100 Barr Harbor Drive ■ PO Box C700 ■ West Conshohocken, PA 19428-2959
Telephone: 610-832-9500 ■ Fax: 610-832-9555 ■ e-mail: service@astm.org ■ Website: www.astm.org

Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

Chairman: W. JAMES BOVER, ExxonMobil Biomedical Sciences Inc, 1545 Route 22 East, PO Box 971, Annandale, NJ 08801-0971, (908) 730-1048, FAX: 908 730 1197, EMail: wjbover@erenj.com
First Vice Chairman: KENNETH O. HENDERSON, Cannon Instrument Co, PO Box 16, State College, PA 16804, (814) 353-8000, Ext: 0265, FAX: 814-353-8007, EMail: kenohenderson@worldnet.att.net
Second Vice Chairman: SALVATORE J. RAND, 221 Flamingo Drive, Fort Myers, FL 33908, (941) 481 4729, FAX: 941-481-4729
Secretary: MICHAEL A. COLLIER, Petroleum Analyzer Co LP, PO Box 206, Wilmington, IL 60481, (815) 458-0216, FAX: 815-458-0217, EMail: macvarlen@aol.com
Assistant Secretary: JANET L. LANE, ExxonMobil Research and Engineering, 600 Billingsport Rd, PO Box 480, Paulsboro, NJ 08066-0480, (856) 224-3302, FAX: 856-224-3616, EMail: janet_l_lane@email.mobil.com
Staff Manager: DAVID R. BRADLEY, (610) 832-9681, EMail: dbradley@astm.org

Originally Issued: December 4, 2013

Reply to: Jason H. Bowden
OH Technologies, Inc.
P.O. Box 5039
Mentor, OH 44061-5039
Phone: 440-354-7007
Fax: 440-354-7080
Email: jhbowden@ohtech.com

Unapproved Minutes of the conference call held on November 5, 2013
Sequence IV Surveillance Panel Meeting held in San Antonio, TX.

Membership
Dan Worcester will now be the voting member for SwRI
Chris Taylor, VP Specialty Chemicals, to be added to the mailing list
Attendance list (Attachment 1)

Motion made by Jason Bowden/ seconded by Ed Altman for Approval of Minutes from October 2, 2013 – Passed Unanimously

Motions and Actions were reviewed (Attachment TBD)

Test Sponsor Report – none

TMC Report (Attachment 2)
Rich Grundza, TMC, presented data on the current tests including four acceptable results on the new fuel batch.

Fuel Supplier Report –
Mark Overaker, Haltermann, presented a presentation outlining the next steps that will need to be taken to produce either a 10,000 barrel batch or a larger batch of 30,000 barrels. There was discussion with regards to how we should proceed with the introduction of a new batch of fuel. Mark provided some options with regards to utilizing a single lab and single oil for pilot batches in order to minimize variables for the initial pilot batches. There were concerns expressed by some using one lab for prove out and also concerns with the pilot batches not being exactly the same as the final batch. Questions were raised as to whether Haltermann would be willing to conduct the initial prove outs on their own and then approach the Surveillance Panel once they have determined they have a successful pilot batch.

Mark would like to have a decision with regards to the size of the new batch soon. Haltermann would also like confirmation from the panel that they would be the long-term supplier of this fuel if they do proceed with a large batch.

Operation and Hardware Items-
Ed Altman has agreed to chair an O & H Panel for Seq. V

Review of Scope and Objectives (Attachment 3)

Old Business-none

New Business
Ron Romano, Ford, provided a presentation on the VH, Chainwear and LSPI Tests (Attachment 4)

The new VH test will have forced oil additions which will total approximately 1,000 grams. Dave Glaenzer recommended using volume instead of mass for measuring oil levels. He believes this should ensure more accurate oil volume in the test as different oil shave different densities.

Afton requested an update with regards to hardware for the VH. Ron will be finalizing the list and will be submitting a hardware purchase agreement to the labs in the next month of two. The labs will most likely have to conduct a one-time build out of blocks, heads, cranks, etc.

Action Item for the O & H panel to review the quantity of hardware that will be require for the build-out to support the life of the VH test.

Ron commented that the blow-by has stayed consistent between 60-70 during test development runs.

The chain wear test will be approximately 120 hours and will be a rebuilt test due to the heavy varnish and piston deposits.

The LSPI development tests have shown differences between oils although they may not be statistically significant at this time due the small quantity of LSPI events and limited data. They are currently running a DOE with different temperatures, speed and load conditions. The ECU has not been locked down at this time.

Chris Taylor, VP Specialty Chemicals gave an introduction to the panel. He commented that they will be making EEE and other specialty fuels for testing and has 35 years of experience. The produce consistent blends between batches and have distribution centers located at IN, TX and the Northeast.

Meeting Adjourned.

Action items recorded during this meeting are included as Attachment 5.

SEQUENCE V

2013

ASTM Sequence V Surveillance Panel (18 Voting members) November 10 ~~2009~~

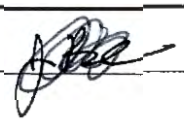
Name/Address	Phone/Fax/Email		Signature
Tracey King Chrysler LLC 800 Chrysler Drive CIMS 482-00-13 Auburn Hills, MI 48326-2757 USA	248-576-7500 248-576-7490 tek1@chrysler.com	Voting Member	Present
Clayton Knight Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249-3423 USA	210-690-1958 210-690-1959 cknight@tei-net.com	Voting Member	Present CK
Patrick Lang Southwest Research Institute 6220 Culebra Road P.O. Box 28510 San Antonio, TX 78228 USA	210-522-2820 210-684-7523 plang@swri.edu	Voting Member	Present
Charlie Leverett Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238 USA	210-647-9422 210-523-4607 charlie.leverett@intertek.com	Voting Member	Present
Josephine G. Martinez Chevron Oronite Company LLC 100 Chevron Way Richmond, CA 94802 USA	510-242-5563 510-242-3173 jogm@chevrontexaco.com	Non-Voting Member	Present
Bruce Matthews GM Powertrain Mail Code 483-730-472 823 Jocyln Avenue Pontiac, MI 48340 USA	248-830-9197 248-857-4441 bruce.matthews@gm.com ~~Test Sponsor Representative~~	Voting Member	Present
Timothy Miranda Castrol Technology Center 240 Centennial Avenue Piscataway, NJ 08854 USA	732-980-3634 973-686-4039 Timothy.Miranda@Castrol.com	Voting Member	Present

Name/Address	Phone/Fax/Email		Signature
Mark Mosher ExxonMobil Technology Company Billingsport Road Paulsboro, NJ 08066 USA	856-224-2132 856-224-3628 mark.r.mosher@exxonmobil.com	Voting Member	Present
Allison Rajakumar The Lubrizol Corporation Drop 152A 29400 Lakeland Blvd. Wickliffe, OH 44092 USA	440-347-4679 440-347-2014 Allison.Rajakumar@Lubrizol.com	Non-Voting Member	Present
Andrew Ritchie Infineum 1900 East Linden Avenue P.O. Box 735 Linden, NJ 07036 USA	908-474-2097 908-474-3637 Andrew.Ritchie@Infineum.com	Voting Member	Present
Ron Romano Ford Motor Company Diagnostic Service Center II Room 410. 1800 Fairlane Drive Allen Park, MI 48101 USA	313-845-4068 313-32-38042 rromano@ford.com Test Sponsor Rep	Voting Member	Present
Jim Rutherford Chevron Oronite Company LLC 100 Chevron Way Richmond, CA 94802 USA	510-242-3410 510-242-3173 jaru@chevrontexaco.com	Non-Voting Member	Present
Philip R. Scinto The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA	440-347-2161 440-347-9031 prs@lubrizol.com	Non-Voting Member	Present
~~Greg Seman~~ George Szappanos The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA	440-347-~~2153~~ 2352 440-347-4096 ~~greg.seman@lubrizol.com~~	Voting Member	Present

ASTM Sequence V Surveillance Panel (18 Voting members) November 19, 2013

Name/Address	Phone/Fax/Email		Signature
Ed Altman Afton Chemical Corporation P.O. Box 2158 Richmond, VA 23218-2158 USA	804-788-5279 804-788-6358 ed.altman@aftonchemical.com	Voting Member	Present
Zack Bishop Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249-3423 USA	210-877-0223 210-690-1959 zbishop@tei-net.com	Non-Voting Member	Present
Doyle Boese Infineum 1900 E. Linden Avenue Linden, NJ 07036 USA	908-474-3176 908-474-3637 doyle.boese@infineum.com	Non-Voting Member	Present
Adam Bowden OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 USA	440-354-7007 440-354-7080 adbowden@ohtech.com	Non-Voting Member	Present
Jason Bowden OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 USA	440-354-7007 440-354-7080 jhbowden@ohtech.com	Voting Member	Present
Dwight H. Bowden OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 USA	440-354-7007 440-354-7080 dhbowden@ohtech.com	Non-Voting Member	Present
Bill Buscher III Southwest Research Institute 6220 Culebra Road P.O. Box 28510 San Antonio, TX 78228 USA	210-522-6802 210-684-7523 william.buscher@swri.org	Non-Voting Member	Present
Bob Campbell Afton Chemical	804 788 5340 F) 6358 Bob.Campbell@Aftonchemical.com	NJ	

ASTM Sequence V Surveillance Panel (18 Voting members) November 19, 2009

Name/Address	Phone/Fax/Email		Signature
James Carter Haltermann Products 3520 Okemos Rd. Suite #6-176 Okemos, MI USA	517-347-3021 517-347-1024 jecarter@jhaltermann.com	Voting Member	Present 
Chris Castanien The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA	440-347-2973 440-944-8112 cca@lubrizol.com	Non-Voting Member	Present 
Timothy L. Caudill Ashland Oil Inc. 22nd & Front Streets Ashland, KY 41101 USA	606-329-1960 x5708 606-329-2044 tlcaudill@ashland.com	Voting Member	Present
Martin Chadwick Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238 USA	210-706-1543 210-684-6074 martin.chadwick@intertek.com	Non-Voting Member	Present
Jeff Clark Sequence III Secretary ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 USA	412-365-1032 412-365-1047 jac@atc-erc.org	Non-Voting Member	Present
Sid Clark Southwest Research 50481 Peggy Lane Chesterfiled, MI 48047 USA	586-873-1255 Sidney.L.Clark@sbcglobal.net	Non-Voting Member	Present 
Johnny M De La Zerda Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238 USA	210-523-4621 210-523-4607 johnny.delazerda@intertek.com	Non-Voting Member	Present

