Sequence III Surveillance Panel
Meeting Minutes
April 2, 2013
Southwest Research Institute
San Antonio, TX

1.0) Attendance

The attendance is shown in **Attachment 1**. Motions and actions items from this meeting are shown in **Attachment 2**.

2.0) Approval of minutes

The minutes from February 26, 2013 teleconference were approved without objection.

3.0) Action Item Review

3.1) Review of RO 434/RO434-1 FTIR data - D. Boese

No new data has been received; subsequently this item has been dropped from panel business.

4.0) Old Business

4.1) Update on Sequence IIIF RO 433-1 tests completed with BC 11 rings - R. Grundza

Attachment 3. The panel had previously agreed to run tests on a new rings due to a manufacturer change. Two tests have been run to date; SwRI stated they can run in the next few weeks, Lubrizol stated their run depends upon stand calibration status. Both tests run to date would fail on SACLW and one test would have failed APV. The panel will review this situation further (see Section 5.2 under New Business).

4.2) Recent experiences with cylinder heads - E. Altman

Attachment 4. Ed inform the panel of a situation where a pin hole in the head caused significant oil consumption. They have seen this problem twice. SwRI had seen this in the past as well. Ed advised the lab to check the heads before testing.

4.3) Report on work at Southwest Research Institute with cylinder head valve seat replacement - P. Lang

Attachment 5. SwRI's study indicates that the valve seat recession seems related to whether or not the valve rotates (a lot of recession indicates the valve was rotating). SwRI has been using EOT head seal vacuum checks and compression checks during

the test to identify the seat recession. Pat stated that the culprit appears to be intake seat widening. SwRI has experimented with hardened seats and identified a material (seat material is a Stellite material) that has significantly improved the situation in regards seat recession. Pat noted that there appears to be a reduction in viscosity increase with the hardened seats. SwRI felt that resolving the recession could also reduce the number of blown head gaskets. Charlie Leverett stated that if the change to the seats is adopted, we would likely see a change in severity that would need to be investigated/resolved. Rich Grundza asked if this would apply to the IIIF as well; Pat stated they haven't investigated that, but his gut feel was that it would.

After a short meeting break to examine some heads, Pat finished the presentation with some recommendations (slide 19 of Attachment 5). Jeff Kettman of GM Racing stated that they are open to the idea of installing intake valve inserts during the new head machining process. A lengthy discussion, covering a range of related topics (test life, hardware supply, introduction process, etc) took place, resulting in ***items 1 through 7*** of the motions and action items shown in **Attachment 2**.

Dave Glaenzer asked the panel to consider the scope of a program needed to introduce this with reference oil testing. Dave also thanked SwRI for all their efforts in this study and stated that the panel will continue to work through this issue.

5.0) New Business

5.1) Sequence IIIF PVIS. All

Following up from previous meetings dealing Seq. IIIF severity issues, Jessica Buchanan presented a proposal (**Attachment 6**) to monitor PVIS using hours. Following the presentation, the meeting broke for lunch. The meeting resumed after lunch at 1 p.m. Chair Glaenzer opened the floor to any motions. George Szappanos (Leverett second)moved to adopt the recommendations as put forth by the proposal.

During the discussion that followed several points were made and questions were asked, some of which are captured below:

- Bruce Matthews of GM stated that he didn't feel it was appropriate to make this a permanent solution.

- Jason Bowden asked that if an engineering solution is found, would this change then be dropped; general agreement indicated that it would be.

- Bruce Matthews asked if the next reblend (433-2) should be introduced before implementing the proposal.

- Charlie Leverett asked what would happen if a lab shifts mild.

- Robert Stockwell asked how many tests worth of 433-1 remained. Rich Grundza indicated it was about 22.

Based upon a concern of Bruce Matthews, the proposal was modified to have a review conducted in 6 months (or sooner) rather than year (change was accepted by motioner and seconder)

Jeff Clark of the TMC advised that details of implementation would need to be worked through for any proposal that is approved by the panel. TMC also requested that the SP send written notification to both class panels concerning the proposal.

At the conclusion of the discussion, the chair called the question on the motion (**item 8** of **Attachment 2**). The motion passed 8-0-8. The passing motion also resulted in the actions items shown in **Attachment 2** as **items 9 through 12**.

The TMC will take action to advise on the implementation progress, so that an official date can be set as implementation gets close; Jeff Clark will aid a 'fast-track' for report form beta test. Dave Glaenzer will notify PC and HD class panels of impending changes.

5.2) Sequence IIIF SACLW Reference Limits. Chadwick

Presented by Charlie Leverett, **Attachment 7**. The concern was the SACLW limits are the same as candidate and may not be appropriate. Two possible solutions that were proposed were to either remove the SACLW for 433-1 or to only judge 433-1 lifter wear against the limit of 20 microns. At the request of the panel, Rich Grundza presented a chart of the percent of reference tests failing SACLW by year (**Attachment 8**). Charlie Leverett moved to remove SACLW as a pass/fail criteria for RO 433-1; the motion died for lack of a second. After further discussion, Charlie re-moved the same motion, which was then seconded by Pat Lang. The motion failed to carry 4-4-9.

5.3) Introduction of RO 433-2 for IIIF test. Grundza

Rich Grundza indicated that the TMC anticipates that 433-2 will soon be available and the panel will need to eventually determine an implementation method. The panel will revisit this item at a future conference call (or meeting).

6.0) Review Scope and Objectives

Reviewed by Chairman Glaenzer, shown in **Attachment 9**.

7.0) Next Meeting / Adjournment

A teleconference will be held to finalize the implementation date for the IIIF proposal. The meeting adjourned at 3 p.m.

ATTACHMENT 1

ASTM Sequence III Surveillance Panel (20 Voting members) date: 04/02/2013

Name/Address	Phone/Fax/Email		Signature
Ed Altman Afton Chemical Corporation 500 Spring Street Richmond, VA 23219 USA	804-788-5279 804-788-6358 ed.altman@aftonchemical.com	Voting Member	Present
Art Andrews ExxonMobil Products Research 600 Billingsport Rd. Paulsboro, NJ 08066 USA	856-224-3013 arthur.t.andrews@exxonmobil.com	Non-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

ASTM Sequence III Surveillance Panel (17 Voting members) date:

Name/Address	Phone/Fax/Email		Signature
Matt Bowden OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 USA	440-354-7007 440-354-7080 mjbowden@ohtech.com	Non-Voting Member	Present
Jerome A. Brys Lubrizol Corp. 29400 Lakeland Blvd. Wickliffe, Ohio 44092 USA	440 347-2631 jerome.brys@lubrizol.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 Corporation 500 Spring Street Richmond, VA 23219 USA	804-788-5340 804-788-6358 bob.campbell@aftonchemical.com	Non-Voting Member	Present
James Carter Haltermann Solutions 2296 Hulett Rd. Okemos, MI 48864 USA	517-347-3021 517-347-1024 jecarter@jhaltermann.com Cell: 517-896-0897	Non-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

ASTM Sequence III Surveillance Panel (17 Voting members) date:

Name/Address	Phone/Fax/Email		Signature
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~~ Sidney.Clark@swri.org	Non-Voting Member	Present
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 ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 USA	412-365-1030 412-365-1047 fmf@astmtmc.cmu.edu	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

ASTM Sequence III Surveillance Panel (17 Voting members) date:

Name/Address	Phone/Fax/Email		Signature
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
Jeff Kettman GM Racing 5388 Hill 23 Drive Flint, MI 48507 USA	313-667-0493 313-319-0139 – cell jeff.kettman@gm.com	Voting Member	Present
Tracey King Haltermann Solutions MI USA	947-517-4107 tking@Jhaltermann.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
Teri Kowalski Toyota Motor North America, Inc. 1555 Woodridge Ann Arbor, MI 48105	734-995-4032 734-995-9049 teri.kowalski@tema.toyota.com	Voting Member	Present
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	Voting Member	Present

ASTM Sequence III Surveillance Panel (17 Voting members) date:

Name/Address	Phone/Fax/Email		Signature
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
Mike McMillan	mmcmillan123@comcast.net	Non-Voting Member	Present
Timothy Miranda BP Castrol Lubricants USA 1500 Valley Road Wayne, NJ 07470 USA	973-305-3334 973-686-4039 Timothy.Miranda@bp.com	Voting Member	Present
Mark Mosher ExxonMobil Technology Co. Billingsport Road Paulsboro, NJ 08066 USA	856-224-2132 856-224-3628 mark.r.mosher@exxonmobil.com	Voting Member	Present
Siamak Moshiri Cad Railway Industries Ltd. 155 Montreal – Toronto Highway H8S 1B4 Montreal, QC, CANADA	1-634-3131, ext. 412 smoshiri@cadrail.ca	Non-Voting Member	Present
Bob Olree 5388 Hill 23 Drive Flint, MI 48507 USA	248-689-3078 olree@netzero.net	Non-Voting Member	Present
Christian Porter Afton Chemical Corp. 500 Spring Street Richmond, VA 23219 USA	804-788-5837 804-788-6358 christian.porter@aftonchemical.com	Non-Voting Member	Present
Phil Rabbat BASF Corporation 500 White Plains Road Tarrytown, NY 10591-9005 USA	914-785-2217 914-785-3681 phil.rabbat@basf.com	Non-Voting Member	Present

ASTM Sequence III Surveillance Panel (17 Voting members) date:

Name/Address	Phone/Fax/Email		Signature
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
Scott Rajala Idemitsu Lubricants America Corp.	srajala@ilacorp.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 By Phone
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	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 Shank Volvo	301-790-5817 greg.shank@volvo.com	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

ASTM Sequence III Surveillance Panel (17 Voting members) date:

Name/Address	Phone/Fax/Email		Signature
Don Smolenski ~~GM~~ Evonik	248-255-7892 ~~donald.j.smolenski@gm.com~~	Non-Voting Member	Present
Mark Sutherland Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249-3423 USA	msutherland@tei-net.com	Non-Voting Member	Present
George Szappanos The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA	440-347-2352 440-347-4096 greg.seman@lubrizol.com	Voting Member	Present
Haiying Tang Chrysler LLC USA	248-512-0593 ht146@chrysler.com	Voting Member	Present
Joe Vujica The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA	440-347-2057 440-347-4096 jsvu@lubrizol.com	Non-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
Tom Wingfield Chevron Phillips Chemical Co.	wingftm@cpchem.com	Non-Voting Member	Present

Robert Stockwell GM

Karin Haumann SwRI

Jessica Buchanan LZ

Scott Stap Chevy Performance

Adam Sworski Ashland Inc aesworski@ashland.com

Jim Linden TOYOTA LINDENJIM@HOTMAIL.COM

Attachment 2

Sequence III Surveillance Panel
April 2, 2013

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

1. Action Item – Surveillance panel chair to issue a survey to the labs and parts suppliers to generate a current critical parts inventory.

2. Action Item – SwRI to provide information to GM on their valve seat insert work.

3. Action Item – GM to investigate the feasibility of installing intake valve seat inserts during the normal new head machining process.

4. Action Item – If feasible, GM to produce a pilot batch of cylinder heads with intake valve seat inserts. Start with a minimum of 2 sets of heads per lab (12 sets total), 1 set of new heads and 1 set of used heads.

5. Action Item – All labs to send 1 set of cleaned used heads to GM for remanufacturing.

6. Action Item – GM to measure and compare the used heads to GM's manufacturing specifications to ensure that all parameters fall within specification.

7. Motion – Labs to measure and record cylinder compression at the end of the timing run and at the end of test on all IIIF and IIIG reference tests. It is also up to the lab's discretion on measuring and recording cylinder compression at intermediate intervals (10, 20, 30, 40, 50, 60, 70 on IIIF and 20, 40, 60, 80 hours on IIIG). Labs to also measure and record intake valve seat recession on all IIIF and IIIG reference tests. TMC to provide a format for reporting this data. Measurement procedures to be defined by SwRI.

   Charlie Leverett / Jason Bowden / Passed Unanimously 17-0-0

8. Motion – Implement IIIF PVIS60 and PVIS80 industry correction factors as per the IIIF surveillance panel statistics task force recommendations found in the proposal to monitor IIIF oxidation using HOURS. Review an analysis of HOURS severity semi-annually or whenever a potential engineering solution to PVIS severity has been identified. Effective date targeted for 4 – 6 weeks from today.
   - Adopt the HOURS to 275% calculations for Reference Oil 433-1 as described here, and use HOURS to monitor IIIF Oxidation in LTMS.
     - Recalculate LTMS history using RO 433-1 and use only RO 433-1 in LTMS.
     - Add the Industry Correction Factor (ICF) of 10 HOURS to RO 433-1 PVIS results after 6/13/2010.
   - Apply Industry Correction Factor (ICF) of -10 HOURS to where candidate oil PVIS80 is measured.
     - ICF = -10 hours
   - Apply Industry Correction Factor (ICF) of -5 HOURS to where candidate oil PVIS60 is measured.
     - ICF = -5 hours
   - Apply Severity Adjustments to PVIS60 that are 0.5 that of the PVIS80 Severity Adjustment.

   George Szappanos / Charlie Leverett / Passed 8-0-8

9. Action Item – Surveillance panel chair to inform PCEOCP and HDEOCP of surveillance panel motions and actions with regards to IIIF PVIS industry correction factors.

10. Action Item – TMC to follow up with DCC to expedite implementation of IIIF report packet changes.

11. Action Item – Surveillance panel chair to schedule a follow up conference call to discuss implementation date of IIIF PVIS industry correction factors.

12. Action Item – Labs to recreate LTMS history use only RO 433-1 with the Yi's calculated using HOURS as per the IIIF surveillance panel statistics task force's proposal to monitor IIIF oxidation using HOURS.

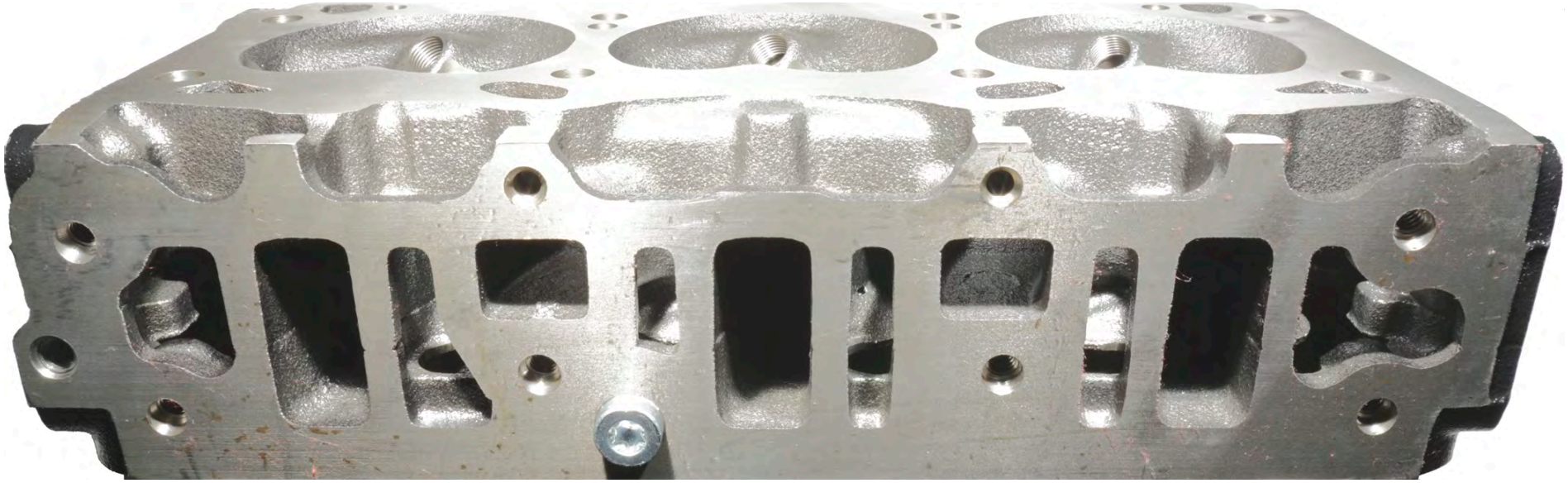
13. Motion – Remove SACLW acceptance limits for RO 433-1. Effective April 16, 2013.

