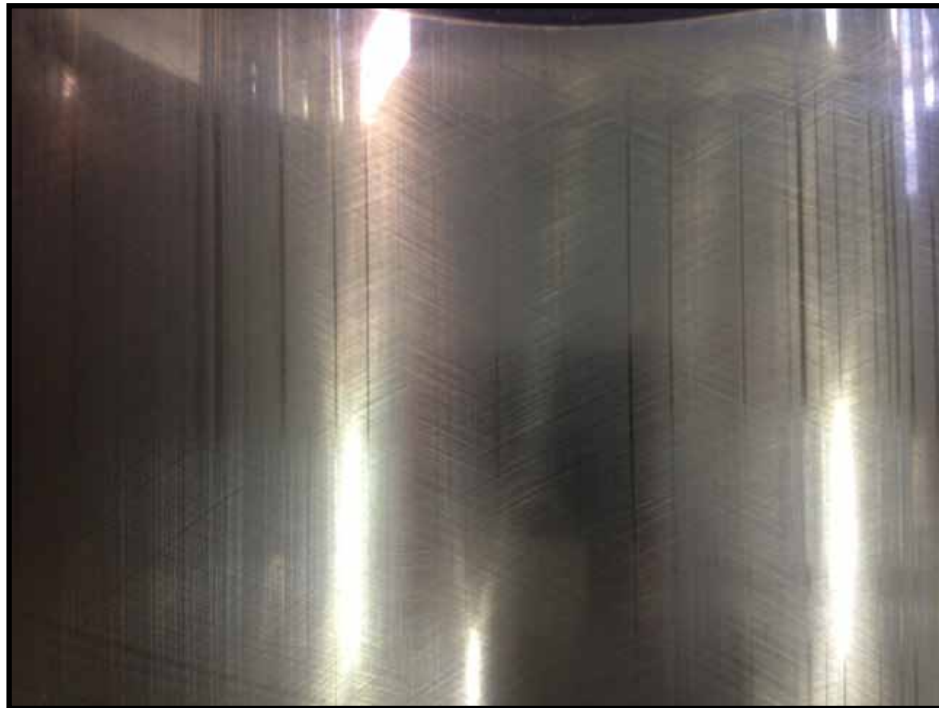
# Cylinder #1



# Cylinder #2



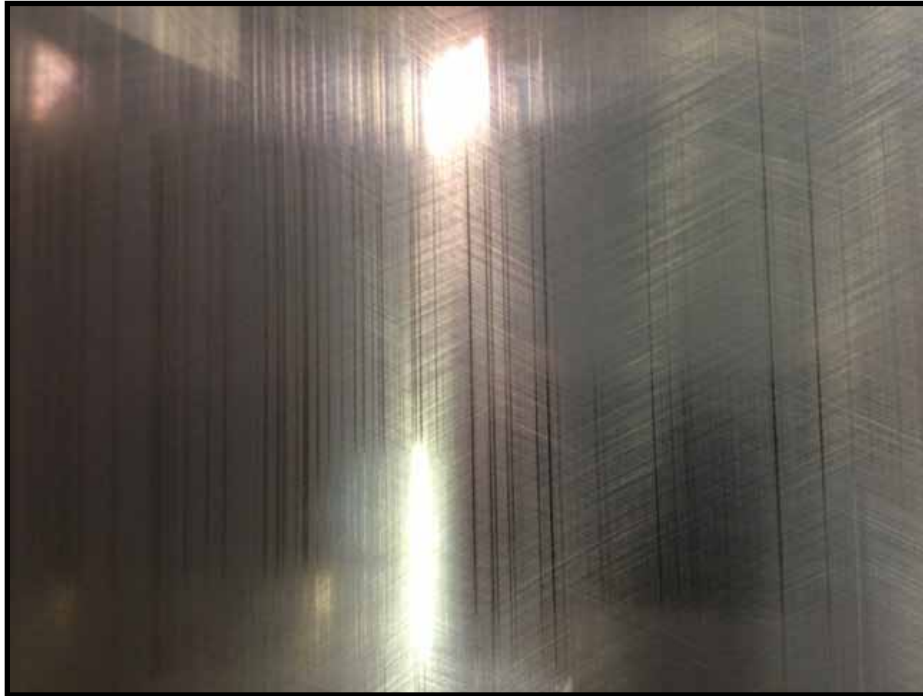
# Cylinder #3