ASTM Sequence V Surveillance Panel (18 Voting members) November 19, 2009 2013

Name/Address	Phone/Fax/Email		Signature
Matt J. Snider GM Powertrain General Motors Corporation MC - 483-730-322 472 823 Joslyn Rd. Pontiac, MI 48090-9055 USA 48340-2920	248-672-3563 248-857-4441 mathew.j.snider@gm.com	Non-Voting Member	Present
Thomas Smith Valvoline P.O. Box 14000 Lexington, KY 40512-1400 USA	859-357-2766 859-357-7084 trsmith@ashland.com PCEOCP Chair	Voting Member	Present
Mark Sutherland Chevron Oronite Company LLC 4502 Centerview Drive Suite 210 San Antonio, TX 78228 USA	210-731-5621 210-731-5699 msut@chevrontexaco.com	Voting Member	Present
Ben O. Weber Southwest Research Institute 6220 Culebra Road P.O. Box 28510 San Antonio, TX 78228 USA	210-522-5911 210-684-7530 bweber@swri.edu **Sub-Committee D02.B01 Chair**	Non-Voting Member	Present
Joe Vujica The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA	440-347-2058 440-347-4096 jsvu@lubrizol.com	Non-Voting Member	Present
Jerry Wang Chevron Oronite Company LLC 7080 Colchester Lane Ypsilanti, MI 48197	734-48-3806 none jwdy@chevron.com	Non-Voting Member	Present
MARK OVERAKER HALTERMANN HOUSTON, TX 77015	713-822-3668 MHOVERAKER@JHALTERMANN.COM		
Rahan Kirkwood SWRI San Antonio, TX	210-689-3481 rkirkwood@swri.org		

ASTM Sequence V Surveillance Panel (18 Voting members) November 10, 2009 20 13

Name/Address	Phone/Fax/Email		Signature
Todd Dvorak Afton Chemical Corporation P.O. Box 2158 Richmond, VA 23218-2158 USA	804-788- 6367 804-788- 6388 todd.dvorak@aftonchemical.com	Non-Voting Member	Present
~~Frank Farber~~ Jeff Clark ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 USA	412-365-10~~30~~-2 412-365-1047 ~~fmf~~@astmtmc.cmu.edu jac	Non-Voting Member	Present
Gordon R. Farnsworth Infineum RR # 5 Box 211 Montrose, PA 18801 USA	570-934-2776 570-934-0141 gordon.farnsworth@infineum.com	Non-Voting Member	Present
Joe Franklin Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238 USA	210-523-4671 210-523-4607 joe.franklin@intertek.com	Non-Voting Member	Present
David L. Glaenzer Afton Chemical Corporation 500 Spring Street P.O. Box 2158 Richmond, VA 23218-2158 USA	804-788-5214 804-788-6358 dave.glaenzer@aftonchemical.com ~~Surveillance Panel Chairman~~	Non-Voting Member	Present
Irwin L. Goldblatt Castrol Americas 240 Centennial Avenue Piscataway, NJ 08854-3910 USA	732-980-3606 973-686-4224 irwin.goldblatt@cnacm.com	Voting Member	Present
Richard Grundza ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 USA	412-365-1031 412-365-1047 reg@astmtmc.cmu.edu	Voting Member	Present
Jerry Brys ~~Larry Hamilton~~ The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA	~~440-347-2326~~ 440-347-4096 ~~ldha@lubrizol.com~~	Non-Voting Member	Present (telephone)

Al Lopez

November 20th 2013 Sequence V Attendance

Kaustav Sinha. KSinha@chevron.com V KS
4800 Fournace Pl
Bellaire Tx 77401
Tel: 713 432 6642
Fax: 713 432 3330
Cell: 281-630-0965

Jeff Hsu
Shell
3333 Hwy 6 South
Mail Drop LI07C
Houston, TX 77082
Tel: 281-544-8619
FAX 281-544-8150
J.Hsu@shell.com V

Joe Gleason
440-520-9763
Joegle@lubrizol.com -NON-

Nathan Moles
NAML@Lubrizol.com
440 547 4472

Matt Bowden
MJBOWDEN@OHTECH.COM
OH TECHNOCOGIES
CHRIS TAYLOR
VP SPECIALTY CHEMICALS
CHRIS.TAYLOR@~~AEE~~ VPRACING.COM

Chad Stovell
SwRI
Office - 210-522-2712
cstovell@swri.org
Non CHS

Tracy King
Haltermann
~~TKing~~ tking@jhaltermann.com

Test Monitoring Center

http://astmtmc.cmu.edu

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ASTM D02.B1 Semi-Annual Report Passenger Car Reference Oil Testing

October 2013

Passenger Car Engine Oil Testing Executive Summary

- VG
  - Batch AK2821NX10-1 approved with correction factors.
  - Two results reported, no significant issues, both resulted in calibration.

Calibrated Labs and Stands*

Test	Labs	Stands
VG	3	6**

** 2 Stands have had calibration periods extended for fuel batch transition

*As of 9/30/2013

Test Activity Levels

- April 1, 2013 – September 30, 2013

Sequence Tests

Test Status	Validity Code	VG
Acceptable Calibration Test	AC	4
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	1
Fuel Approval	AF	24
Operationally Invalid, Lab & TMC	RC	0
Decoded/Donated	NN/AG	0
Total		**29**

Lost Tests*

Test Status	Cause	VG
Aborted	Cam Sensor Wiring Failed	1

*Invalid and aborted tests

Test Severity

- April 1, 2013 – September 30, 2013

Test Severity

- VG
  - AEV, RAC and APV in severity EWMA Warning alarm (Mild)
  - AES and OSCR are in control for severity and precision.

- Charts shown in Appendix 1.d.