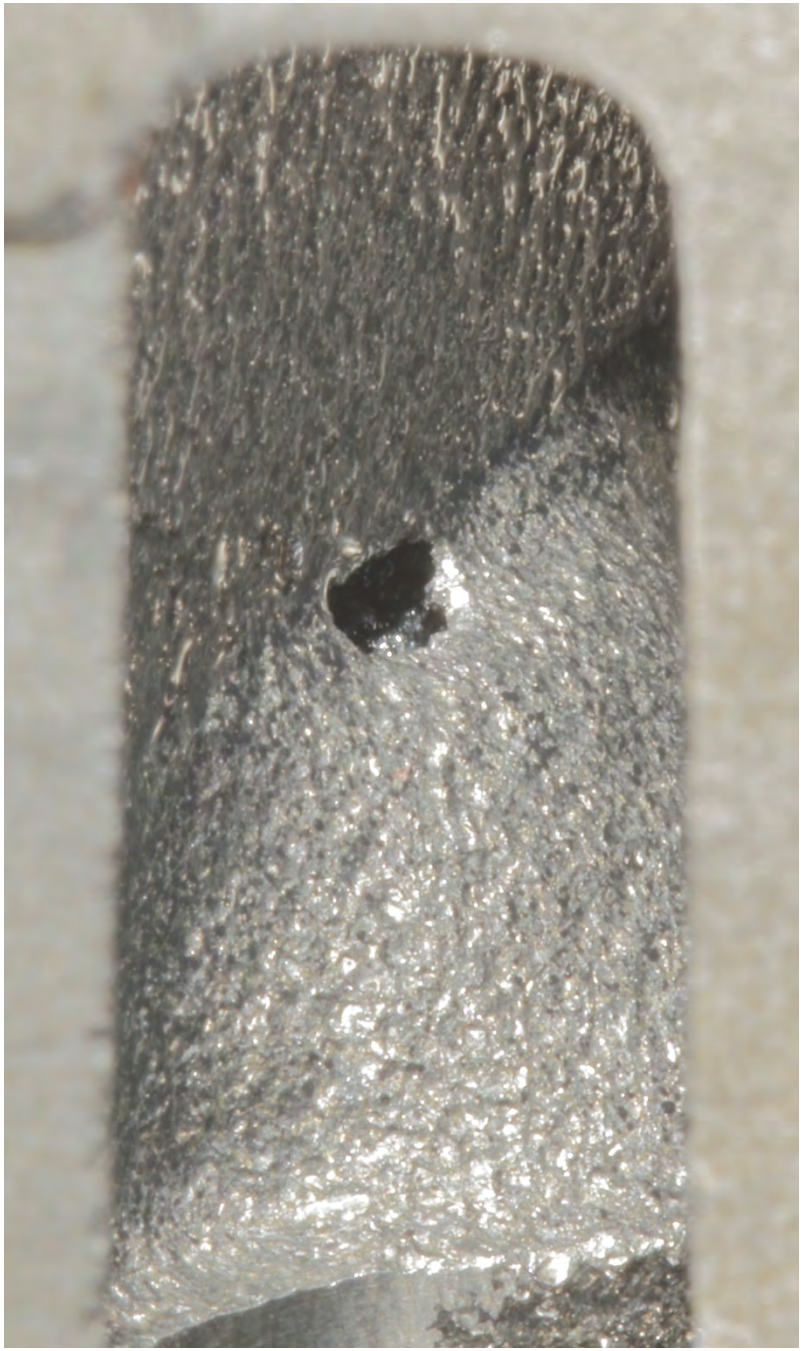
    Charlie Leverett / Pat Lang / Failed 4-4-9

ATTACHMENT 3

TESTKEY	LTMSLAB	IND	PVIS	PVISyi	APV	APVyi	WPD	WPDyi	PV60yi	OILCON	SACLW
93099-IIIF	M2	433-1	37.5	-0.007	9.88	1.9333	4.45	-0.2009	1.5145	3.85	27.8
92481-IIIF	G	433-1	58.6	-1.0877	9.75	1.5	4.5	-0.1291	1.3481	4.7	137.7
				-0.54735		1.71665		-0.165	1.4313	4.275	

ATTACHMENT 4





ATTACHMENT 5

Sequence III Intake Valve Seat Studies

By Patrick Lang and Sid Clark, SwRI

Presented April 2, 2013

Sequence III Valve Recession

- Surveillance Panel has been aware of the Sequence III valve recession for years.
- End of test inspections of cylinder heads at SwRI suggests that valve recession is related to whether or not the intake valve rotates during engine operation.
- Based on a visual inspection of the valve tip, the valves that recede always exhibit a wear pattern that suggests rotation.

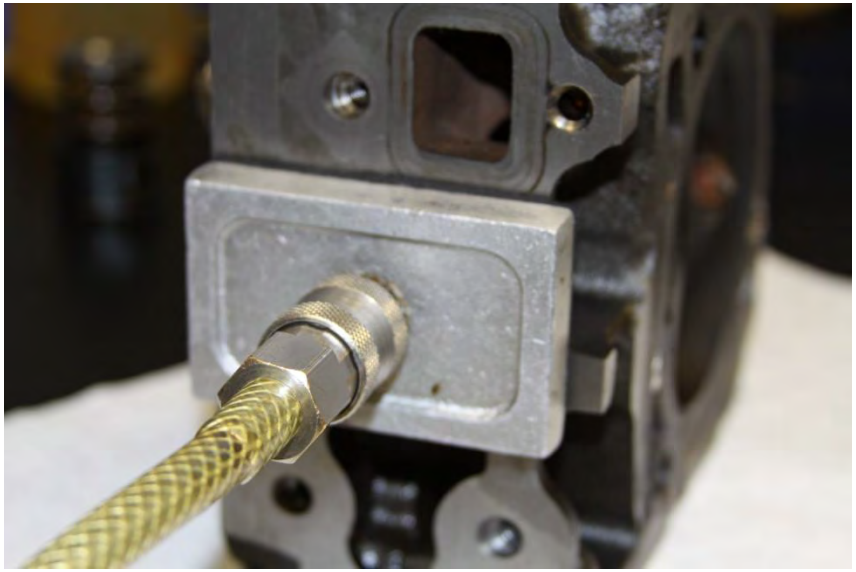
Intake Valve Tip w/out Rotation

Intake Valve Tip with Rotation

Additional EOT Valve Seat Observations

- Although valve recession is very undesirable and needs to be corrected it may not be the worst of the problems that we have with Sequence III cylinder heads.
- Studies at SwRI have identified that the intake valve seats are losing their sealing ability as the test is running.

