

Attendees:

Intertek - Al Lopez, Jason Soto, Bill Buscher

Ford – Ron Romano

Afton – Christian Porter, Ed Altman

Lubrizol – George Szappanos

TMC – Rich Grundza

Oronite –Mahboob Hosseini, Jo Martinez, Kustav Sinha

OHT – Jason Bowden, Matt Bowden

Exxon – Jordon Smith

Ashland – Amol Savant

Testing Update:

Afton has completed another run on the Low Wear Oil. The wear number was .0758

Ashland completed another run on the Ford Reference oil and got a milder result than they'd hoped. At this point, Ashland is not optimistic about participating in the Precision Matrix. Amol plans to work with some of the other labs to find some unseen differences in testing.

In addition to the prove out tests, Lubrizol ran tests on both oils with a results of .074 on the LWO, and .012 on the high wear oil. Lubrizol wanted to make it clear some of the equipment in the stand is slightly different than what is in the current Chain Wear Procedure.

Development Update:

Ron discussed his updated Chain Wear Development Presentation which is attached. We spent most of the time discussing slide three which describes differences in the way the prove out tests were run. Ron wanted be clear that most of the data was run in a very similar manner. Only four of those tests were run in what the Task Force would consider different, two of those tests have been excluded from the statistical data.

George stressed the necessity in explaining how changes in the test have influenced results. This seems to further indicate readiness for Matrix testing.

Chain Wear Measurement:

The Task force finalized the chain wear measurement procedure. Afton provided results using several methods on Motorized Chain Measurement Rig, "MCMR 1000". All measurements were similar. There was discussion of possibly eliminating use of the sonic cleaner in favor of spraying only with Stoddard. George presented information which shows very little residual oil on the chain after spraying with Stoddard only. The group still felt it was worth continuing use of the sonic cleaner. Georges presentation is here and the updated measurement procedure is on the next page.

Comparison of methods of cleaning –

New Stoddard = ICP on fresh Stoddard

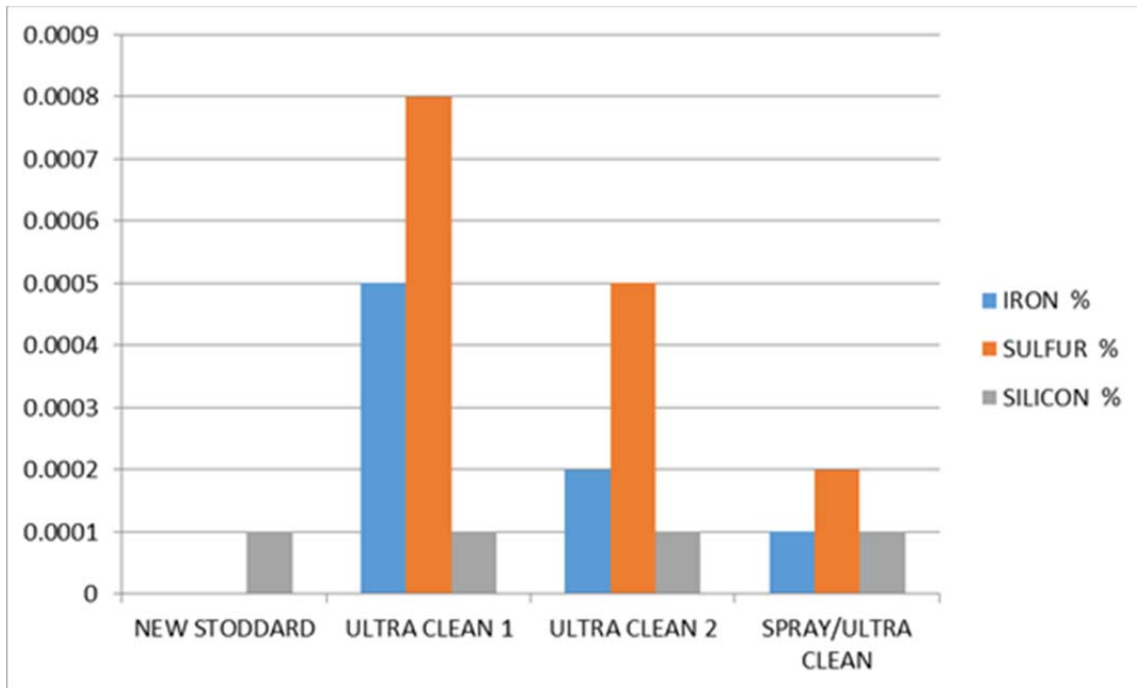
Ultraclean 1 = ICP on Stoddard after cleaning a new chain

Ultraclean 2= ICP on fresh Stoddard after a second cleaning of same chain

Spray = ICP on Stoddard after cleaning a new spray-washed chain

All other elements were zero. Used a 400 mL bath of Stoddard.

I'd say, based on this data (granted, values in the mud) there's similar residual oil in either method, and you could argue the chain's cleanliness is similar.



Timing chain cleaning procedure: (Completed before break in measure and EOT measure)

1. Remove chain from engine and wipe lightly with lint free cloth.
2. Place timing chain into an **un heated** ultrasonic bath with Stoddard solvent for 20 minutes
3. Remove the chain from the ultrasonic cleaner and dip into room temperature Stoddard solvent to cool chain
4. Dip the chain in heptane or solvent 142 to remove excess Stoddard and prevent rust
5. Dip Chain in EF- 411
6. Wipe off excess EF- 411
7. Place in metrology lab a minimum of 2 hours before starting the measurement procedure. This will allow the temperature of the chain to stabilize.
8. Measure Chain

After the break in measurement is complete:

1. Place timing chain into an ultrasonic bath with Stoddard solvent for 20 minutes
2. Remove the chain from the ultrasonic cleaner and dip into room temperature Stoddard solvent to cool chain
3. Dip the chain in heptane or solvent 142 to remove excess Stoddard and prevent rust
4. Dip Chain in Test oil
5. Wipe off excess Test oil
6. Install timing chain on engine and start the test.