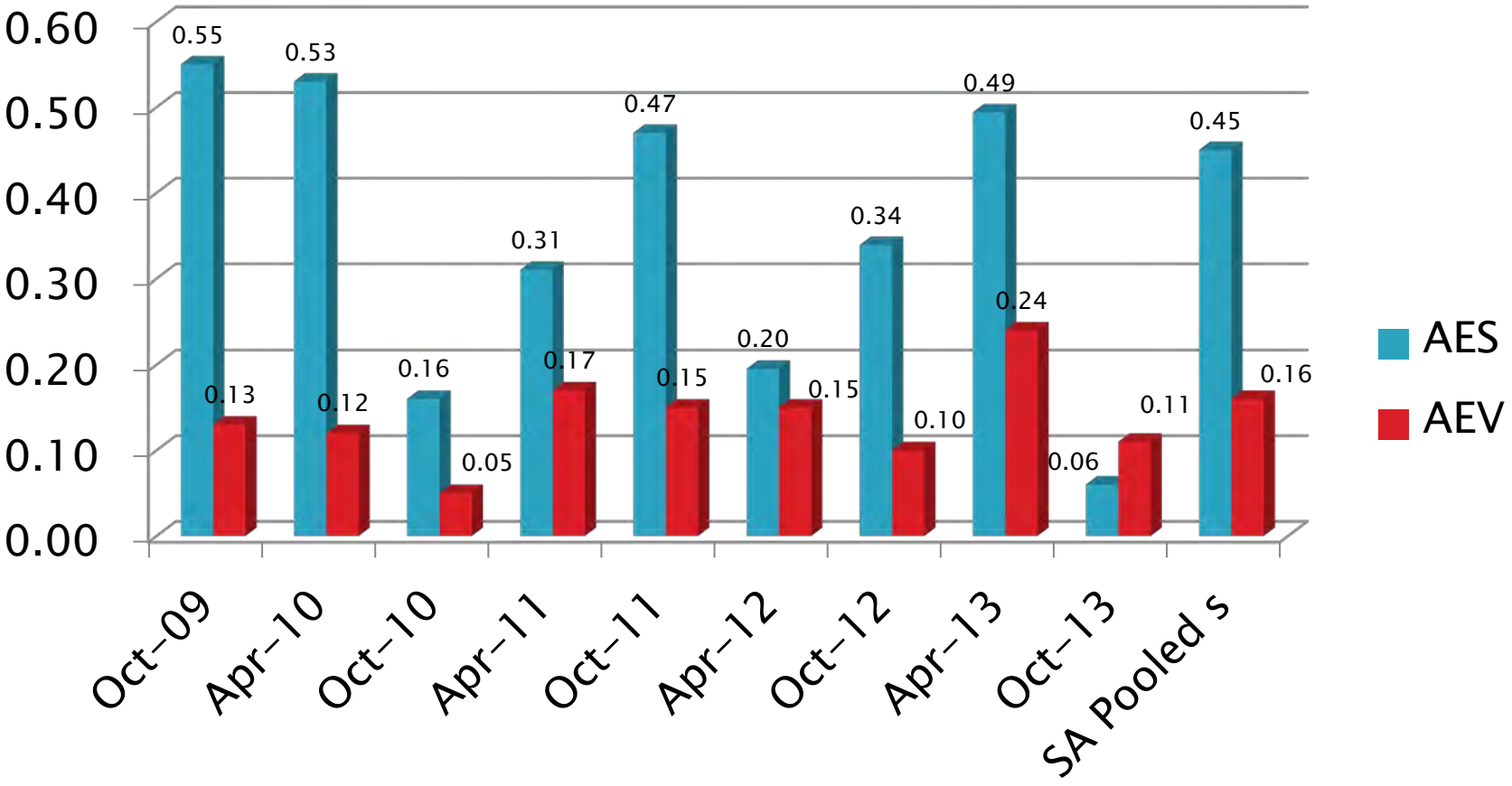
Test Precision

- April 1, 2013 – September 30, 2013

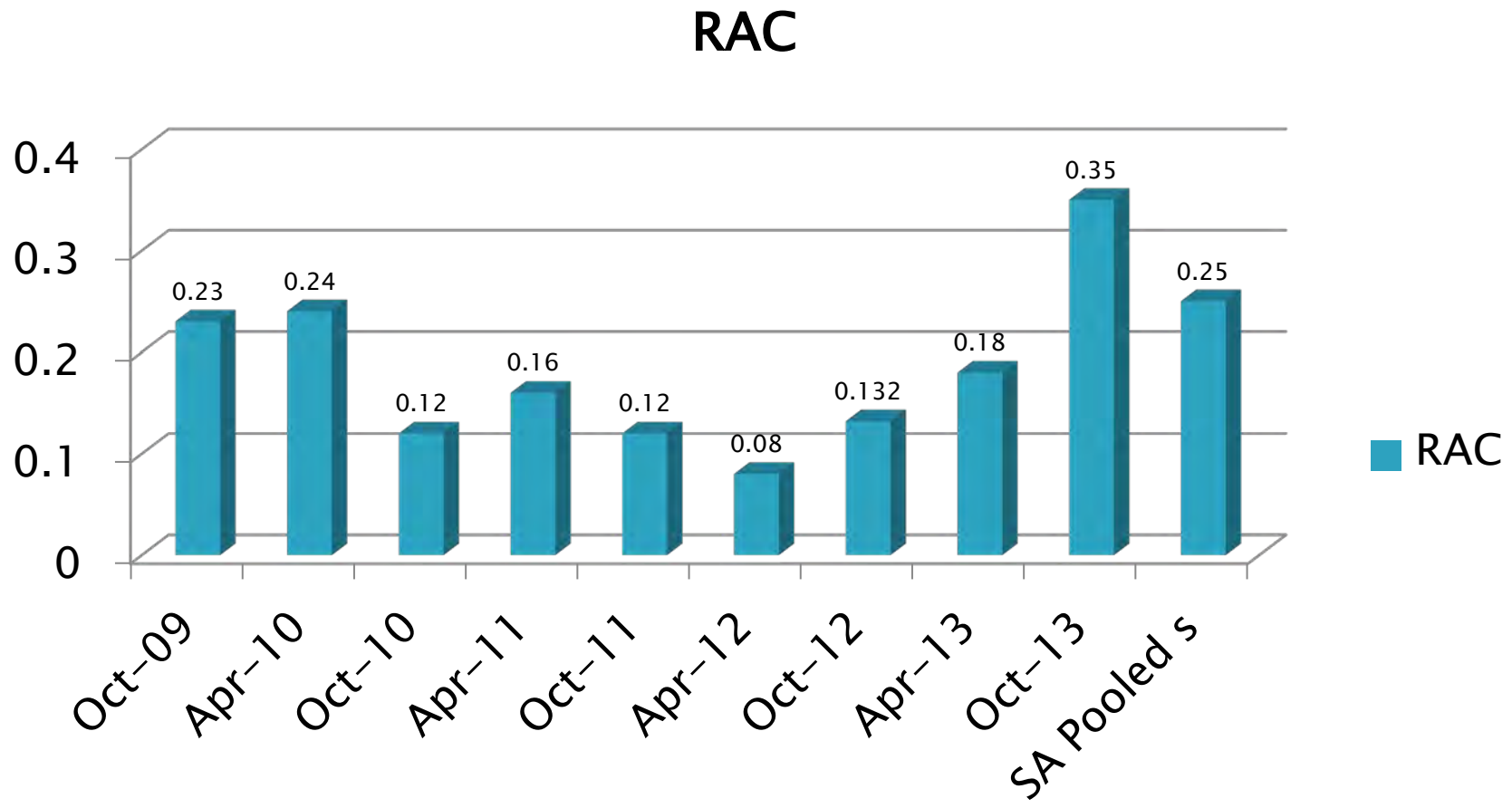
Test Precision Estimates

- Presented on a six month basis.
- Data presented for past four years.

Sequence VG Precision Estimates



Sequence VG Precision Estimates



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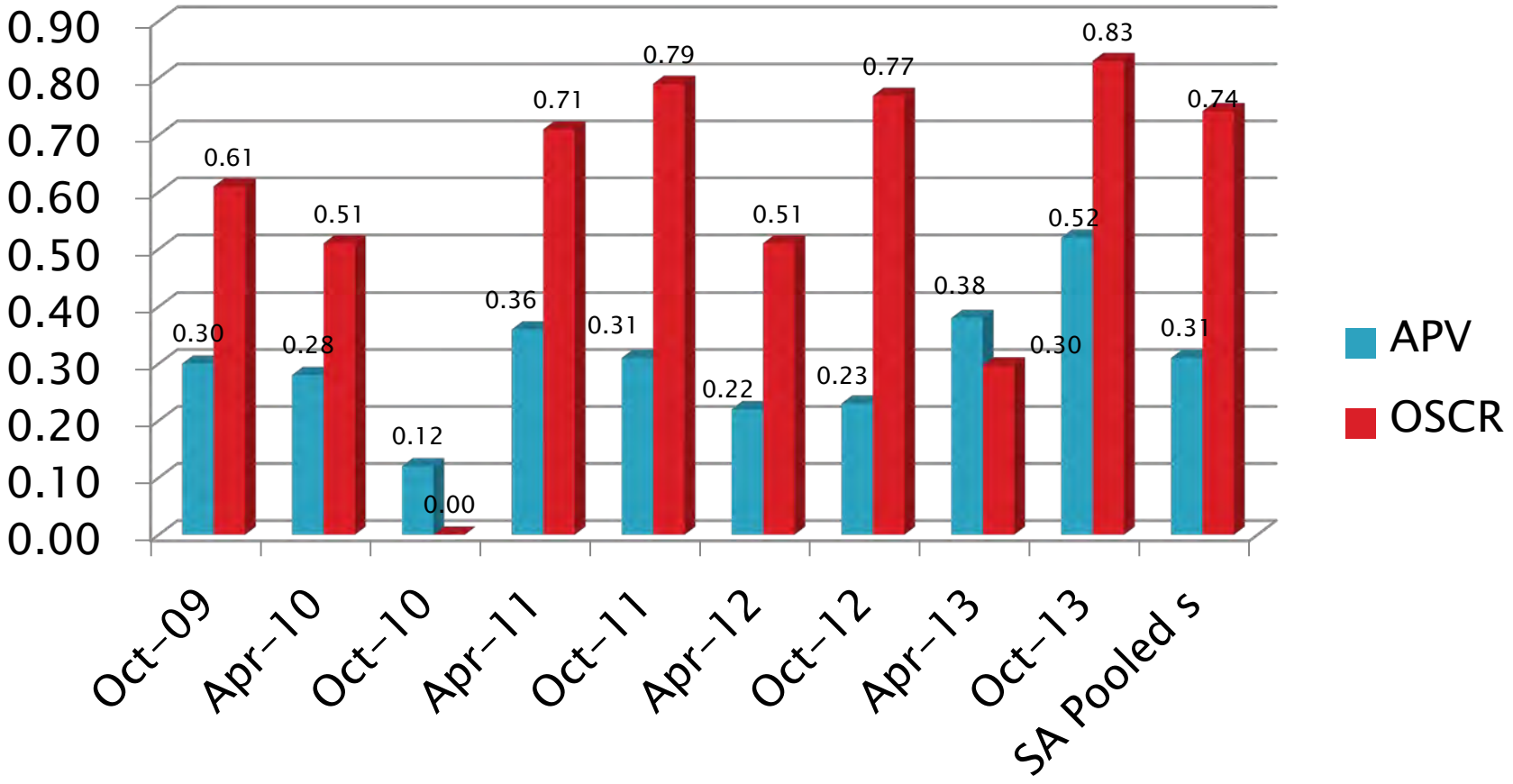


Information Letters

- April 1, 2013 – September 30, 2013

Information Letters*

Test	Date	IL	Topic
VG	20130925	13-2	Approved Fuel Batch AK2721NX10-1 and implemented correction factors for AES, RAC, AEV and OSCR and decreased the length of calibration periods.

*Available from TMC Website

Return to Exec. Summary

Reference Oil Inventory

- Actions, Re-blends, Inventories and Estimated Life

Test Area Timelines

- April 1, 2013 – September 30, 2013

Test Area Timeline Additions*

Test	Date	Topic	IL
VG	20130925	Adopted use of oil 1009 standard deviations for AES, AEV, APV and OSCR with reference oil 1006-2 and adopted new standard deviations for RAC for all reference oils and dropped precision for OSCR and increased shewhart limit to 2.0	
VG	20130925	Approved Fuel Batch AK2821NX10-1 and implemented correction factors for AES, RAC, APV and OSCR when using this fuel batch	13-1

*As of 09/30/2013

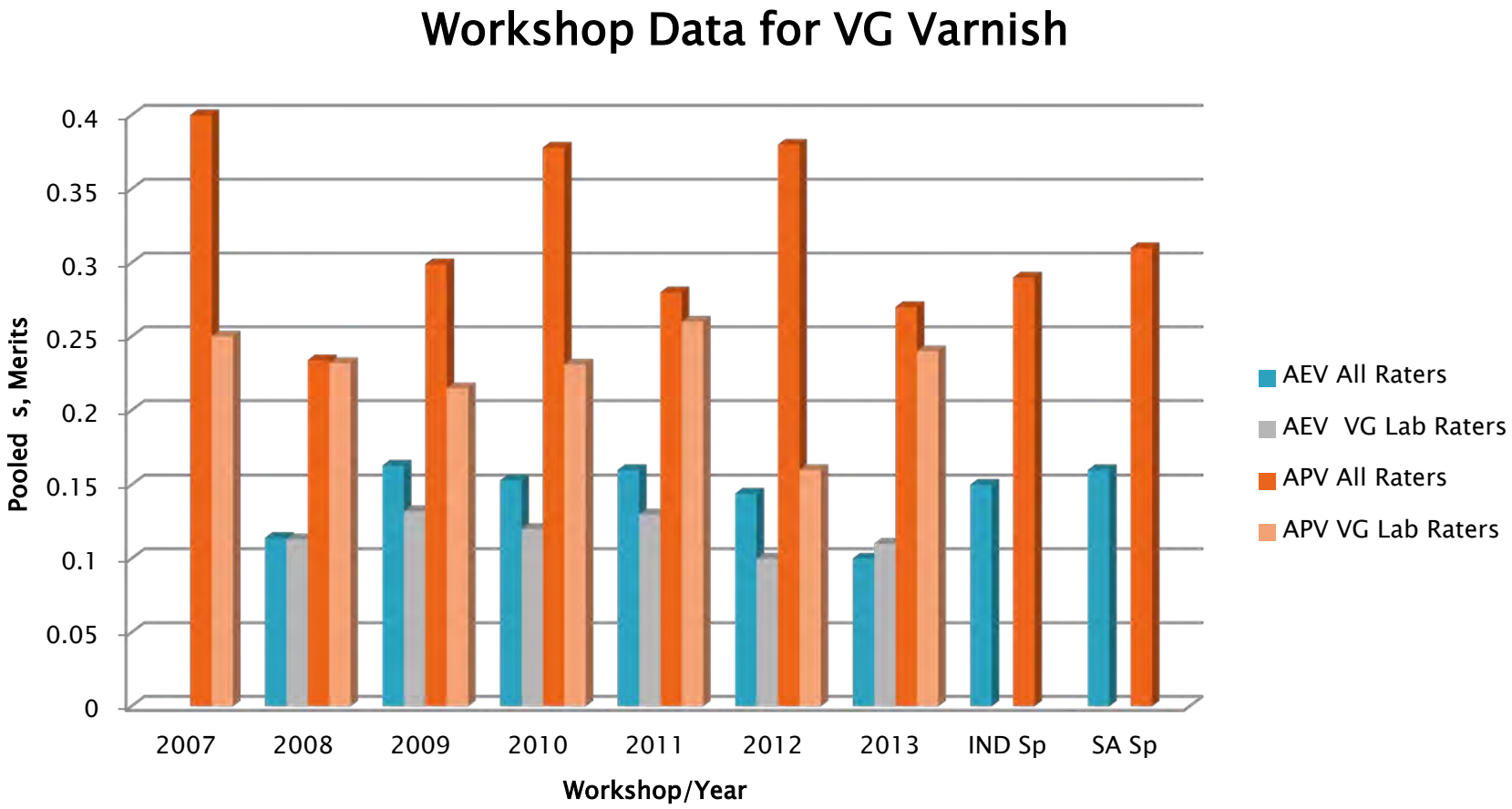
Additonal Information

- April 1, 2013 –
  September 30, 2013

Additional Information

- Summary of Precision Data From Light Duty Rating workshops:
  - VG Average Piston and Average Engine Varnish.
  - IIIG WPD.