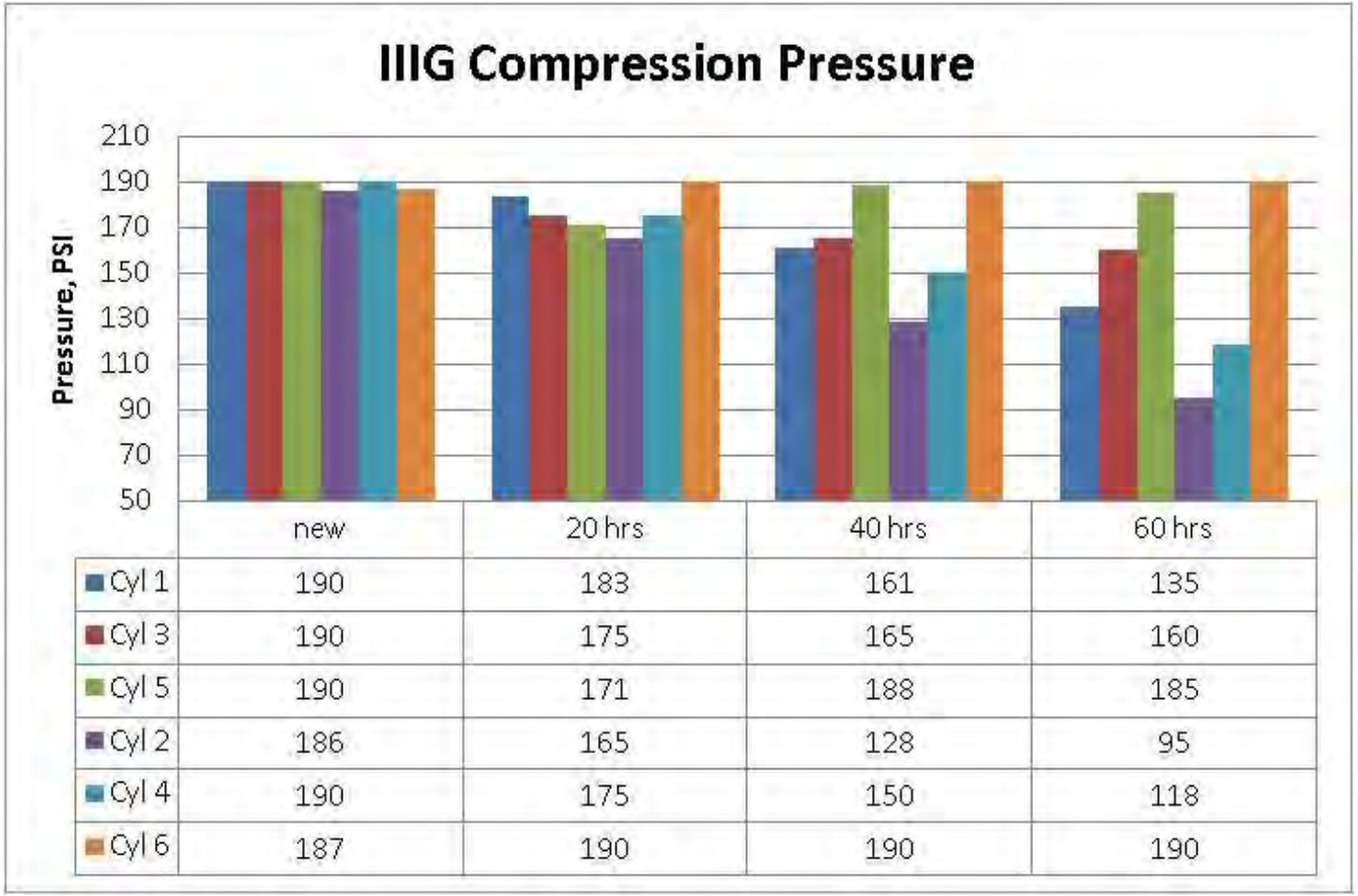
Cylinder Head Valve Seat Seal Checking Apparatus



IIIG Typical Cyl Head Sealing Check

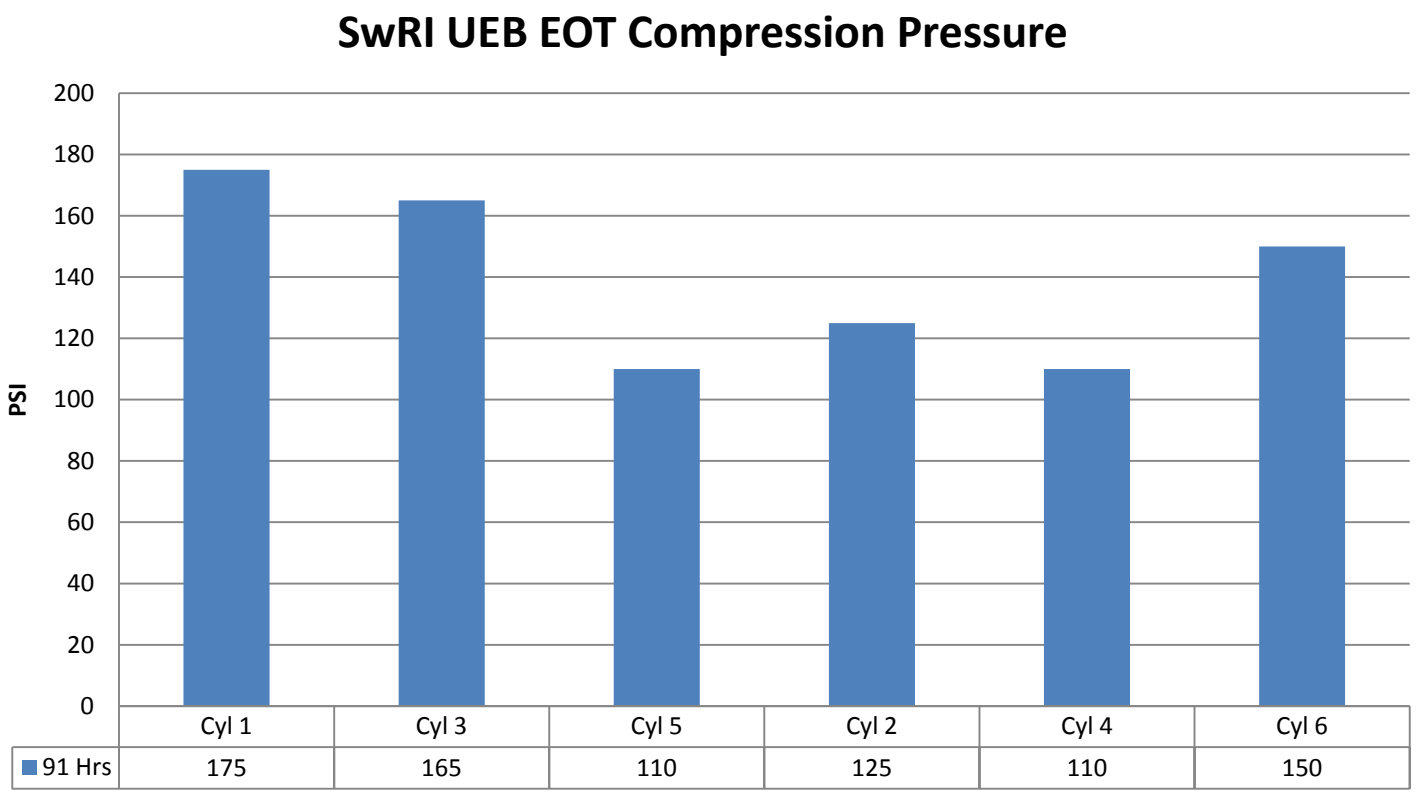
Cylinder	SOT Intake Valve Vacuum Check	SOT Exhaust Valve Vacuum Check	EOT Intake Valve Vacuum Check	EOT Exhaust Valve Vacuum Check
1	0.9	0.9	0.25	0.70
3	0.9	0.9	0.05	0.80
5	0.9	0.9	0.60	0.80
2	0.9	0.9	0.70	0.85
4	0.9	0.9	0.30	0.85
6	0.9	0.9	0.05	0.80