Ready For Matrix:

All Lopez motioned and Ron Romano seconded:

“The Task Force Considers the Ford Chain Wear Test Ready For Matrix Testing”

Most of the discussion centered around whether the running data had been thoroughly examined and whether additional tests were needed on the 0W16 matrix oil. Ron felt the prove out was complete on the basis we’ve fully satisfied what is mandated in the MOA. Kustav felt since the oil is in the matrix it might be prudent to run additional tests.

A vote was taken and the motions was approved:

3 Affirmative

1 Negative

4 Waive

Action Item:

All labs to submit ramping data to the TMC. Data should include only Stage 1 to Stage 2 ramp, and Stage 2 to Stage 1 ramp from the 3rd cycle of the first 24 hours of the test.

Next Meeting: TBD

Ford Engine Test Development Update

Chainwear

Ron Romano
Ford Motor Company
November 5, 2015

Chain Wear Prove Out Test Data

216 Hour Test Length					
Ford Ref Oil		Low Wear Oil		Tech 0W-16	
Afton 1	0.0960	Afton 2	0.0518		
Afton 3	0.109	Afton 4	0.0758		
Ashland	In Prog	Ashland	Sched		
		Ashland	Sched		
IAR 93-0-11	0.1058	IAR 93-0-8	0.0659	IAR 93-0-17	0.1110
IAR 93-0-4	0.1367	IAR 93-0-12	0.0600		
IAR 93-0-7	0.1290	IAR 95-0-19	0.0753		
IAR 94-0-22	0.1071				
IAR 95-0-14	0.0968				
IAR 95-0-18	0.1057				
IAR 95-0-20	0.1210				
IAR 93-0-19	0.1295				
SWRI 27-2	0.0921	SWRI 27-3	0.0653		
SWRI 8-18	0.0945	SWRI 8-17	0.0741		
SWRI 27-11	0.0998				
Avg	0.1095		0.0669		
Std Dev	0.0142		0.0082		

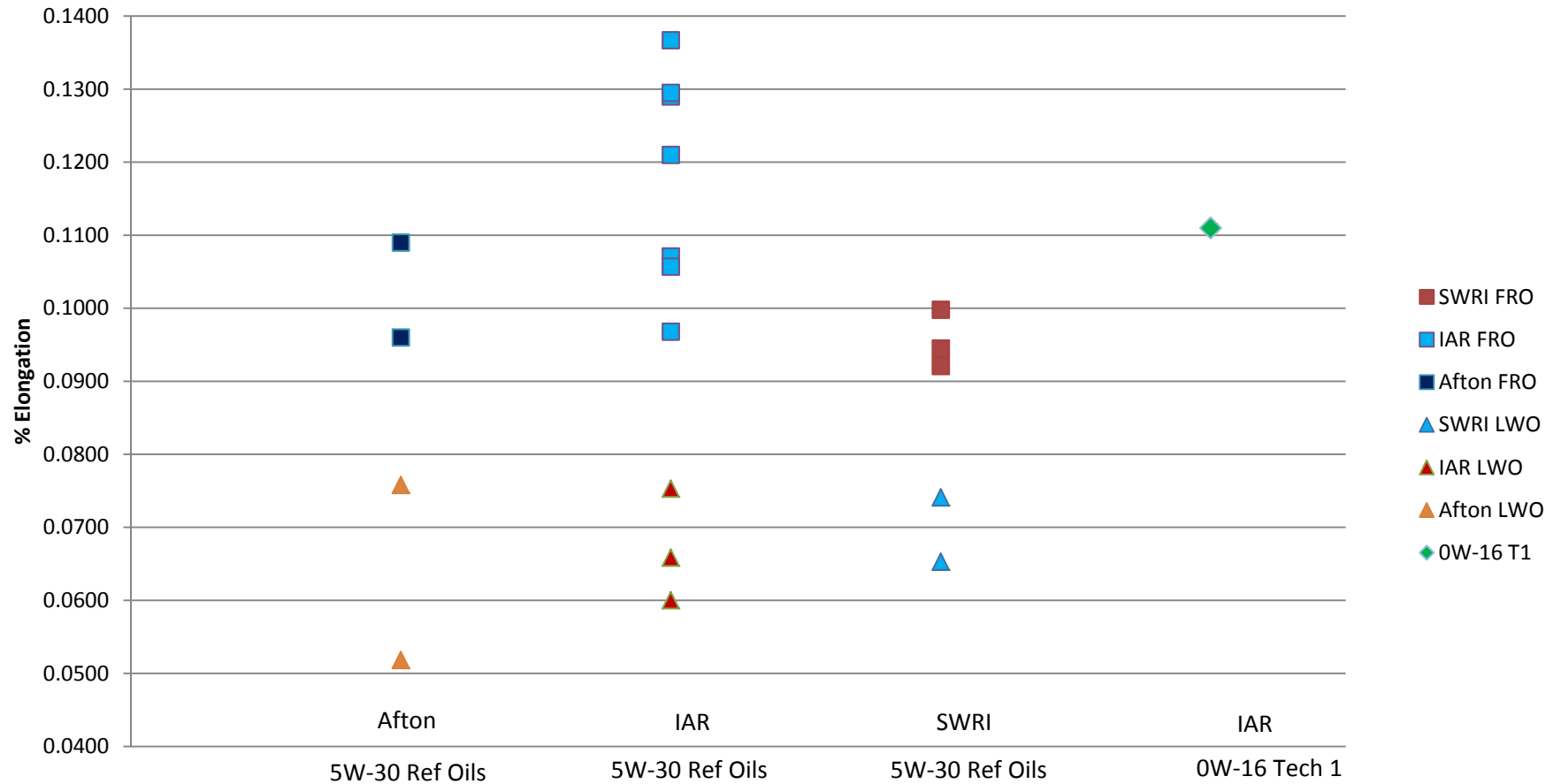
- Procedure changes
 - Speed/Load ramps designed to match IAR.
 - Blowby ramps changed to match original prove out test ramps
 - Extend cycle at oil leveling and sampling
- SwRI Ford Reference Oil with procedure changes
 - Chain wear elongation = 0.0998%
- Afton Ford Reference Oil with procedure changes
 - Chain wear elongation = 0.109%
- Aton Low Wear Oil with procedure changes
 - Chain wear elongation = 0.0758%
 - Chain wear elongation = 0.0695% (oiled chain)
- Ashland 3 tests
 - First test in progress