Sequence VG Precision Estimates



Additional Information

- Available on TMC Website:
  - Live Reference Test Data Bases
  - Surveillance Panel Meeting Minutes
  - Test Area Alarm Logs
  - Complete Test Area Timelines
  - LTMS Manual

- www.astmtmc.cmu.edu

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Appendix 1
PCMO Reference Oil Testing Control Charts

October 2013

Appendix 1.d
Sequence VG Control Charts

- Severity, Precision, and CuSum

Test Monitoring Center
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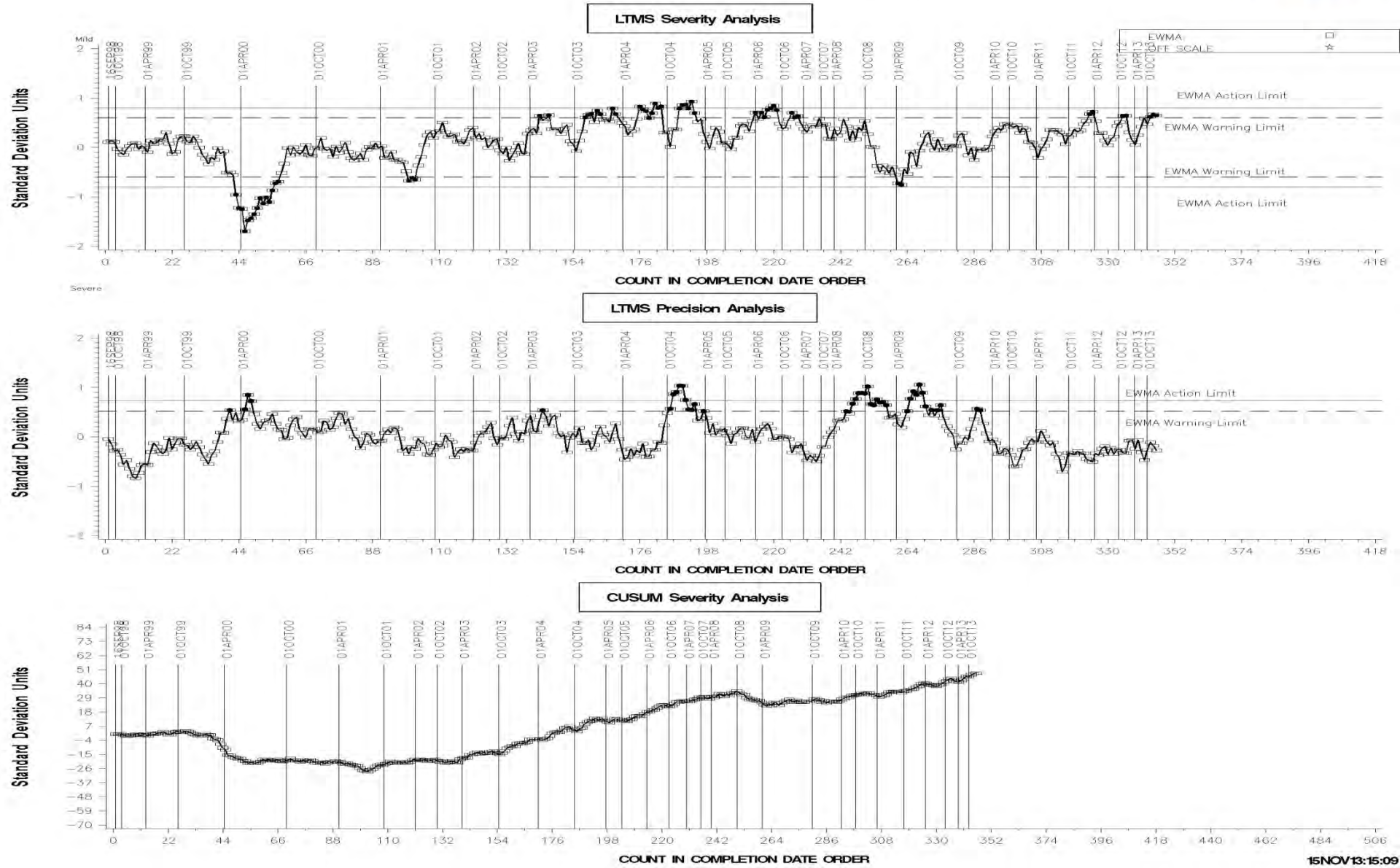
SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ENGINE SLUDGE



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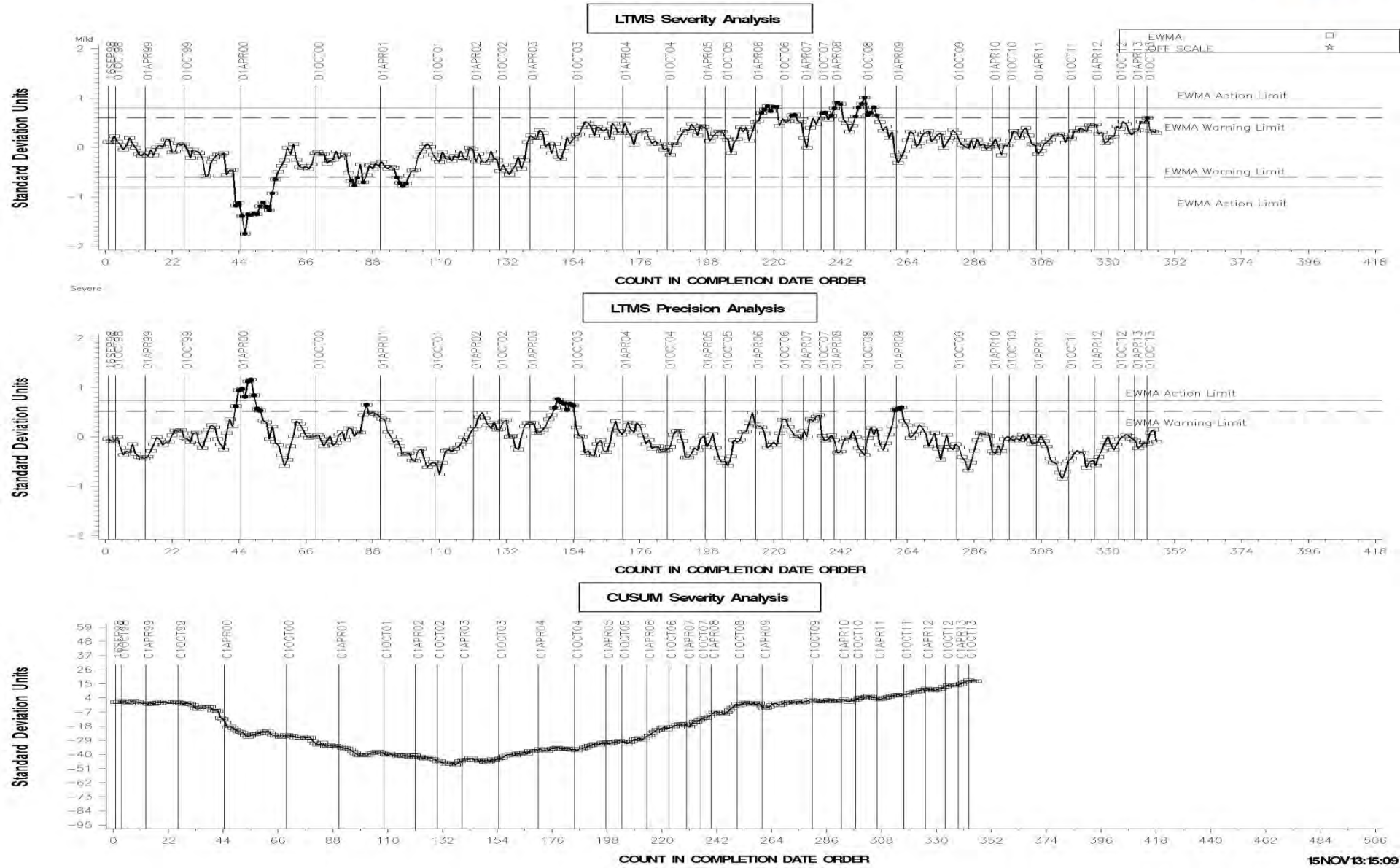
SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ROCKER COVER SLUDGE



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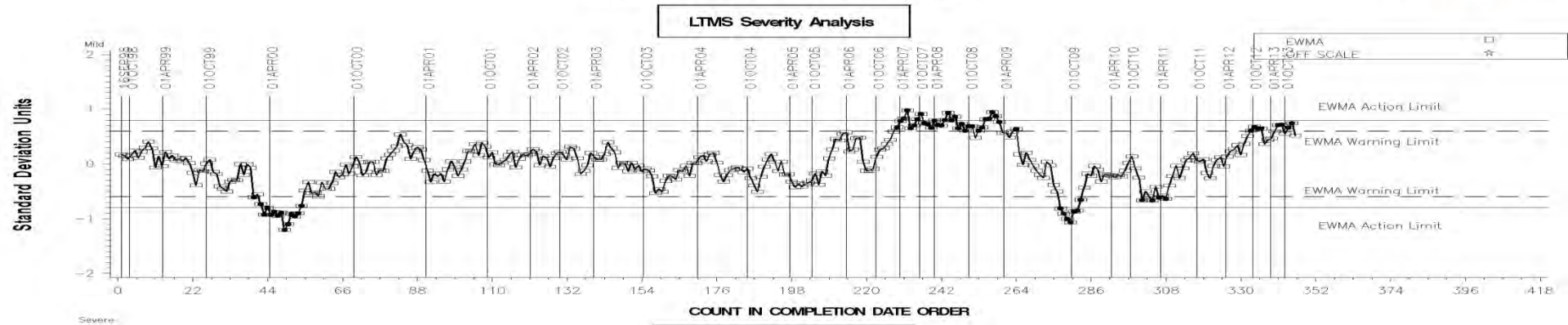
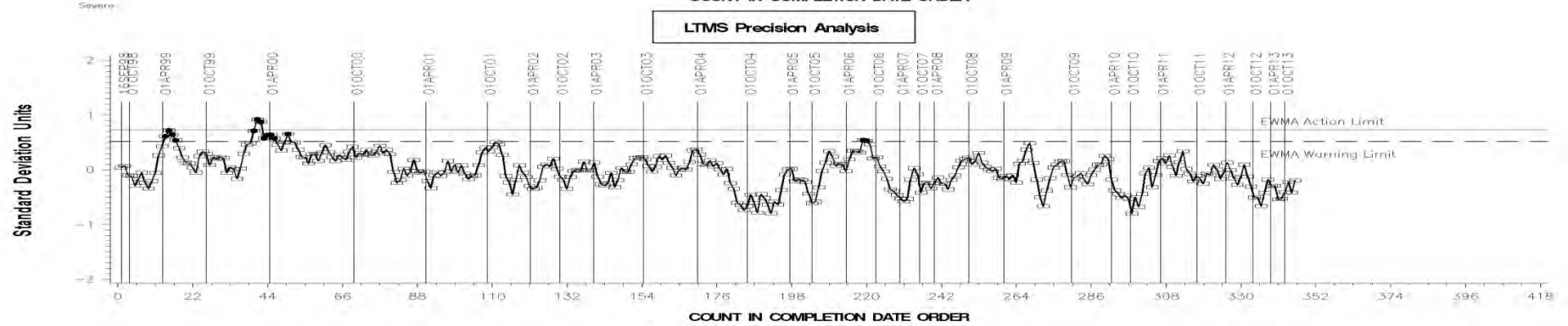
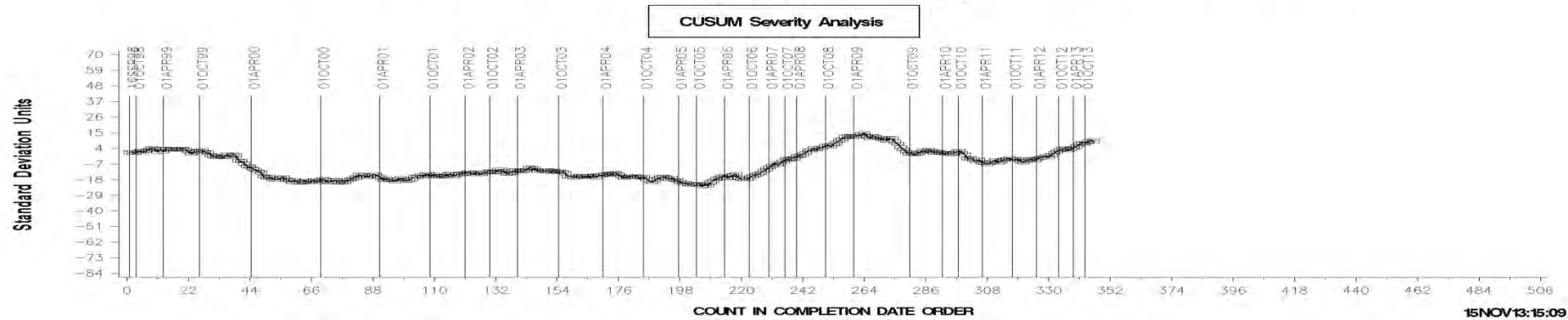
AVG. ENG. VARN. 3—PART APV + BAFFLES