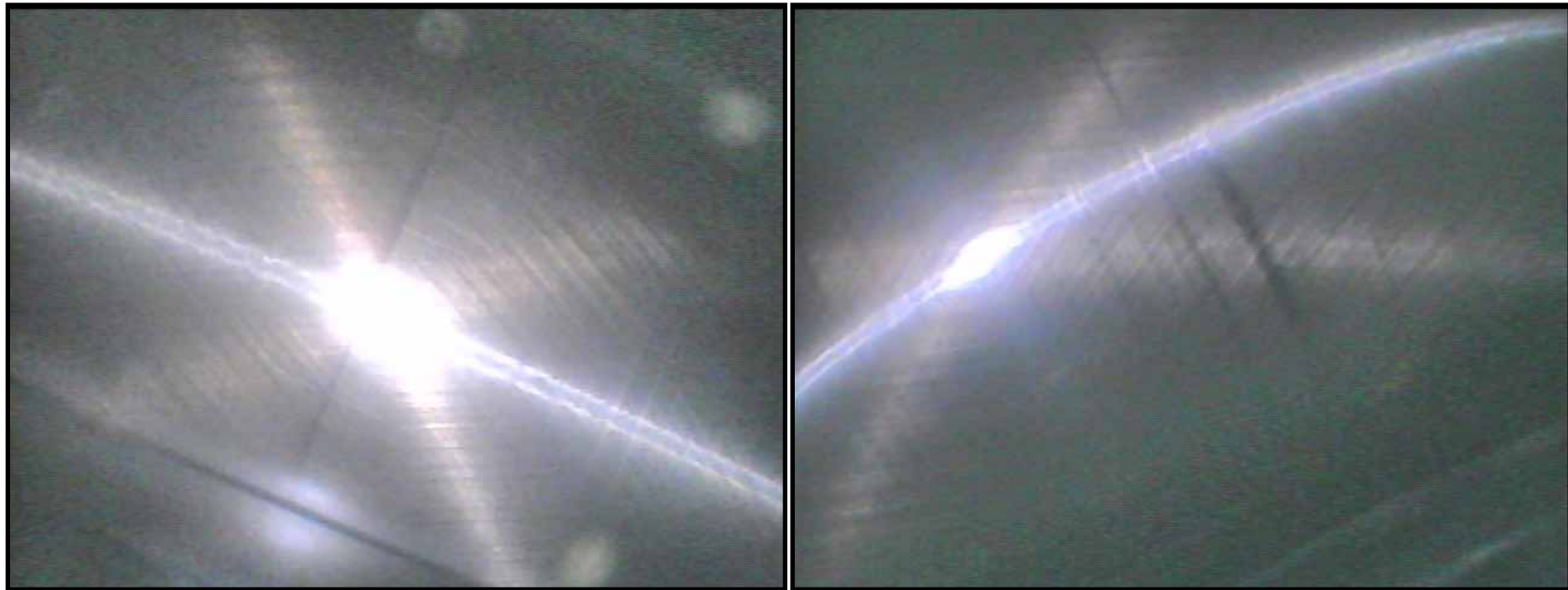
# Cylinder #5



# Cylinder #6



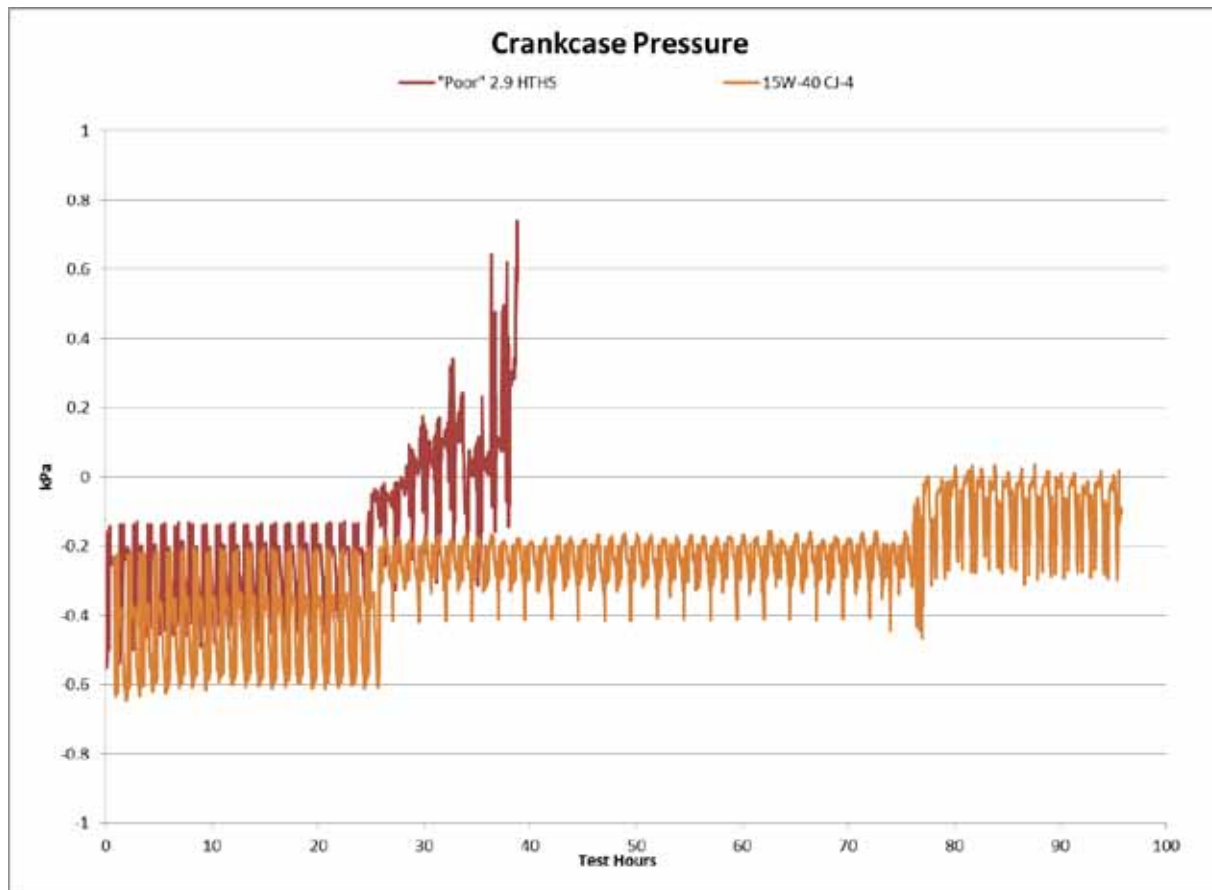
## 700hr Inspection with Coated