Prove Test Running Conditions

Ford Ref Oil		Test Date	Long S/L ramp	Short S/L ramps	Long BB ramp	Short BB ramp	Full 6th cycle	Short 6th cycle	Engine Run#	Engine #	# Interim measure	EOT Measure	Caliper measure	Motorized Rig measure	Oil batch	Measure notes
Afton 1	0.0960	1/16/2015		✓	✓		✓		1	13-03	2	Test Oil	0.0960		FRO	BHJ/CMM
Afton 3	0.1090	10/9/2015	✓		✓		✓		3	15-01	0	Dry		0.1090	FRO	
Ashland	In prog															
IAR 93-0-4	0.1367	11/04/2014	✓		✓		✓		3	ICW3	24hr	Test Oil	0.1367		CW Ref Oil	
IAR 95-0-14	0.0968	11/14/2014	✓		✓		✓		2	CW4	24hr	Test Oil	0.0968		A	
IAR 93-0-7	0.1290	01/22/2015	✓		✓		✓		2	ICW5	24hr	Test Oil	0.1290		ATO	
IAR 94-0-22	0.1071	02/10/2015	✓		✓		✓		1	ICW6	24hr	Test Oil	0.1071		ATO	
IAR 95-0-18	0.1057	2/24/2015	✓		✓		✓		1	CW5	2	Test Oil	0.1057		ATO	
IAR 93-0-11	0.1058	04/19/2015	✓		✓		✓		1	ICW7	2	Test Oil	0.1058		ATO	
IAR 95-0-20	0.1210	5/4/2015	✓		✓		✓		1	CW6	24hr	Test Oil	0.1210		ATO	
IAR 93-0-19	0.1295	9/9/2015	✓		✓		✓		2	CW10	0	Dry	0.1103	0.1295	ATO	
SWRI 27-2	0.0921	3/17/2015		✓	✓		✓		2	CW5	2	Test Oil	0.0921		ATO	
SWRI 8-18	0.0945	4/16/2015		✓	✓		✓		3	CW5	2	Test Oil	0.0945		ATO	
SWRI 27-11	0.0998	9/24/2015	✓		✓		✓		2	CW8	0	Dry	0.0998		ATO	
Low Wear Oil																
Afton 2	0.0518	3/30/2015		✓	✓		✓		4	13-03	2	Test Oil	0.0518		LWO	BHJ/CMM
Afton 4	0.0758	10/23/2015	✓		✓		✓		2	15-02	0	Dry		0.0758	LWO	LZ Rig
Ashland	Sched															
Ashland	Sched															
IAR 93-0-8	0.0659	02/13/2015	✓		✓		✓		3	ICW5	24hr	Test Oil	0.0659		LWO	
IAR 95-19	0.0753	4/10/2015	✓		✓		✓		2	CW5	24hr	Test Oil	0.0753		LWO	
IAR 93-12	0.0600	5/11/2015	✓		✓		✓		2	ICW7	24hr	Test Oil	0.0600		LWO	
SWRI 8-17	0.0741	3/25/2015		✓	✓		✓		3	CW4	2	Test Oil	0.0741		LWO	
SWRI 27-3	0.0653	4/6/2015		✓	✓		✓		6	V8-1	2	Test Oil	0.0653		LWO	
Tech OW-16																
IAR 93-0-17	0.1110	8/2/2015	✓			✓		✓	1	CW10	0	Dry	0.0980	0.1110	Tech1	
Below test drove the procedure changes to increase test severity.																
SWRI 27-7	0.0656	7/27/2015		✓		✓		✓		CW7/1	0	Dry	0.0656		ATO	
Aton 2.5	0.085	8/2/2015		✓		✓		✓				Dry		0.085	ATO	

Chain Wear Prove Out Test Data

Chain Wear Data



FORD CHAIN WEAR PROVE OUT ANALYSIS

November 5, 2015

D. Boese

Performance you can rely on.



Summary



- Oil discrimination is statistically significant.
- Lab effect is not statistically significant.