IIIG Compression Pressure Loss

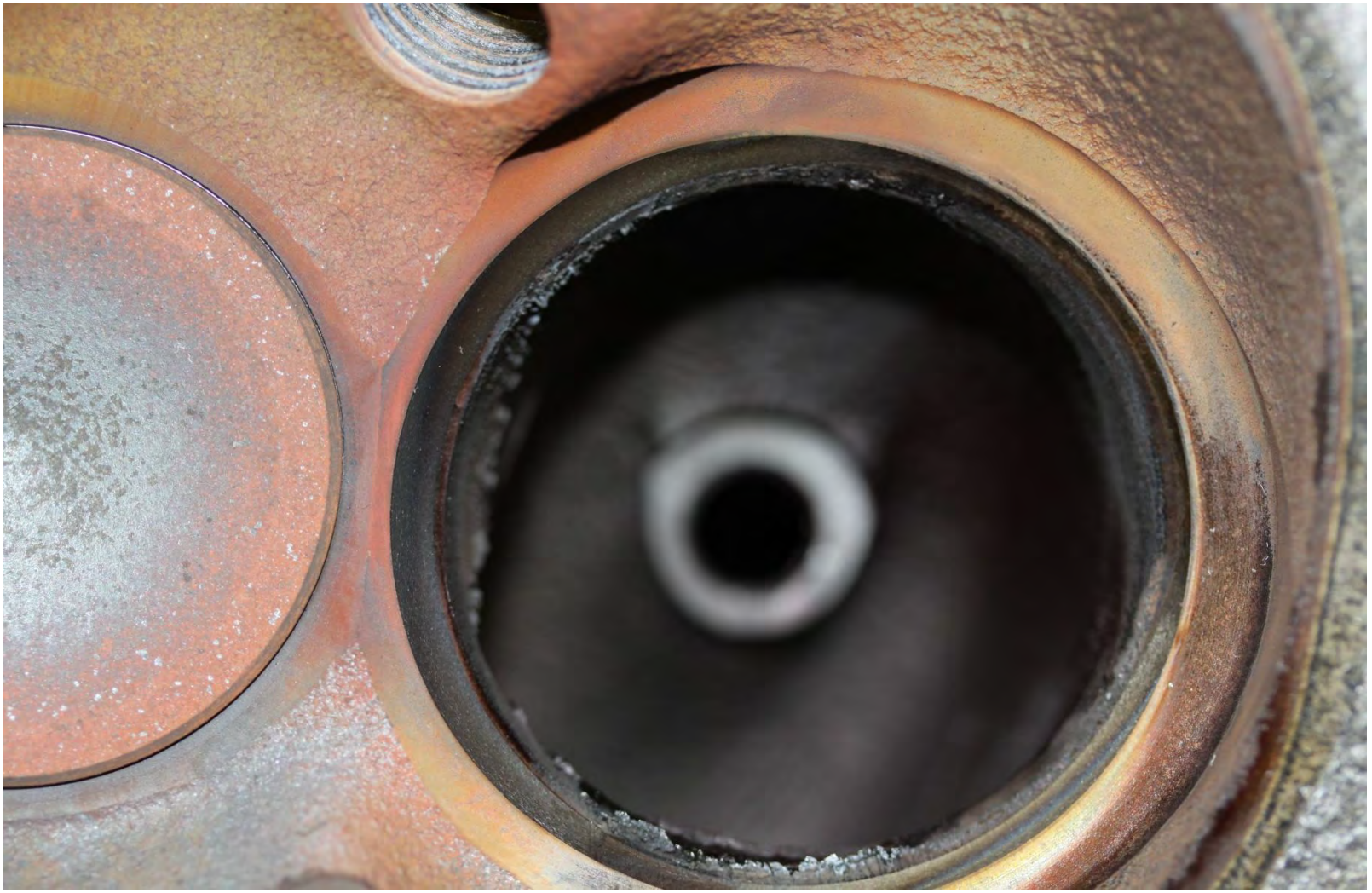


	new	20 hrs	40 hrs	60 hrs
Cyl 1	190	183	161	135
Cyl 3	190	175	165	160
Cyl 5	190	171	188	185
Cyl 2	186	165	128	95
Cyl 4	190	175	150	118
Cyl 6	187	190	190	190

SwRI UEB Engine at 91 Hours



Culprit for Compression Loss - Intake Seat Widening



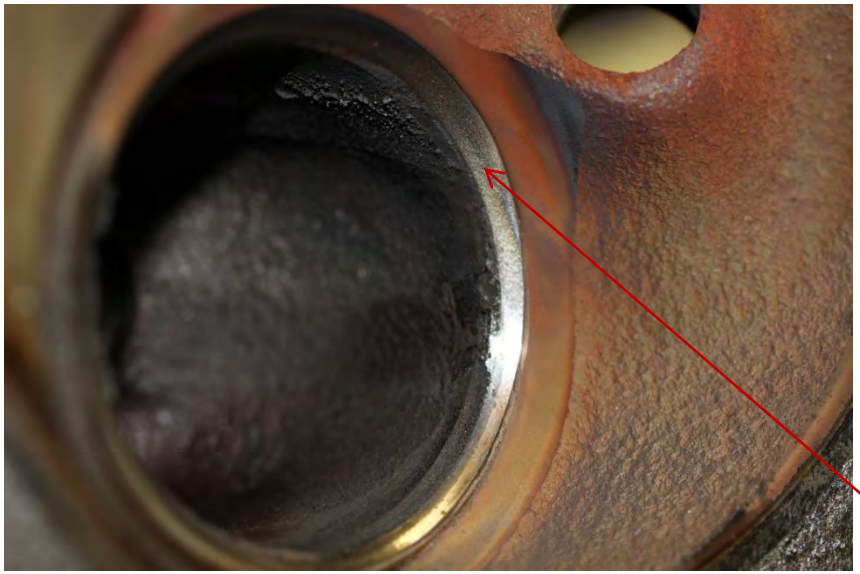
Intake Valve Hot Spot

How Do We Fix the Problem?

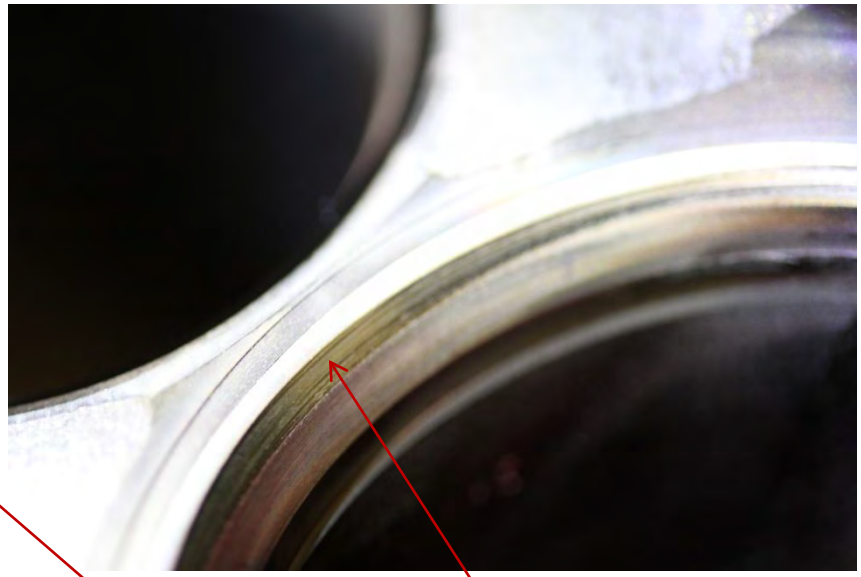
- SwRI had hardened seats installed in the intake valve position on new cylinder heads.
- Three full length tests were conducted using oil 434-1.
- The seat material chosen for test number 1 did not show any improvement in seat condition at end of test.
- Tests 2 and 3 were conducted with a different seat material and the end of test seat condition was significantly better.

Post Test Seat Comparison

Post 3G Test w/out intake seat insert (worst case scenario)