Rings (borescope)



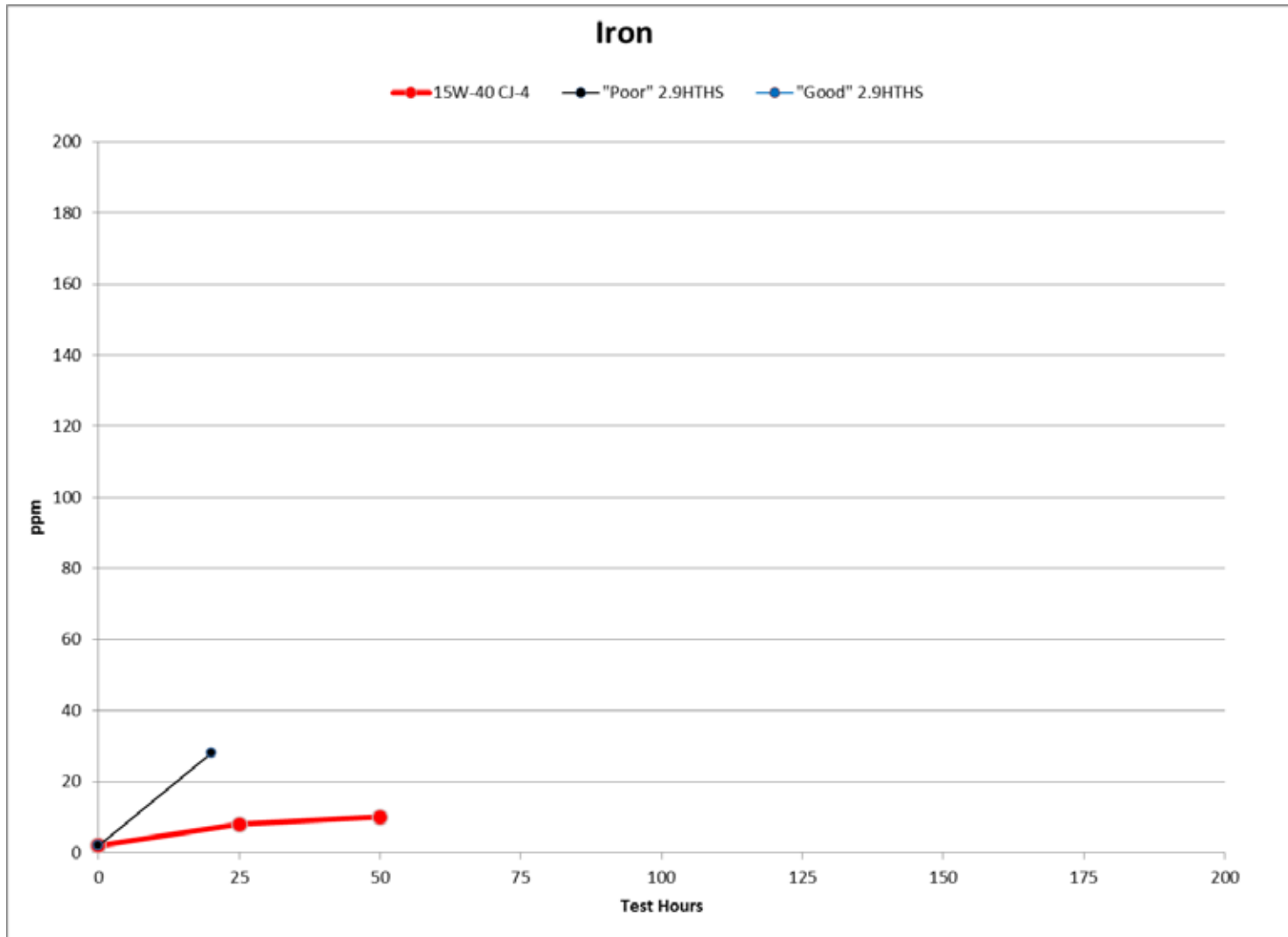
***Photos and results of coated rings test @ 970hrs will be available soon***