Prove Out Data



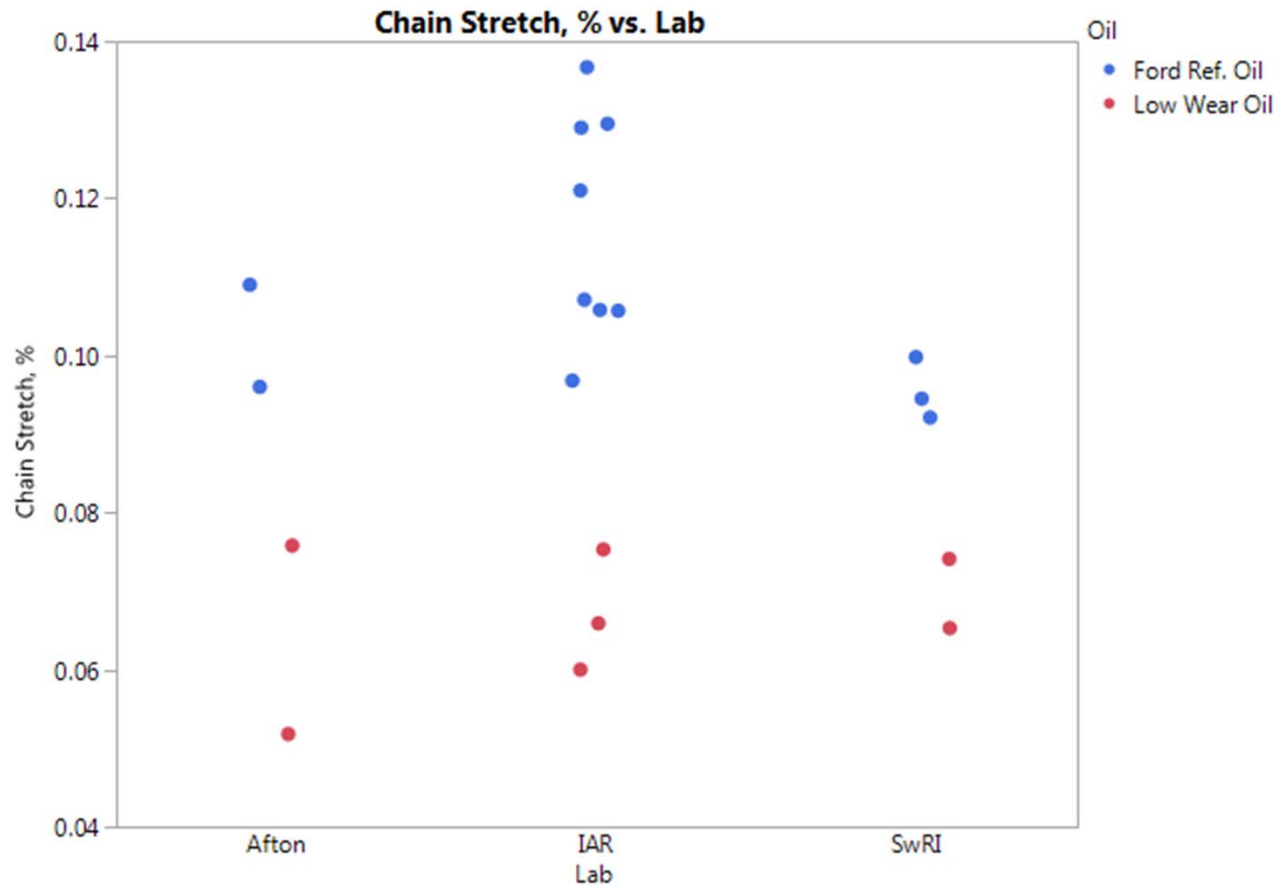
- Data analyzed is tabulated to the right.
- Test conditions have changed somewhat from test to test.
 - Analysis omits test condition differences.
 - Affects from test condition differences are therefore included in regression error term and potentially, lab term.

Ford Chain Wear Test

Reference Data Results
% Chain Stretch

216 Hour Test Length			
Ford Ref Oil		Low Wear Oil	
Afton	0.0960	Afton	0.0518
Afton	0.1090	Afton	0.0758
IAR 95-0-14	0.0968	IAR 93-0-8	0.0659
IAR 95-0-18	0.1057	IAR 95-0-19	0.0753
IAR 93-0-4	0.1367	IAR 93-12	0.0600
IAR 93-0-7	0.1290	SWRI 8-17	0.0741
IAR 94-0-22	0.1071	SWRI 27-3	0.0653
IAR 93-0-11	0.1058		
IAR 95-0-20	0.1210		
IAR 93-0-19	0.1295		
SWRI 27-2	0.0921		
SWRI 8-18	0.0945		
SwRI 27-11	0.0998		
Average	0.1095		0.0669
Std. Dev.	0.0149		0.0089

Plot of Prove Out Data



Overall, and for each lab, there is clear separation between the results of the two oils indicating discrimination capability.

Regression Analysis



- The data indicates a transformation of Ln(Chain Stretch) is needed.
 - RMSE = .1296 [Ln(% Chain Stretch) units]
- If no transformation is used:
 - RMSE = 0.0124 % Chain Stretch
- In both cases:
 - Oil effect is statistically significant.
 - Lab effect is not statistically significant.

Ln(Chain Stretch) Effect Test

Term	df	p-Value
Oil Code	1	<.0001
Lab	2	0.2108

Chain Stretch Effect Test

Term	df	p-Value
Oil Code	1	<.0001
Lab	2	0.1438

Permission is given for storage of one copy in electronic means for reference purposes. Further reproduction of any material is prohibited without prior written consent of Infineum International Limited. The information contained in this document is based upon data believed to be reliable at the time of going to press and relates only to the matters specifically mentioned in this document. Although Infineum has used reasonable skill and care in the preparation of this information, in the absence of any overriding obligations arising under a specific contract, no representation, warranty (express or implied), or guarantee is made as to the suitability, accuracy, reliability or completeness of the information; nothing in this document shall reduce the user's responsibility to satisfy itself as to the suitability, accuracy, reliability, and completeness of such information for its particular use; there is no warranty against intellectual property infringement; and Infineum shall not be liable for any loss, damage or injury that may occur from the use of this information other than death or personal injury caused by its negligence. No statement shall be construed as an endorsement of any product or process. For greater certainty, before use of information contained in this document, particularly if the product is used for a purpose or under conditions which are abnormal or not reasonably foreseeable, this information must be reviewed with the supplier of such information.

Links to third party websites from this document are provided solely for your convenience. Infineum does not control and is not responsible for the content of those third party websites. If you decide to access any of those websites, you do so entirely at your own risk. Please also refer to our Privacy Policy.

© INFINEUM INTERNATIONAL LIMITED 2015. All rights reserved

"INFINEUM, PARATAC, SYNACTO, VISTONE and the interlocking ripple device are Trade Marks of Infineum International Limited

Chain Measurement

- Labs met to discuss chain wear measurements and chain oscillation.
- Discovered that the rig works better if the chain is lubricated while on the measurement rig.
- The group didn't want to lubricate the chains with test oil due to concerns about contaminating the rig and subsequent chains. Lubricate with EF411
- The group feels the new chains should be cleaned to remove the preservative oil and cleaned after break in to remove the break in oil.
- The group is investigating a new stoddard solvent cleaning procedure as the stoddard solvent is getting close its flash point in the ultrasonic cleaner.