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SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

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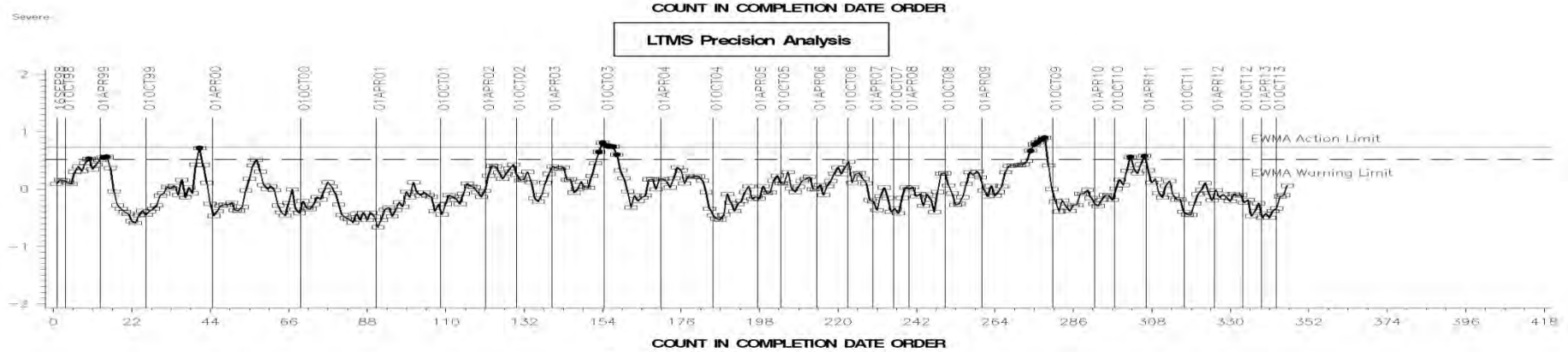
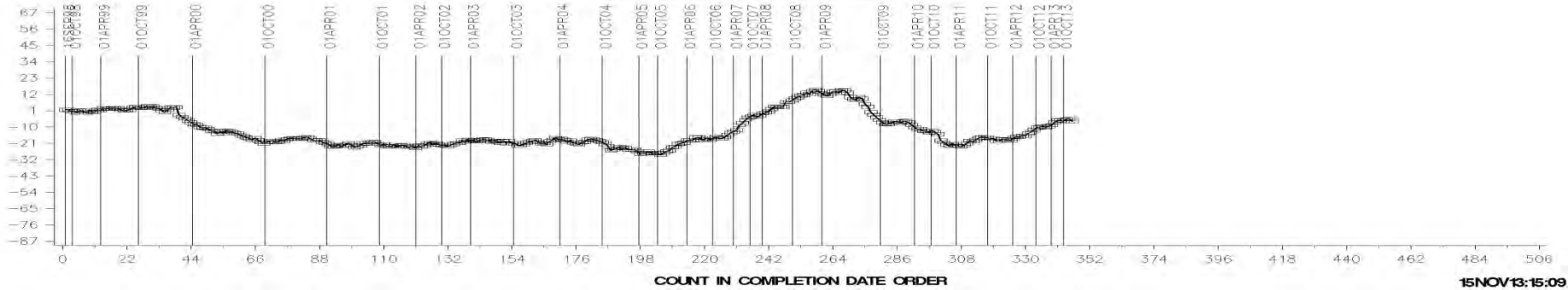
AVG PISTON SKIRT RATING

LTMS Severity Analysis

LTMS Precision Analysis



CUSUM Severity Analysis



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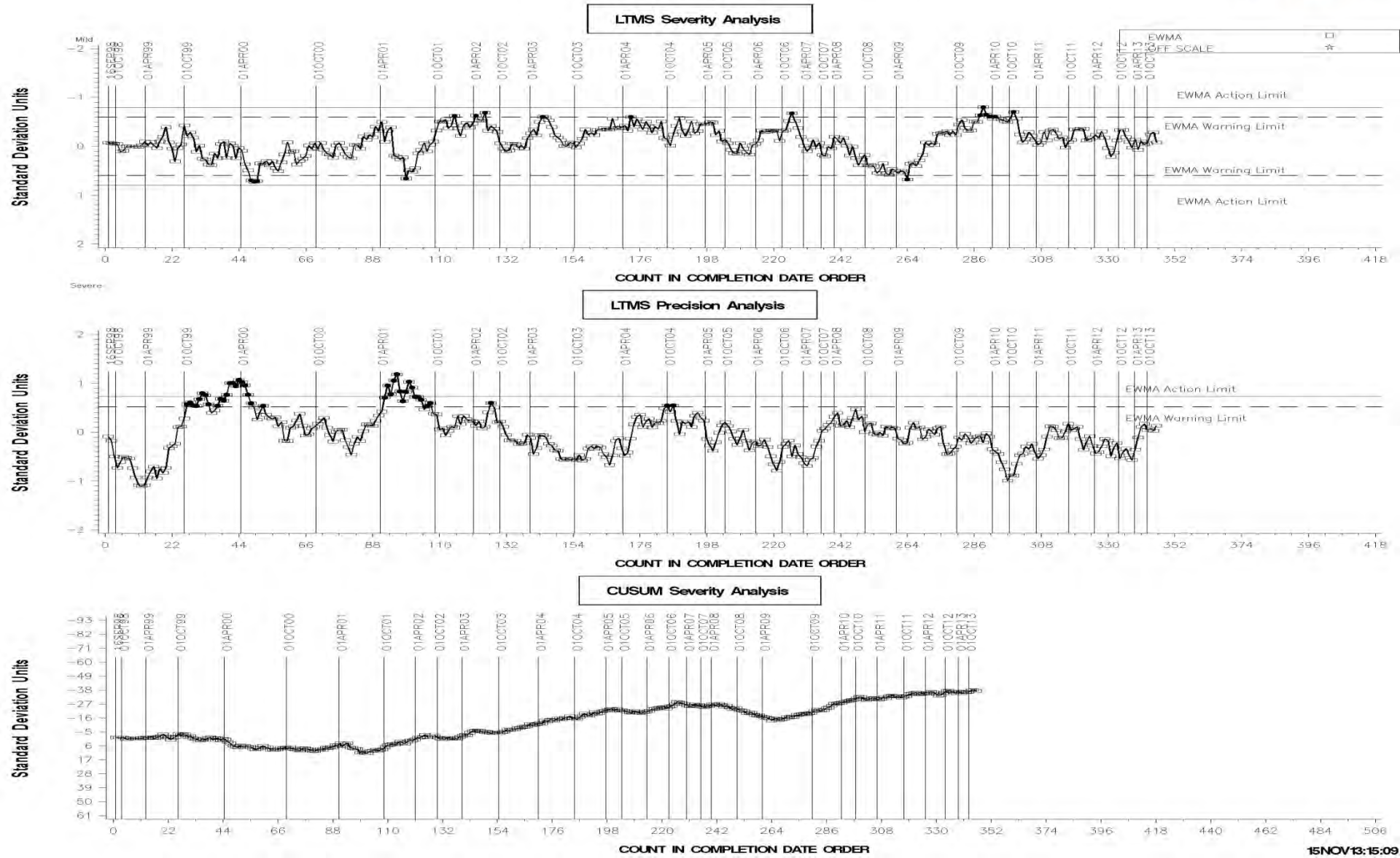
SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

OIL SCREEN SLUDGE



Return

Test Monitoring Center
http://astmtmc.cmu.edu

Sequence VG 940 Results

Sequence V Surveillance Panel

November 20, 2013

Summary of Results

- 12 tests reported from 3 labs
- 2 supplier results, 3 donated, 7 reference results.
- Summary in next few slides