# Current Test

- Commercially available CJ-4 15W-40
- 95 hours on 3-1-13



# Analytical Comparison





# Test Outline

	Step	Time (min)	Speed	Torque	Notes
Warm-up	1	xxx	idle		idle to check stand and get oil pressure
	2	5min	1800	1200	
	3	5min	1800	1800	
	4	10min	1800	2032	restrictions locked at end of step
	5	5min	idle		
Test	n/a	200hr	See Cycle Details		
Cool Down	1	5min	idle		

# Test Cycle

<b>Test Cycle (200HRS)</b>						
<b>STEP</b>	<b>Time (sec)</b>	<b>SPEED (rpm)</b>	<b>Throttle (%)</b>			<b>Step Type</b>
			<b>0-25hrs</b>	<b>25-75hrs</b>	<b>75-200hrs</b>	
1	120	600	0	0	0	Steady
2	10	1800	50	75	100	Ramp
3	900	1800	50	75	100	Steady
4	10	900	35	35	35	Ramp
5	130	900	35	35	35	Steady
6	10	600	0	0	0	Ramp
7	130	600	0	0	0	Steady
8	10	1100	50	75	100	Ramp
9	1250	1100	50	75	100	Steady
10	1500	2000	50	75	100	Ramp
11	180	2000	50	75	100	Steady
12	120	1800	50	75	100	Ramp
13	120	1800	50	75	100	Steady
14	10	600	0	0	0	Ramp
<b>Total Time</b>	<b>4500sec</b>	<b>Cycles</b>	<b>20</b>	<b>40</b>	<b>100</b>	

**TEST LENGTH IS SUBJECT TO CHANGE**

# Operating Conditions

Restrictions Set at End of Warm-Up Step 4			
Exhaust Back Pressure	CAC Delta Pressure	CAC Outlet Temperature	Intake Air Restriction
30 kPa	12 kPa	73 °C	3 kPa <sub>vac</sub>
Control Points During Test Cycles			
Intake Air Temperature	Coolant Outlet Temperature	Fuel Temperature	Coolant Pressure
35 °C	110 °C	38 °C	70 kPa
Key Non-Controlled Parameters During Cycling			
Oil Gallery Temperature	Oil Sump Temperature	Intake Manifold Pressure	Exhaust Temperature
110-120 °C	110-120 °C	0-255 kPa	250-520 °C
Fuel Flow	Oil Gallery Pressure	Intake Manifold Temperature	Oil Consumption
3-77 kg/hr	115-480 kPa	45-100 °C	< 30g/hr
Max Power	385kW @ 1800rpm/2045Nm (510hp)		
Max Torque	2450Nm @ 1100 rpm		
Idle	600rpm and no throttle		
Exhaust Back Pressure	Tailpipe pressure		
CAC Delta Pressure	Turbo Outlet Pressure - Intake Manifold Pressure		
CAC Outlet Temperature	Charge Air Cooler Outlet Temperature		
Intake Air Restriction	Restriction at turbo inlet		
Intake Air Temperature	Temperature at turbo inlet		
Coolant Outlet Temperature	Coolant temperature at engine outlet		
Fuel Temperature	Inlet Fuel temperature		

## New Hardware

- Current liners have been phased out of production
- Plan to switch to current hardware as soon as possible
  - This current hardware will be locked in going forward
- New liners incorporate a Carbon Scraper Ring
  - More details to follow