Readiness

- Meet validity requirements of the MOA
- All three oils are at TMC
 - TMC1011 - Tech 1 (0W-16)
 - TMC270 - Tech 5 (5W-30) – Failing reference oil
 - TMC271 - Tech 10 (5W-30) – Low wear reference oil
- Test Procedure – ASTM format in progress. Draft on TMC website, complete enough to run PM
- Test Forms – On TMC website. Beta test complete. Data transfer from IAR and SWRI in progress.
- Reference period – will have to shorten 1st referencing period. Will need to rereference about April 2016

AOAP Motion

The Chain Wear Test Operations Test Procedure has been finalized as of Oct. 8, 2015. It is posted on TMC web site and will not be changed.

With the final Operational Test Procedure the Chain Wear Test is ready for matrix testing using the two independent labs. When the other two labs have completed their prove out tests and the data accepted by the Chain Wear Task Force they will join the precision matrix. If the Ashland or Afton labs have not completed the prove out matrix by December 1 the Precision Matrix will proceed with fewer labs.

If there are fewer labs the Precision Matrix will have to be redesigned to accommodate the reduced number of labs

Motion: Ron Romano

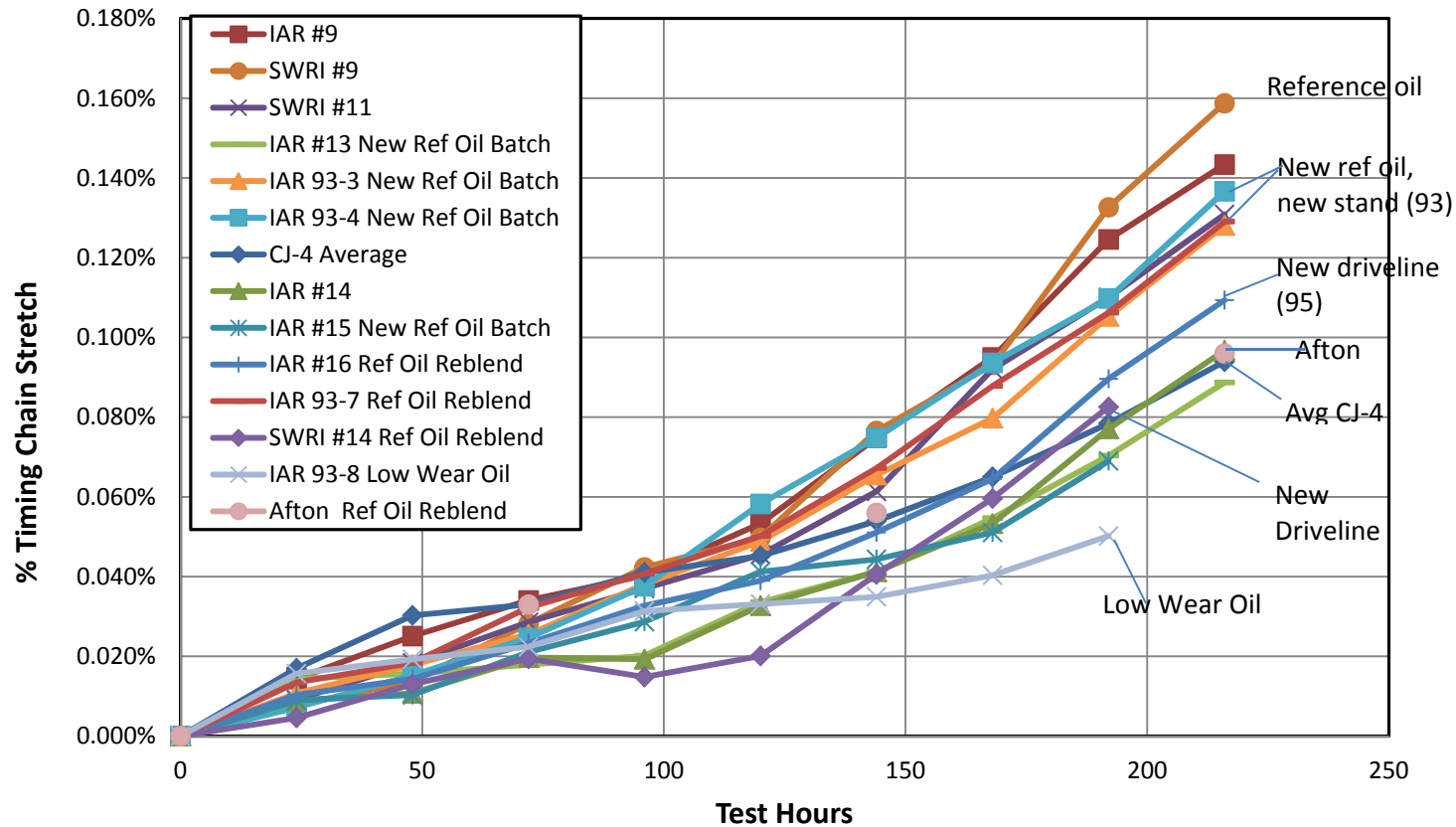
Second: Don Smolenski

Questions?