Target Values

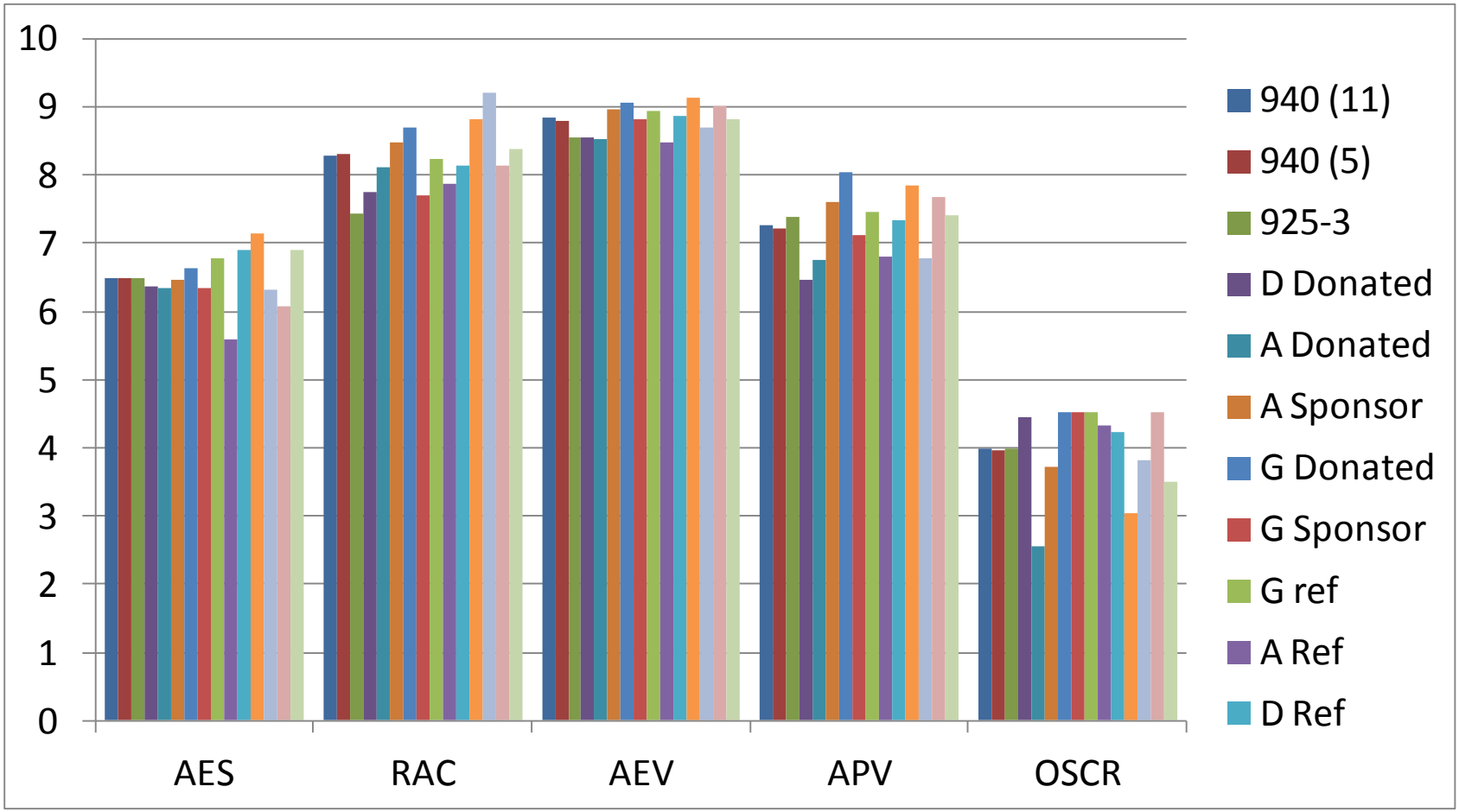
Lab	AES	RAC	AEV	APV	OSCR	OSCRTi
A	6.47	8.48	8.97	7.6	40	3.7136
G	6.34	7.7	8.82	7.12	90	4.5109
G	6.64	8.70	9.07	8.04	90	4.5109
A	6.34	8.11	8.52	6.75	12	2.5649
D	6.36	7.75*	8.55*	6.47	85	4.4543
G	6.78	8.24	8.94	7.45	90	4.5109
A	5.59	7.86	8.48	6.8	75	4.3307
G	7.15	8.82	9.13	7.85*	20	3.0445
D	6.9*	8.15*	8.86*	7.33	67	4.2195
A	6.32	9.2	8.69	6.77	44.5	3.8177
G	6.07	8.15	9.02	7.68	92	4.5326
G	6.91	8.37	8.97*	7.4	32.3	3.5056
Mean	6.49	8.29	8.84	7.27	52.3’	3.976
S	0.42	0.45	0.22	0.49		0.66
925-3	6.49	7.43	8.76	7.18	51 ‘	3.997
S	0.51[#]	0.92	0.25	0.63		0.84

*Laboratory SA’s applied

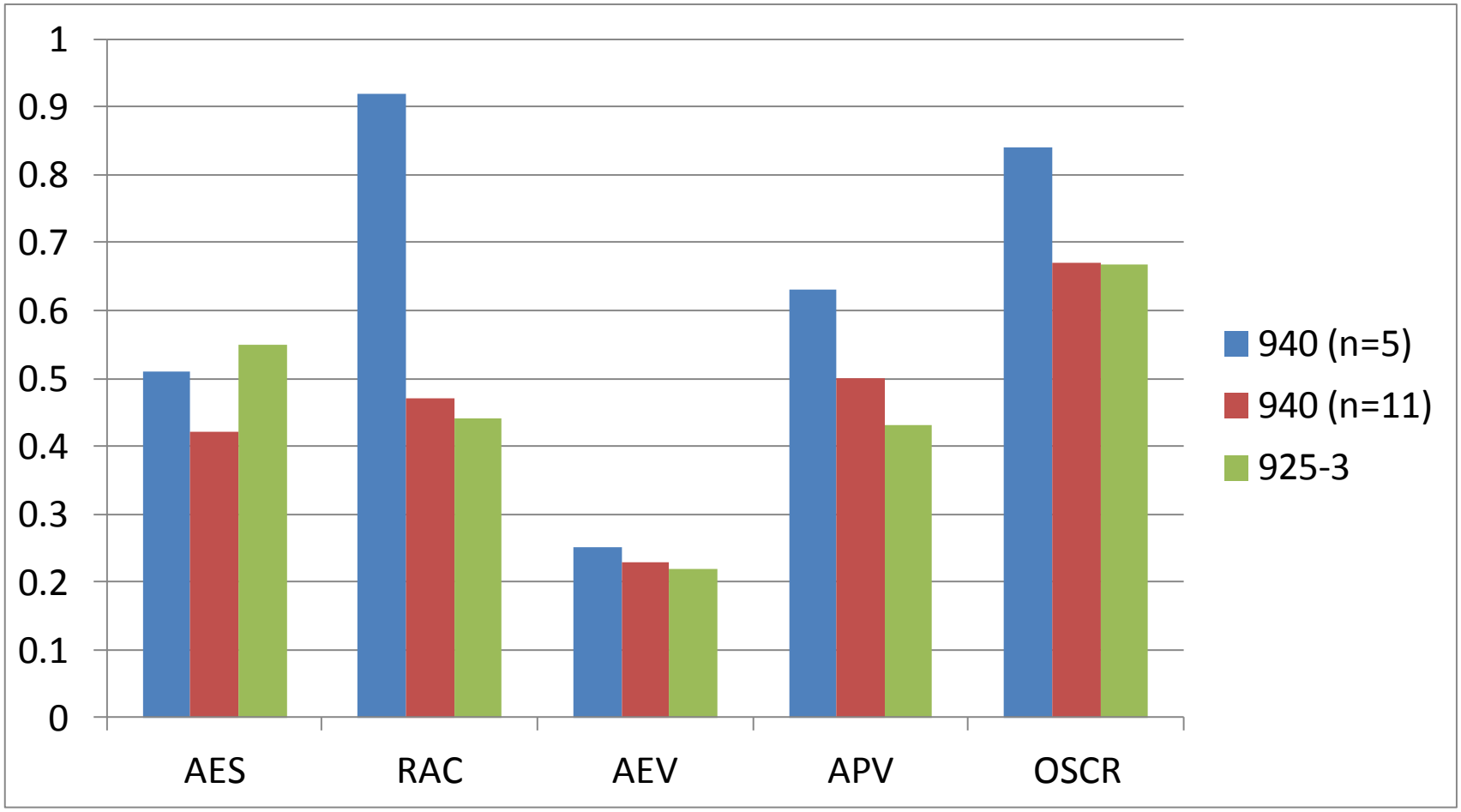
‘ Mean of transformed results converted back to original units.

[#] standard deviation pooled s from 925-3 (n=26) and 940 (n=5)

Comparison of Mean Performance of 940 (n=12) with 940 (n= 5) and 925-3 targets



Comparison of Standard Deviations of 940 (n= 12) with 925-3 and Current 940 targets (n = 5)



A Program of ASTM International

Sequence VG S.P. Report

Sequence VG S.P. Objectives

Objectives	Target Date
1. Prepare and evaluate a new batch of SVGM2 fuel.	Preparation started Q4 2012. Completed September 2013