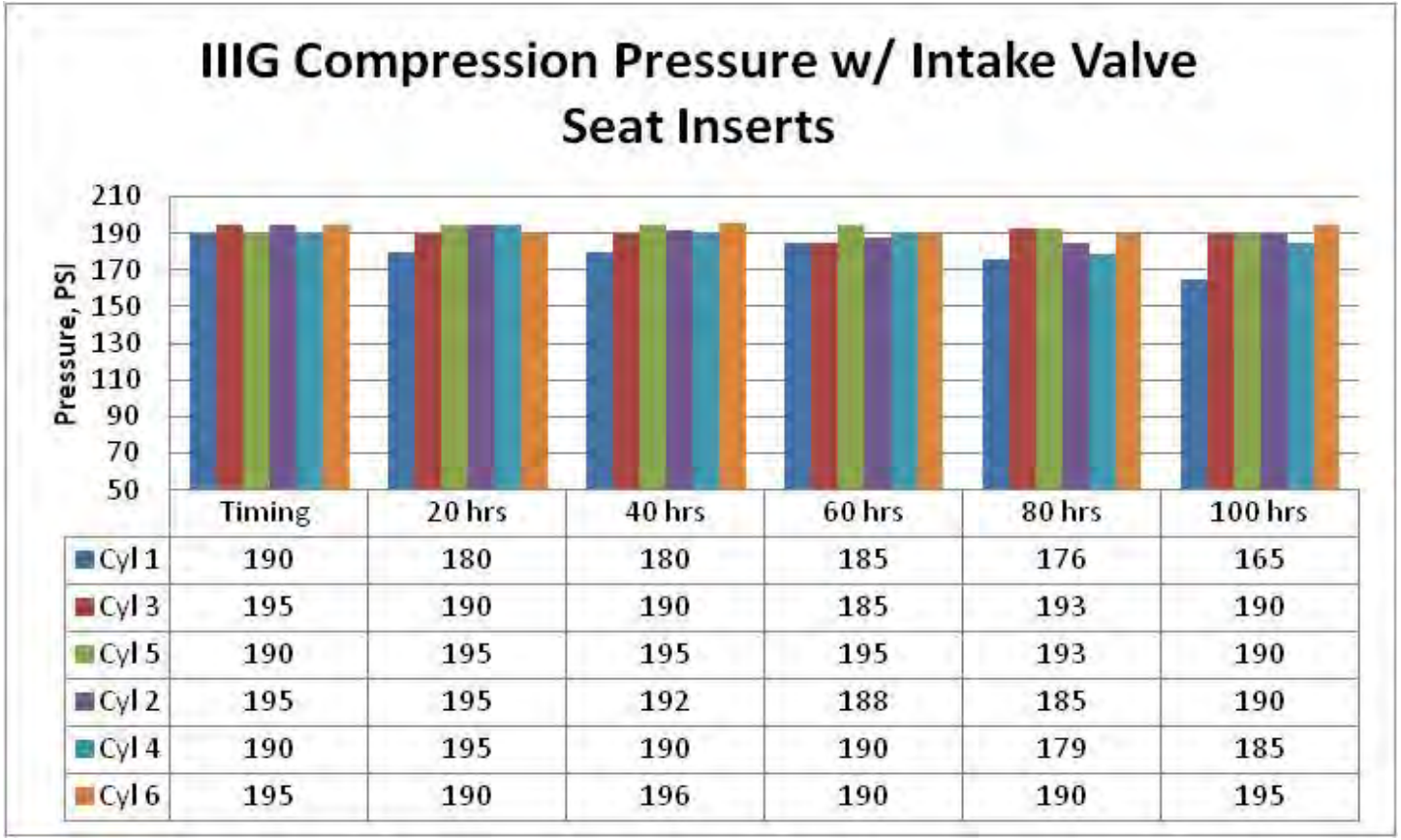


Post 3G Test with Insert, Test 2



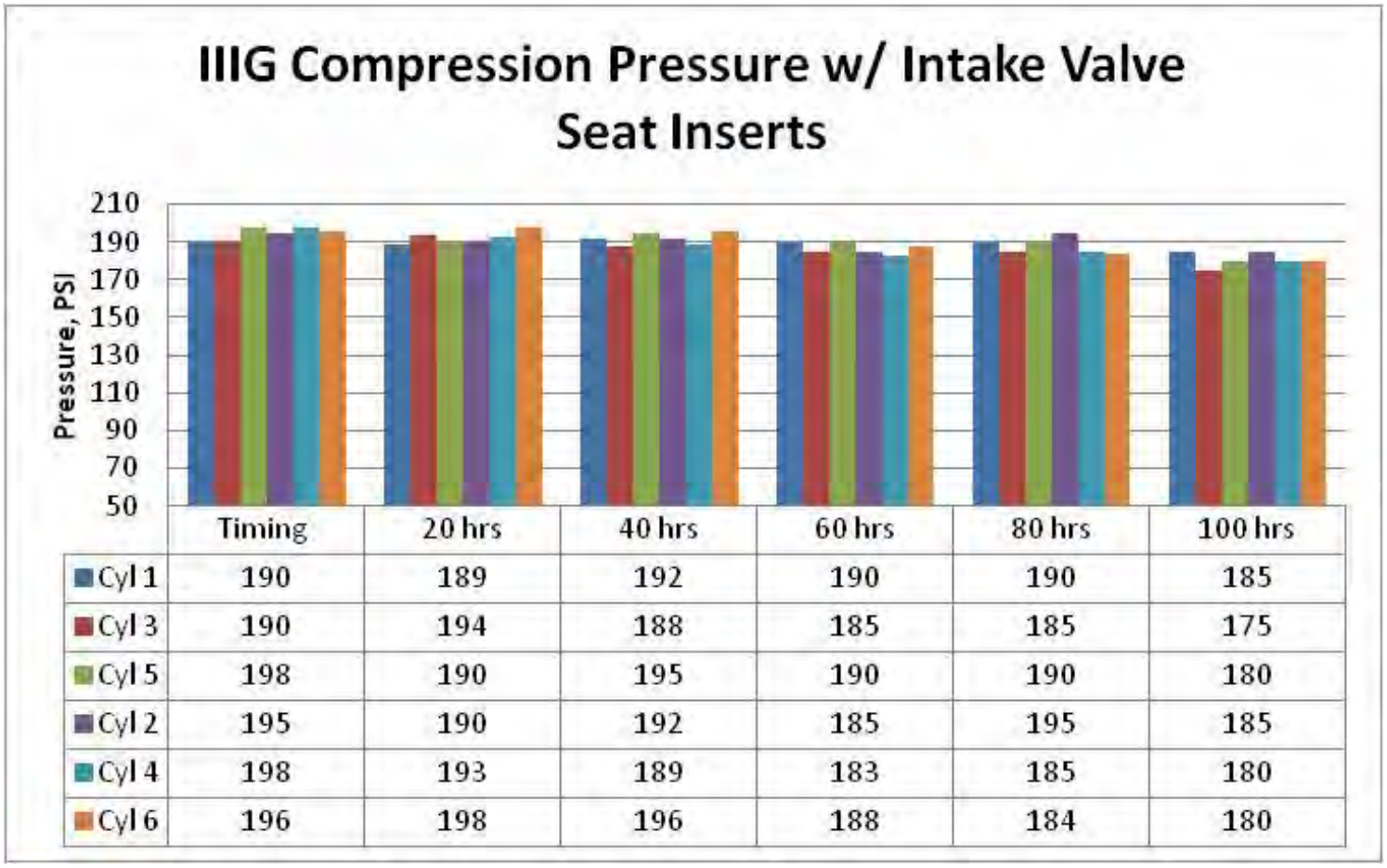
Seat Contact Area

IIIG Compression Pressure w/Seat Insert (Test 2)