Back up information

Chain Wear (2.0LGTDI)

Reference Oil, Low Wear Oil and CJ-4, EEE Fuel



- IAR reference oil test in a stand 93 compares well with previous reference oil tests.
- Original IAR stand 95 seems to have shifted mild. Installing new driveline may have shifted it more severe
- SWRI stand also seems to have shifted mild, SWRI #14
- Still investigating mild shift.
- Test on “low wear” oil appears to showing an improvement over the reference oil.
- Measurement round robin with motorized chain wear measurement rig gave identical results to manual method used at SWRI and IAR.
- Reference oil is at dependent labs for testing

Chain Analysis

Chain analysis never really discovered anything unusual on field samples, abrasives, tribofilms, etc., other than iron oxides on the link surfaces. Field links showed the presence of Fe_3O_4 , magnetite and Fe_2O_3 , hematite. Fe_3O_4 , magnetite is normally found on engine component surfaces and is soft and normally doesn't cause wear. Fe_2O_3 , hematite is a hard brittle oxide that isn't normally found on engine components but was present on the field chain links. These were also found on links from the Ford Reference Oil chain wear test samples.

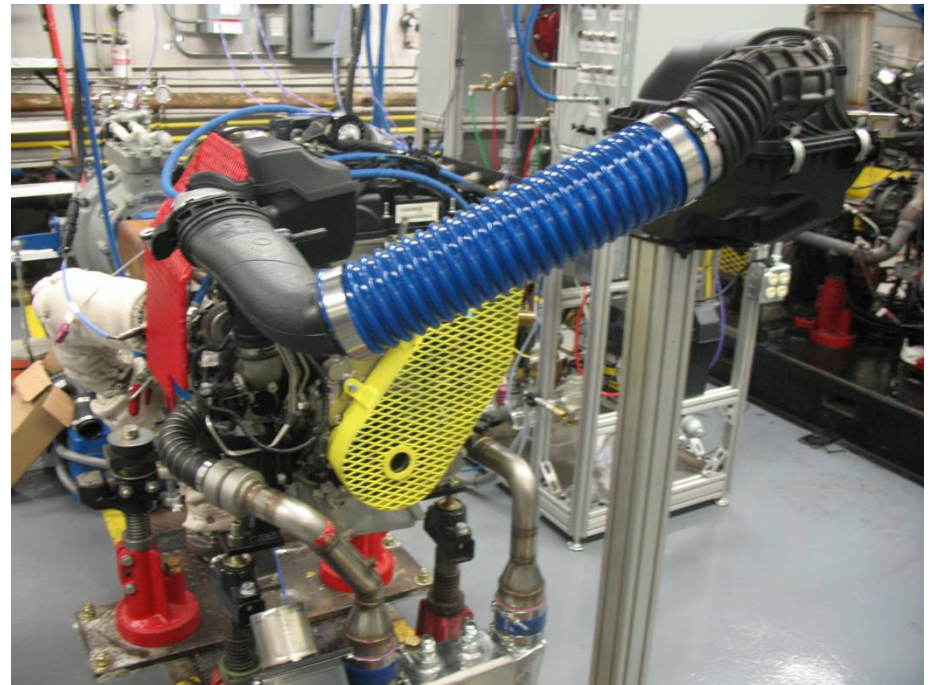
Ford Engine Test Development Update

Chainwear

Ron Romano
Ford Motor Company
July 9, 2015

Timing Chain Wear Test Overview

- Test engine: 2012 Ford 2.0L, EcoBoost, 4-cylinder
178Kw@5500
366N-m@3000
- Soot induced chain wear
- Low- moderate speed and load.
- Two stage test, low and normal running temperatures.
- Test duration 216 hours



Chain Wear Prove Out Test Data

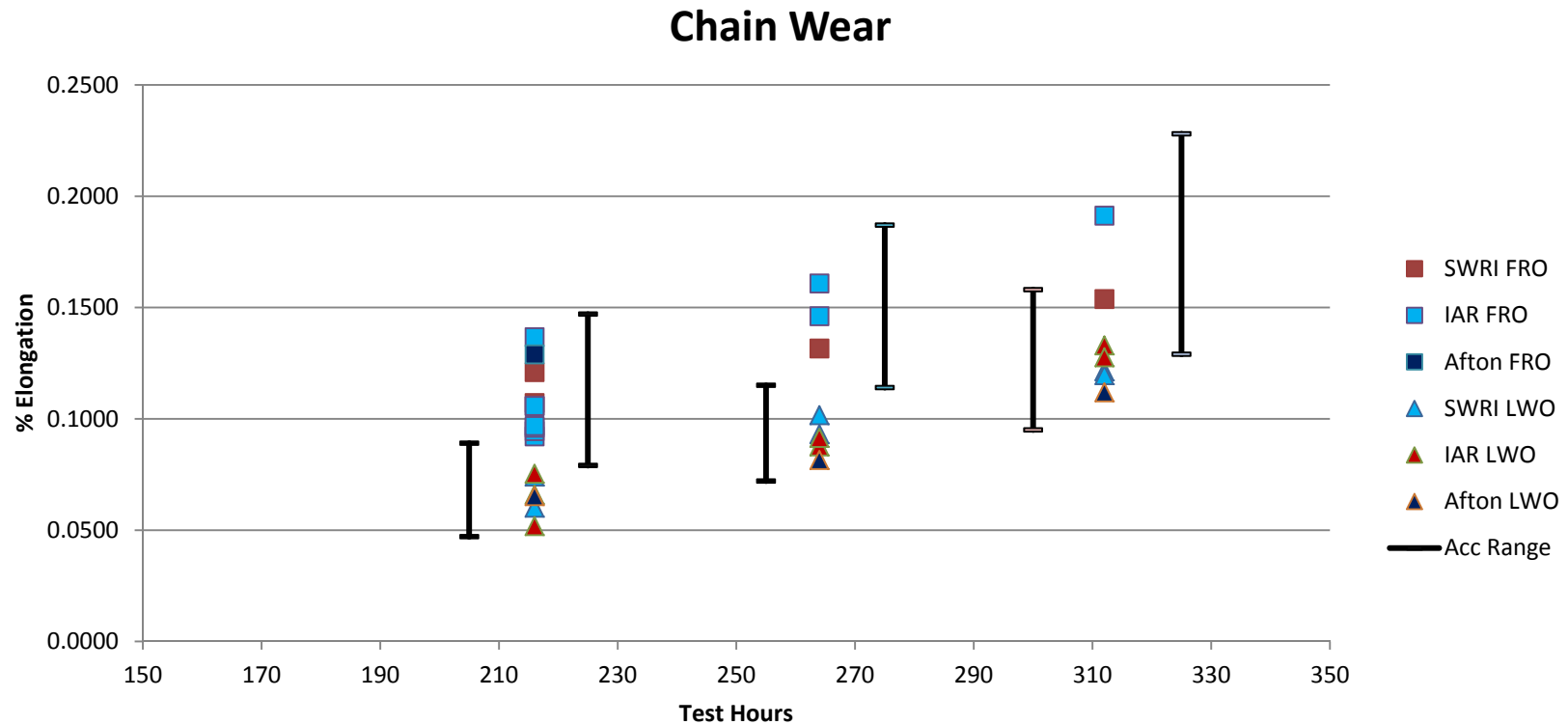
216 Hour Test Length			
Ford Ref Oil		Low Wear Oil	
Afton	0.0960	Afton	0.0518
Afton	Sched		
Ashland	In Prog	Ashland	Sched
		Ashland	Sched
IAR 93-0-11	0.1058	IAR 93-0-8	0.0659
IAR 93-0-4	0.1367	IAR 93-12	0.0600
IAR 93-0-7	0.1290	IAR 95-19	0.0753
IAR 94-0-22	0.1071		
IAR 95-0-14	0.0968		
IAR 95-0-18	0.1057		
IAR 95-0-20	0.1210		
SWRI 27-2	0.0921	SWRI 27-3	0.0653
SWRI 8-18	0.0945	SWRI 8-17	0.0741
avg	0.1085		0.0654