Ford EngineTest Development Update

Sequence VH

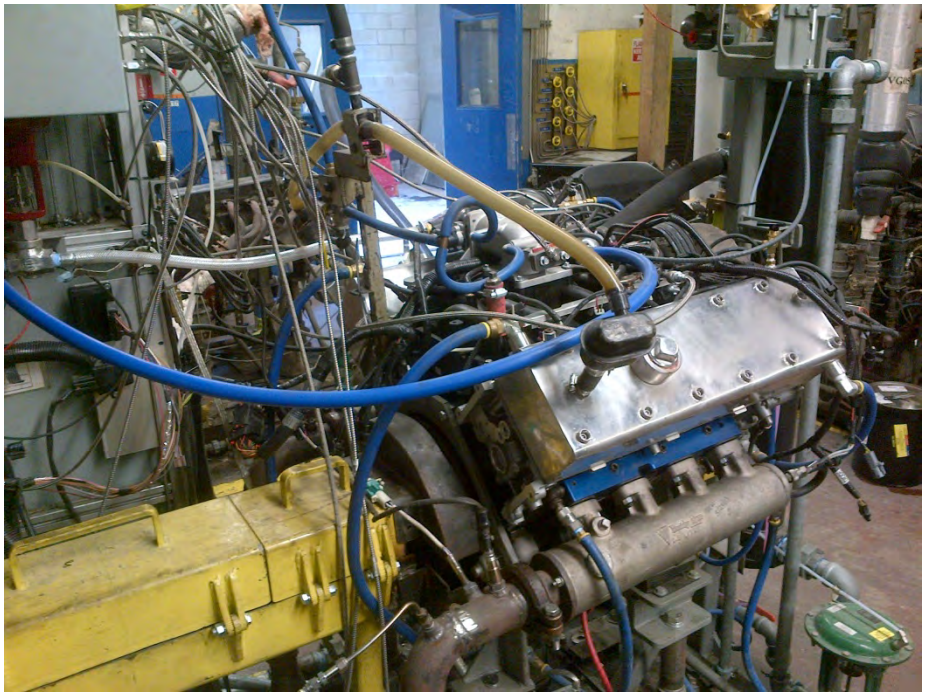
Chainwear

Low Speed Pre-ignition

Ron Romano
Ford Motor Company
November 19, 2013

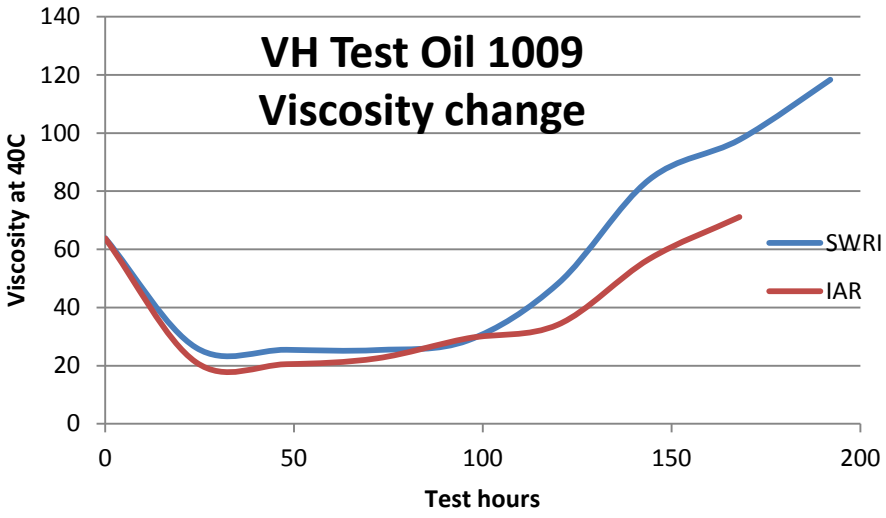
Sequence VH Sludge Test Overview

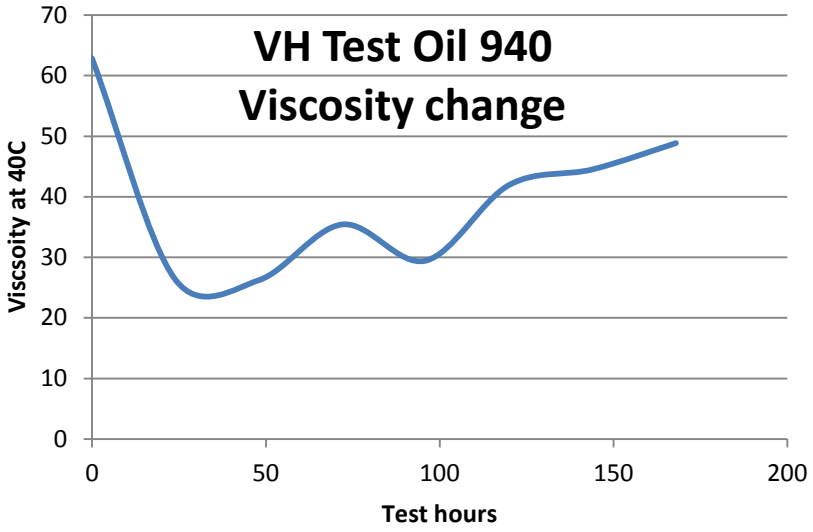
- 2013 4.6L 2V V8 engine
  - 178 Kw@4900
  - 389 N-m@4100
- Same 3 stage conditions as the Sequence VG.
- VG fuel
- Test duration TBD, possibly shorter than Seq VG.



Sequence VH (4.6L 2V)

VH Sludge and Varnish Ratings								FUEL DILUTION
	Test hours	AES	AEV	RAC	APV	OSC		
940 VG Historic		**6.55**	**8.60**	**8.68**	**7.10**	**77.71**		
VH 940 SWRI	144 Hours	7.78						
	168 Hours	7.18						
	180 Hours	6.90	7.86	7.99	6.71	95.00		22.30
1009 VG Targets		**7.94**	**8.99**	**9.29**	**7.79**	**8.00**		
VH 1009 SWRI	144 Hours							
	168 Hours	8.57						
	180 Hours	7.57		9.14		5.00		
	192 Hours	7.10	8.56	9.15	7.34	40.00		19.60
1009 IAR	168 Hours	7.82		9.10				
	180 Hours	7.19		9.3				19.4





Sequence VH Test Conditions

Condition	Stage I	Stage II	Stage III
Duration, min	120	75	45
Engine speed, r/min	1200 ± 5	2900 ± 5	700 ± 15
Engine power, kW	record	record	1.30 6 0.2
Manifold abs press, kPa (abs)	69 ± 0.2	66 ± 0.2	record
Engine oil in, °C	68 ± 0.5	100 ± 0.5	45 ± 1
Engine coolant out,° C	57 ± 0.5	85 ± 0.5	45 ± 1
Engine coolant flow, L/min	48 ± 2	record	record
Engine coolant pressure, kPa (gage)	70 ± 10	70 ± 10	70 ± 10
RAC coolant in, °C	29 ± 0.5	85 ± 0.5	29 ± 1
Rocker cover flow, L/min	15 ±1	15±1	15± 1
Intake, air, °C	30 ± 0.5	30 ± 0.5	30 ± 0.5
Intake air press, kPa (gage)	0.05 ± 0.02	0.05 ± 0.02	0.05 ± 0.02
Lambda, typical values	1.0	1.0	0.75
Blowby flow rate, avg, L/min	record	60-70	—
Intake air humidity, g/kg	11.4 ± 0.8	11.4 ± 0.8	11.4 ± 0.8
Exhaust back pressure, kPa abs	104 ± 2	107 ± 2	record
Fuel flow, kg/min	record	record	record
3000 gram oil charge			

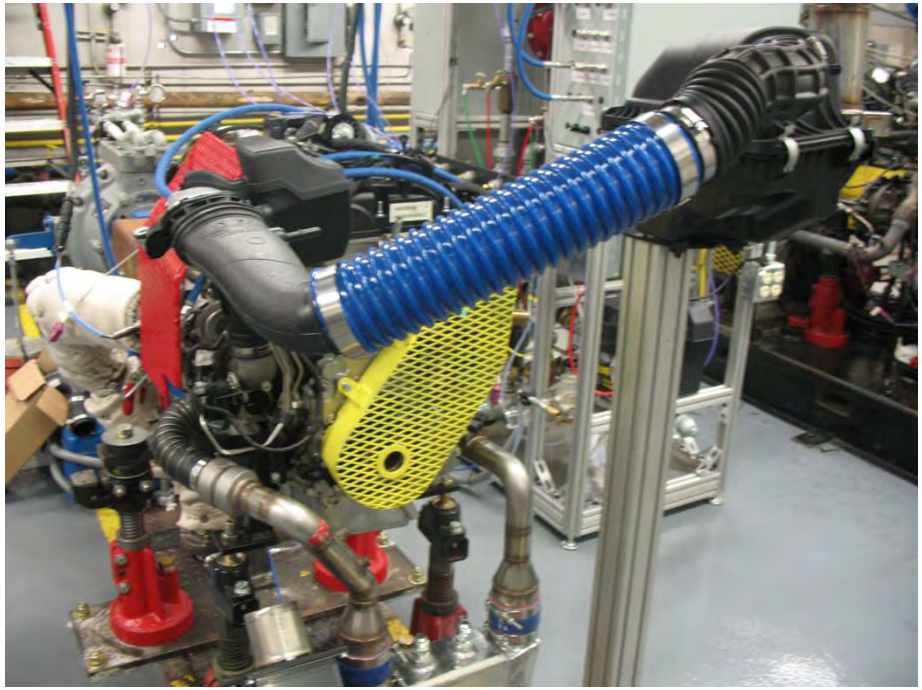
Additional testing:

1) Testing was conducted with no oil adds . Starting with a 4000 gram oil charge turned the test mild. 9+ AES after 192 hours on oil 1009

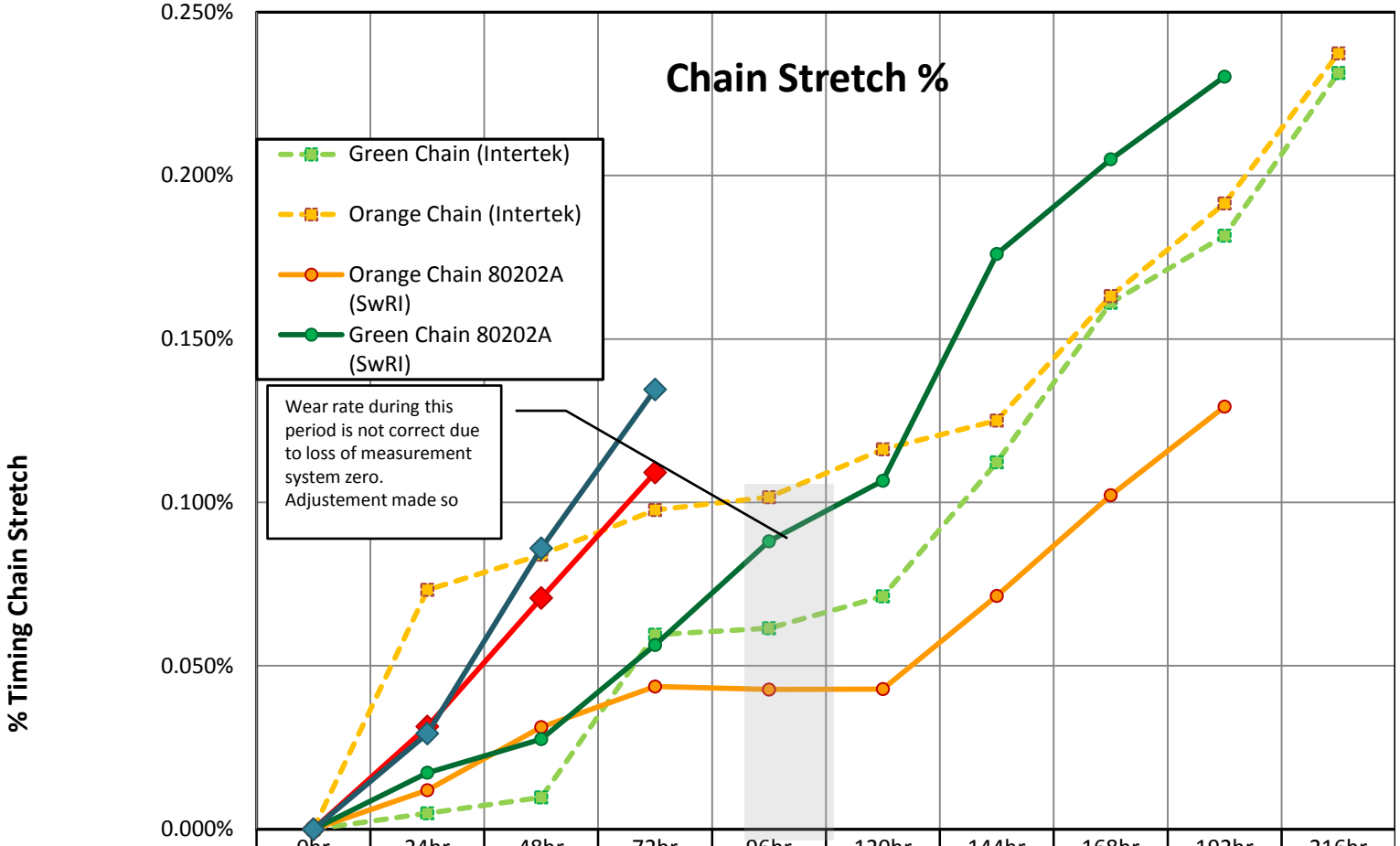
2) Investigating forced oil adds 200 grams of new oil every 24 hours starting at 72 hours and 3000 initial oil charge.