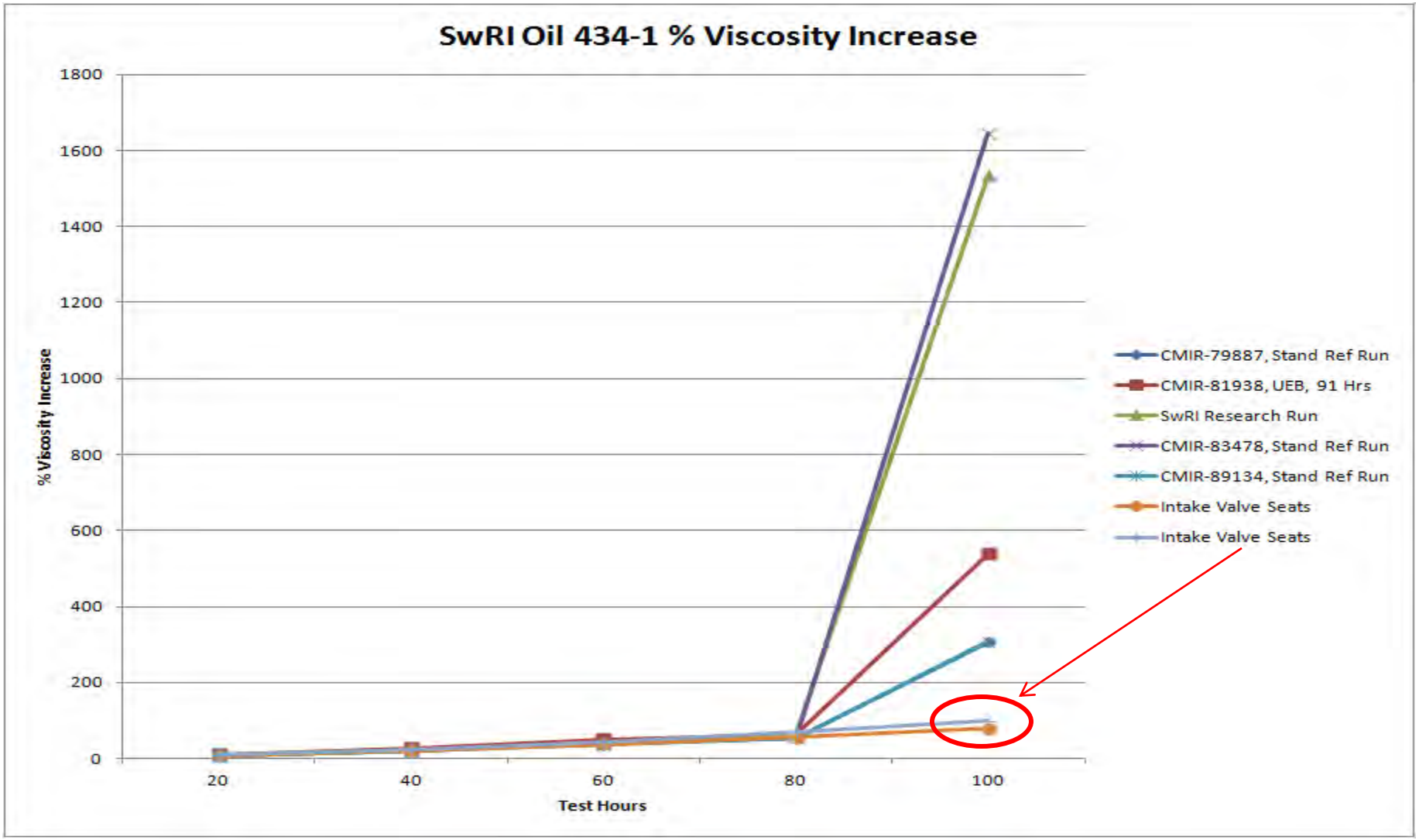
	Timing	20 hrs	40 hrs	60 hrs	80 hrs	100 hrs
Cyl 1	190	180	180	185	176	165
Cyl 3	195	190	190	185	193	190
Cyl 5	190	195	195	195	193	190
Cyl 2	195	195	192	188	185	190
Cyl 4	190	195	190	190	179	185
Cyl 6	195	190	196	190	190	195

IIIG Compression Pressure w/Seat Insert (Test 3)



	Timing	20 hrs	40 hrs	60 hrs	80 hrs	100 hrs
Cyl 1	190	189	192	190	190	185
Cyl 3	190	194	188	185	185	175
Cyl 5	198	190	195	190	190	180
Cyl 2	195	190	192	185	195	185
Cyl 4	198	193	189	183	185	180
Cyl 6	196	198	196	188	184	180

SwRI Recent Visc Increase Performance on Oil 434-1



SwRI IIIG Test Results on Oil 434-1

TEST Description	*EOT DATE*	*% Visc Incr*	*WPD*	*ACLW*	*Oil Cons*
RO 434-1 Targets	N/A	112.9	4.80	32.0	N/A
CMIR-79887, Stand Ref Run	20110124	307.0	4.56	8.8	4.08
CMIR-81938, UEB, 91 Hrs	20110502	539.4	4.09	28.2	3.57
SwRI Research Run	20110703	1534.3	3.09	40.2	4.50
CMIR-83478, Stand Ref Run	20111126	1645.1	2.83	30.8	4.50
CMIR-89134, Stand Ref Run	20121015	307.6	3.36	15.2	4.13
Intake Valve Seats	20121207	79.6	3.63	20.2	3.73
Intake Valve Seats	20130322	98.4	3.67	29.4	3.86

Summary

- The intake valve seat inserts have shown to be durable enough to live through a IIIG test.
- Both of the SwRI tests with seat inserts have demonstrated consistent compression pressure throughout a IIIG test. This will help maintain engine efficiency for the duration of a test and should enhance test consistency.
- Both of the SwRI seat insert runs produced viscosity increase results closer to target (milder) as compared to recent SwRI reference test performance on oil 434-1.

Recommendations

- Suggest that GM investigate the feasibility of installing intake valve seat inserts during the normal new head machining process.
- When the modified cylinder heads become available, labs to conduct their next reference with the modified heads. After completing a successful calibration test, labs will use these heads on all subsequent candidate and reference tests.

ATTACHMENT 6

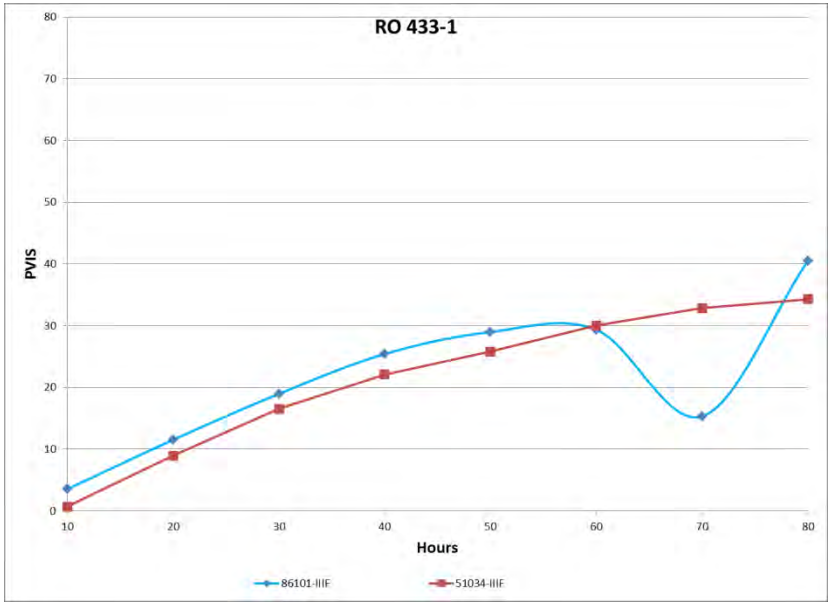
Proposal to monitor IIIF Oxidation using HOURS

IIIF Surveillance Panel Statistics Task Force

Janet Buckingham, Martin Chadwick, Doyle Boese, Jessica Buchanan, Phil Scinto, Todd Dvorak, Jim Rutherford, Rich Grundza, Andy Buczynsky, Robert Stockwell

Purpose

- This proposal is designed to use RO 433-1 to Industry correct and LTMS monitor IIIF PVIS (oxidation) by calculating the number of hours to 275% PVIS
- The point at which candidate category specification PVIS is measured will be determined by HOURS



Attention

- This proposal for monitoring IIIF oxidation is put forth by the IIIF Surveillance Panel Statistics Task Force (consensus)
  - Several methods and many approaches were considered, and the one presented is considered the best
- This does not ‘fix’ the test; an engineering solution should still be pursued
- The analysis only considered slopes starting from 30 to 40 hour period
- This proposal entails extrapolation. Although extrapolation is not typically recommended (prediction confidence interval widens with the distance from the support data) , in this situation it is the best band-aid available to tie back to a borderline oil

Recommendations

- Adopt the HOURS to 275% calculations for Reference Oils as described here, and use HOURS to monitor IIIF Oxidation in LTMS
  - Recalculate LTMS history using RO 433-1 and use only 433-1 in LTMS
  - ADD the Industry Correction Factor (ICF) of 10 HOURS after 6/13/2010
- Apply Industry Correction Factor (ICF) of 10 HOURS to where candidate oil PVIS80 is measured (by subtraction)
    - ICF = 10 hours
- Apply Industry Correction Factor (ICF) of 5 HOURS to where candidate oil PVIS60 is measured (by subtraction)
    - ICF = 5 hours
- Apply Severity Adjustments to PVIS60 that are 0.5 that of the PVIS80 Severity Adjustment