264 Hour Test Length			
Ford Ref Oil		Low Wear Oil	
Afton	N/A	Afton	0.0815
Ashland	N/A	Ashland	N/A
		Ashland	N/A
IAR 93-0-11	0.1461	IAR 93-12	0.0914
IAR 95-0-20	0.1608	IAR 95-19	0.0876
SWRI 8-18	0.1316	SWRI 27-3	0.0931
		SWRI 8-17	0.1016
avg	0.1462		0.0910

312 Hour Test Length			
Ford Ref Oil		Low Wear Oil	
		Afton	0.1119
IAR 95-0-20	0.1913	IAR 95-0-19	0.1330
		IAR 93-12	0.1277
SWRI 8-18	0.1538	SWRI 8-17	0.1213
		SWRI 27-3	0.1196
avg	0.1726		0.1227

- Proveout testing complete at SWRI, and IAR.
- Afton needs 1 test on Ford reference oil. Should be complete before matrix starts
- Ashland need to complete all tests. Test stand updates in progress
- Lab inspection complete at SWRI, IAR, Afton and Ashland.
- SAE 0W-16 oil candidate data provided by two test sponsors
- Oils tested (All oils are fully formulated oil designed with the intention to pass all tests)
 - Ford Reference Oil - GF-5 5W-30
 - Low Wear Oil – GF-6 prototype 5W-30
 - A 0W-16 - SN additive system, KV100=6.48 cSt, HTHS150=2.14 cP (actually a 0W-12)
 - B 0W-16 - GF-6 prototype, KV100°C=7.3 cSt, HTHS150°C=2.4 cP

Chain Wear Prove Out Test Data (cont.)



- P-Values show statistical difference between Ford Reference Oil and Low Wear Oil at 216 hours
- Test length finalized at 216 hours
- Low Wear Oil shows 40% reduction in wear at 216 hours
- Statistical analysis on data shows no advantage running beyond 216 hours.
- Lab effect is borderline statistically significant, should improve with more data from Afton and lab and operation improvements in place

SAE 0W-16 Chain Wear Test Data

Stage 1 Operational Data					Oil A SAE 0W-16			Oil B SAE 0W-16			94-0-22 SAE 5W-30			18-FCW-8 SAE 5W-30		
Parameter	Setpoint	AVG	Min	Max	Avg	Min	Max	avg	min	max	Avg	Min	Max			
Engine Speed	1550.00	1549.98	1535.34	1561.81	1550.05	1540.00	1559.00	1549.99	1537.99	1562.31	1549.98	1534.00	1562.00			
EBP	104.00	104.00	103.09	105.04	104.20	103.30	104.70	104.00	103.55	104.55	98.27	97.50	99.00			
Oil Gallery Temp	50.00	50.00	49.86	50.12	48.21	32.10	57.10	50.00	48.64	50.93	50.00	49.90	50.30			
Torque	50.00	50.00	42.34	55.91	49.98	47.80	51.90	50.00	46.13	53.26	49.99	45.10	53.70			
Coolant Out Temp	45.00	44.96	13.43	45.34	44.93	39.20	45.80	45.00	44.49	45.46	45.00	44.10	45.70			
Coolant Flow	40.00	40.00	39.14	40.89	40.00	38.10	49.30	40.00	39.52	40.48	39.85	37.60	40.50			
Inlet Air Temp	32.00	31.99	30.25	33.62	31.96	30.40	33.80	31.96	29.45	34.76	29.99	28.10	31.60			
Air Charge Temp	30.00	29.86	27.33	33.08	29.95	27.90	31.40	29.84	25.78	30.79	32.00	30.90	35.90			
BB HX Temp In	20.00	20.00	19.93	20.07							23.67	21.30	43.50			
AFR Ratio	0.78	0.78	0.76	0.85	0.76	0.76	0.77	0.78	0.76	0.79	0.77	0.77	0.77			
Inlet Air Press	0.05	0.05	0.04	0.06	0.05	0.02	0.08	0.05	0.04	0.06	0.05	0.03	0.07			
Oil Gallery Press		401.67	370.56	435.65	374.76	345.70	452.50	435.74	409.33	475.98	451.99	422.70	482.10			