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.



Chain Wear (2.0LGTDI)



	0hr	24hr	48hr	72hr	96hr	120hr	144hr	168hr	192hr	216hr
Green Chain (Intertek)	0.000%	0.005%	0.010%	0.060%	0.062%	0.071%	0.112%	0.161%	0.182%	0.231%
Orange Chain (Intertek)	0.000%	0.073%	0.084%	0.098%	0.102%	0.116%	0.125%	0.163%	0.191%	0.237%
Orange Chain 80202A (SwRI)	0.000%	0.012%	0.031%	0.044%	0.043%	0.043%	0.071%	0.102%	0.129%	
Green Chain 80202A (SwRI)	0.000%	0.017%	0.028%	0.056%	0.088%	0.107%	0.176%	0.205%	0.230%	
Orange 80166A (SwRI)	0.000%	0.031%	0.071%	0.109%						
Green 80166A (SwRI)	0.000%	0.029%	0.086%	0.135%						

Chain Wear (2.0LGTDI)

IAR Chemical Analysis

TEST HRS	FUEL DIL.	Fe	TAN	TBN	TGA% Soot	VIS 100 C	VIS 40 C	1ST BB l/m	2nd BB l/m
0	1.5	0	2.24	5.7	0.052	9.95	58.76	41.00	75.44
24	14.8	30	1.86	4.5	0.163	6.46	31.19	38.93	70.26
48	9.5	43	2.43	3.3	0.257	6.35	31.1	41.27	69.47
72	11.6	59	2.78	2.6	0.462	6.26	30.51	36.07	66.14
96	7.5	69	2.82	1.5	0.583	6.07	29.2	39.19	73.74
120	7.8	87	3.5	0.6	0.721	5.98	28.86	33.77	69.70
144	8.6	109	3.99	1.1	0.903	5.9	28.31	35.28	65.91
168	10.2	150	4.3	0.9	1.043	5.86	28.43	33.03	64.56
192	10.1	182	4.85	0.9	1.191	5.81	28.11	34.97	70.40
216		274	5.47	0.9	1.408	5.71	27.42	35.29	67.87
240									

SWRI Chemical Analysis

TEST HRS	FUEL DIL.	Fe	TAN	TBN	TGA% Soot	VIS 100 C	VIS 40 C	1ST BB l/m	2nd BB l/m	
0	0	3	1.43	5.88	0.104	9.371	54.751	48.72	64.7	
24	14	26	1.12	3.59	0.242	7.049	36.104	41.93	52.23	
48	5.4	47	1.49	2.5	0.39	8.166	42.753	32.42	74.43	
72	8.3	57	1.77	1.26	0.502	6.375	31.714	49.41	71.36	
96	9.6	66	2.14	0.69	0.617	5.948	28.775	44.68	62.87	
120	8.8	82	2.31	0.42	0.792	6.201	30.995	36.12	58.95	
144	9.3	105	2.52	0.34	0.865	5.709	27.363	37	70.66	
168	8.2	145	2.98	0.25	1.114	6.213	31.428	47.42	72.79	
192	7.3	170	3.37	0.19	1.164	6.345	31.874	45.34	63.73	
216	7.7	215	3.56	0.18	1.398	6.376	32.707	35.07	55.53	New Chain
240	7.8	297	4.14	0.11	1.622	6.355	32.781	34.28	59.86	

New chain installed at 192 hours to see wear rate in used oil

Chain Wear Test Conditions

Condition	Stage 1	Stage 2
Duration, min	120	60
Speed (rpm)	1550	2500
Torque (N-m)	50	128
Engine oil in, °C	50+/- 0.5	100+/- 0.5
Engine coolant out,° C	45+/- 0.5	85+/- 0.5
Engine coolant pressure, kPa (gage)	70 +/- 10	70 +/- 10
PCV cooler coolant in, °C	20+/- 0.5	85+/- 0.5
PCV cooler flow, L/min	12 +/-1	12+/-1
Intake, air, °C	30+/- 0.5	30+/- 0.5
Intake air press, kPa (gage)	0.05 +/- 0.02	0.05 +/- 0.02
Air/Fuel Ratio (lambda)	0.78	0.98
Blowby flow rate, SOT, L/min record		60-70
3600 gram initial oil charge, no oil additions		

30 minute temp ramp between stages
30 sec speed/load ramp between stages
Ramp time is not counted in the stage time

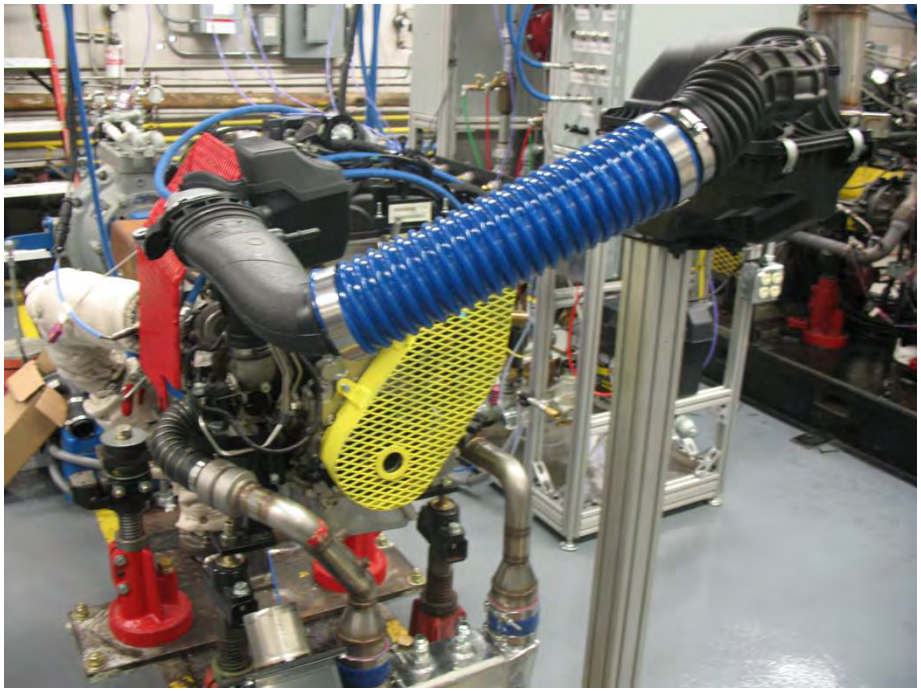
Low Speed Pre-Ignition Test Overview

- Test engine: 2012 Ford 2.0L, EcoBoost, 4-cylinder

  178Kw@5500

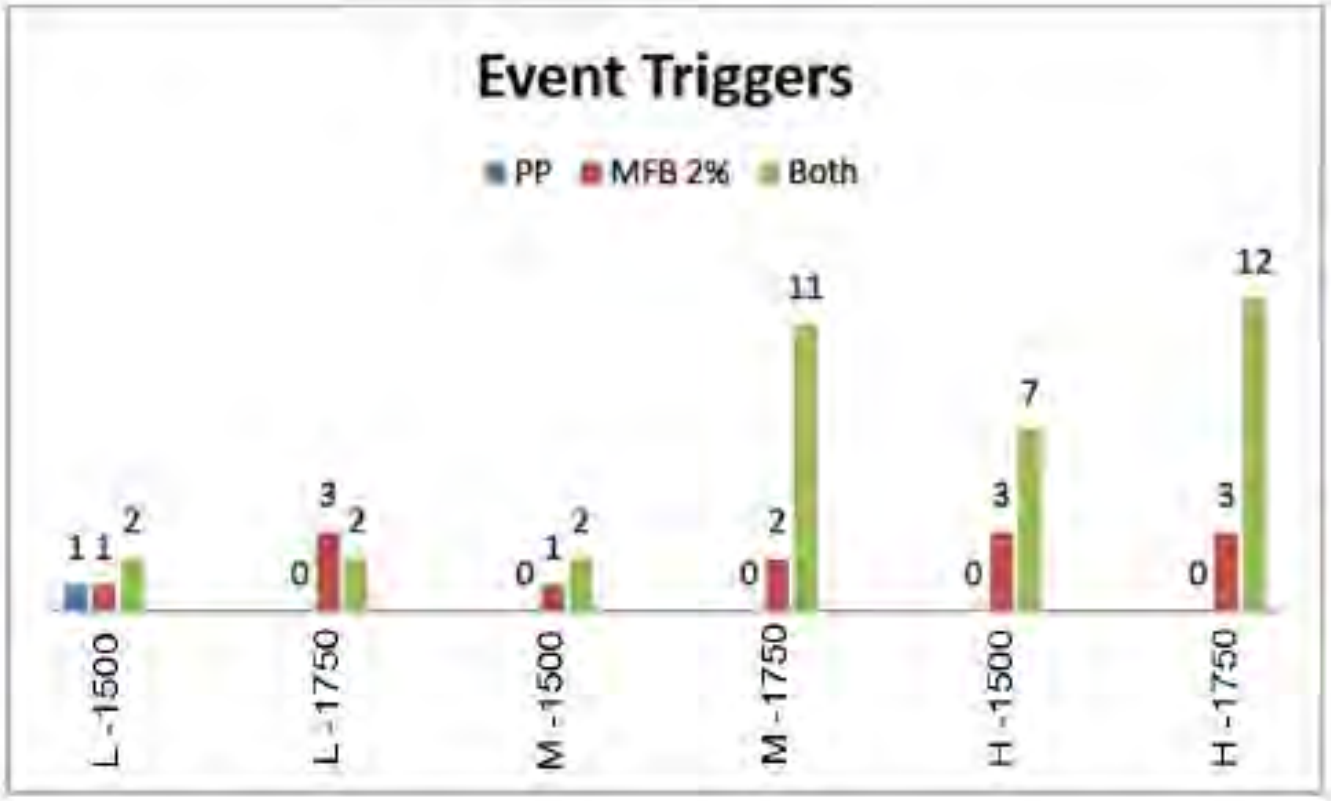
  366N-m@3000

- Combustion analysis data acquisition system: AVL IndiSmart Gigabit 612
- Running conditions
  - Low speed, < 2000 rpm
  - High Load, >70% max BMEP



LSPI Results

4 hour test duration
1500 RPM/80% BMEP
1750 RPM/80% BMEP
Test run on 3 oils with low, medium and high tendency to cause LSPI



Sequence V Surveillance Panel
November 20, 2013
10:00AM – 1:00PM
Southwest Research Institute
San Antonio, TX

Motions and Action Items
As Recorded at the Meeting by Bill Buscher

1. Action Item – Surveillance panel to address RO 1010 use in the VH.

2. Action Item – TEI to place another order for camshaft bearings.