Stage 2 Operational Data					Oil A SAE 0W-16			Oil B SAE 0W-16			94-0-22 SAE 5W-30			18-FCW-8 SAE 5W-30		
Parameter	Setpoint	AVG	Min	Max	Avg	Min	Max	avg	min	max	avg	min	max			
Engine Speed	2500.00	2499.92	2480.66	2509.96	2499.96	2495.00	2503.00	2499.99	2489.14	2510.87	2500.04	2497.00	2504.00			
Torque	128.00	128.00	124.73	132.48	127.94	123.60	133.40	128.00	124.48	132.41	127.77	123.90	131.10			
EBP	107.00	107.00	106.54	107.75	106.99	106.00	108.60	107.00	106.23	108.01	98.82	97.60	100.00			
Oil Gallery Temp	100.00	99.93	96.85	100.77	97.41	91.60	99.20	100.01	98.59	100.55	100.00	99.70	100.30			
BB HX Temp In	85.00	85.03	84.80	86.08							80.12	76.80	84.60			
Coolant Out Temp	85.00	85.10	77.62	85.66	84.95	84.30	85.60	85.11	84.39	85.83	84.99	83.20	87.60			
Coolant Flow	70.00	69.99	69.18	70.91	69.99	67.40	73.80	70.00	69.15	71.13	69.69	68.40	70.20			
Inlet Air Temp	32.00	31.72	30.36	32.23	31.96	31.60	32.30	31.97	31.41	32.23	30.01	28.80	37.30			
Air Charge Temp	30.00	30.00	28.88	31.11	29.99	29.30	30.90	30.22	28.60	32.20	32.00	31.70	32.30			
AFR Ratio	1.00	1.01	0.98	1.10	0.99	0.98	1.01	1.00	0.99	1.04	0.99	0.99	1.00			
Inlet Air Press	0.05	0.05	0.02	0.08	0.05	-0.01	0.13	0.05	0.04	0.07	0.05	0.01	0.09			
Oil Gallery Press		276.90	257.51	313.84	267.41	254.90	299.00	288.13	264.18	338.87	346.64	329.40	380.20			

- Operational data provided on two different SAE 0W-16 candidate oils
- One test was operationally valid.
- Second test couldn't achieve oil temperature. Investigation determined that there was a control problem with the oil cooling system not allowing the cooling water to be shut off.
- Data shows that an operationally valid test can be conducted with a SAE 0W-16 viscosity oil

Chain Wear Field Correlation

		Chain Material	
Lab		Orange	Green
	Test Time	Ford Ref Oil	Ford Ref Oil
SWRI	hrs.	% stretch	% stretch
(8 hr BI)	120	0.07	0.09
(24Hr BI)	192	0.13	0.23
(24Hr BI)	192	0.12	0.21
IAR			
(8 hr BI)	144	0.06	0.09
(24 hr BI)	120	0.04	0.05
(24 hr BI)	192	0.16	0.23

			Proveout data	
Test Time	Orange	Orange		
hrs.	Ford Ref Oil	LWO		
216	% stretch	% stretch		
Average	0.11	0.07		
Minimum	0.09	0.05		
Maximum	0.14	0.08		
	10 Tests	6 Tests		

- Initial testing was conducted using two different chain materials
- Orange chains performed better in the field than green chains on “all” GF-5 oils. This includes Ford reference oil.
- The Chain Wear test was developed to show discrimination between the two chain materials since it would show correlation to the field and a good wear oil wasn’t available for correlation at that time.
- The development team felt that if the test could discriminate wear performance between chain materials it would also discriminate wear performance between oils.
- Data above shows discrimination between the two chain materials in the same direction shown in the field.
- Test times and break-in times are different as these tests were conducted during early development before these were finalized. Other test conditions, speed load, temperatures are the same.

Chain Wear Field Correlation (cont.)

- Field performance: chain wear issues in the field have been shown with GF-5 oils, (Ford Reference oil).
- Material change has been made in the field (green to orange) but additional wear performance is needed from the oil.
- Chains still have field issues due to soot and oil degradation in GTDI engines with GF-5 oils.
- Passing oil must be better than Ford reference oil. An oil of equivalent performance to Ford reference oil shouldn't be able to pass the test. Estimating pass/fail limit to be 0.07% at 216 hours based on the present prove out data. This will also depend on statistical review of all the prove out data and precision matrix data.
- Testing at Ford shows that GF-5 oil results in chain wear 10% beyond acceptable limits, so an oil with a similar performance to the low wear reference oil will provide adequate wear protection.

Task Force

- The task force voted the test ready for matrix on June 30, 2015.
- 5 approve
 - Afton, Infineum, Intertek, Southwest, Ford
- 1 negative
 - Lubrizol
- 4 waive
 - Ashland, Oronite, TEI, TMC
- Task Force reviewed operational data for the prove out tests and made operational recommendations to improve test control.

New Test Readiness Checklist

- Reference Oils – Reference oil should be at TMC by July
- Test Parts – final hardware at all the labs. Enough parts at labs for one reference period or more beyond precision matrix
- Test Fuel – EEE.
- Test Procedure – 2nd edition of draft procedure posted on the TMC website. Facilitator working on procedure.
- Rating and Reporting of Results – chain stretch measurement method finalized.
- Calibration, Monitoring and Surveillance – LTMS will be set up after precision matrix
- Test prove out data – complete at SWRI and IAR. Remaining testing scheduled and running at Afton and Ashland.
- Prove out test data available on the TMC website. Includes oil analysis and operational data.
- SAE 0W-16 oil successfully tested.

Questions?

Thank You

- Ford would like to sincerely thank our development partners for their contributions to the Chain Wear test development.
 - Intertek
 - Southwest Research Institute
 - Infineum
- Ford would also like to thank Haltermann and OHT for donating a quantity of fuel and hardware to the labs during the test development. Also like to thanks Lubrizol for developing the chain wear measurement rig and procedure
- Ford would also like to thank a few anonymous donors for things like oil, data, etc.