Definitions

- $SLOPE_{(t-10,t)} = \frac{\sqrt{PVIS_t} - \sqrt{PVIS_{t-10}}}{t-(t-10)}$
  - For example

    $$SLOPE_{7080} = \frac{\sqrt{PVIS_{80}} - \sqrt{PVIS_{70}}}{10}$$
- t = time in hours (40, 50, 60, 70, 80, 90)
- Dip = negative slope
  - Note that ANY Negative Slopes seen in $SLOPE_{3040}$ or $SLOPE_{4050}$ need to be verified by a $SLOPE_{7080}$ of >=0.1
    - If NOT verified, then treat as if a Dip DID NOT happen
- Dip periods generally last from 5 to 15 hours and the average dip period is assumed to be 10 hours
- Bottom out slope = largest negative slope; estimated (and thus, assumed) to be -0.15 ($\sqrt{PVIS}$ per 10 hours)
- Dip rate for a negative slope is estimated to be -0.015 ($\sqrt{PVIS}$ per hour)
- AH=Additional Hours to bottom out slope
- r = the subsequent positive slope after the dip period bottoms out

Definitions

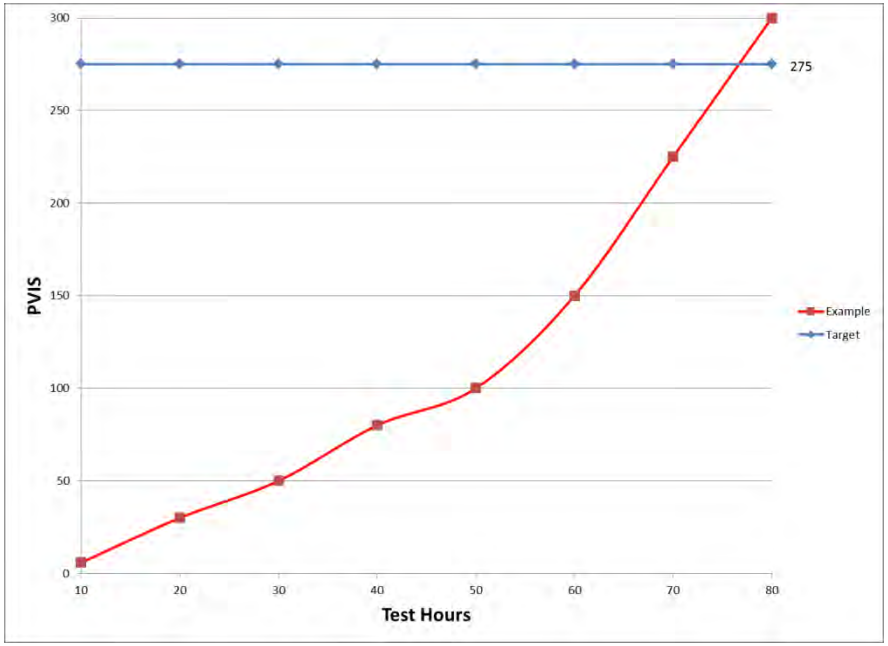
- EOT = End of Test
- PVIS = Percent Viscosity Increase
- EAD = Equation to Anticipate Dip
    - $0.0408*LN(MAX(0.002, SLOPE_{7080})) + 0.1022$
- c = the hours at which PVIS is listed in a performance category (60 or 80)
- h = time in hours at which candidate category specification PVIS is measured for candidate oils after ICF and SA
- ICF = Industry Correction Factor
- SA = Lab Severity Adjustment

Important Notes

- The following equations for calculating HOURS apply to RO 433-1 only
- The calculations are presented in stepwise order. Use the first applicable instance to calculate HOURS for the reference test
  - (1) RO reaches 275% PVIS before 80 hours
  - (2) RO dips before 70 to 80 hours
  - (3) RO dips at 70 to 80 hours only
  - (4) RO has not dipped by 80 hours
- Candidates are to be evaluated and measured in terms of PVIS. The point at which candidate category specification PVIS is measured will be determined by HOURS.
- Examples are given

Calculating HOURS for RO433 (1)

- RO reaches 275% PVIS before 80 hours
- Has never happened, but it is possible
  - Interpolate to get HOURS to 275% PVIS (see next slide)
  - Use square root transformation to interpolate



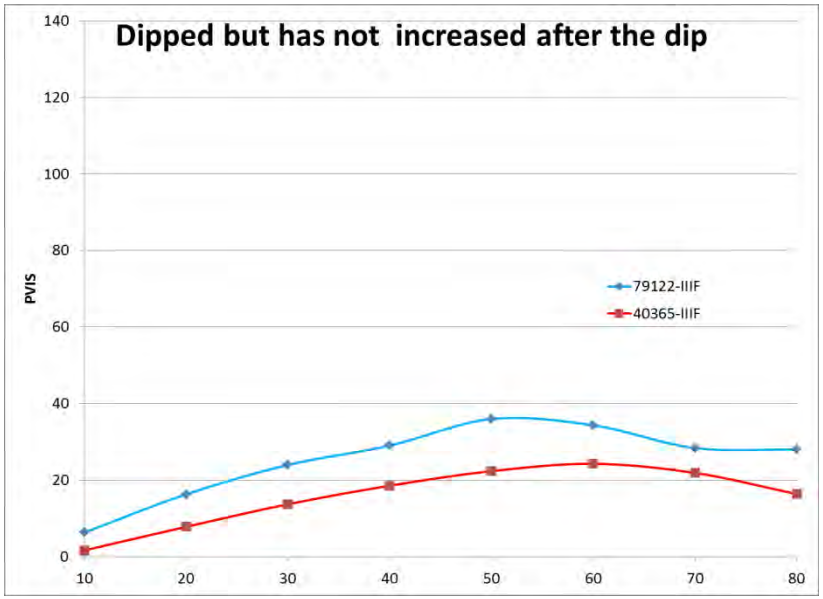
Interpolation for reference tests

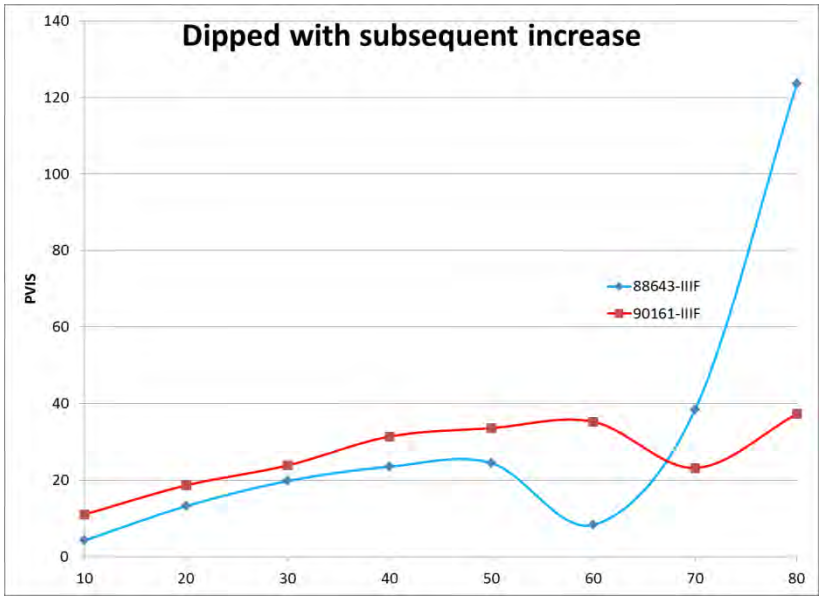
- Calculation of HOURS for Reference test results that fall under scenario 1
  - Step 1: Find t such that $PVIS_{t-10} < 275\% < PVIS_t$
  - Step 2: Interpolate hours distance on the square root scale
    - Distance = $((275^{0.5} - PVIS_{t-10}^{0.5})/((PVIS_t^{0.5} - PVIS_{t-10}^{0.5})/10))$
  - Step 3: Complete calculation of Hours to 275% Viscosity Increase for the reference oil test result that exceeded 275% before 80 hours
    - HOURS = (t – 10) + Distance

Calculating HOURS for RO433 (2)

- Have already dipped* **before** 70 to 80 hours
  - Extrapolate HOURS as $\frac{\sqrt{275}-\sqrt{PVIS_{80}}}{r}+80$

    r = MAX(0.42, $SLOPE_{7080}$)

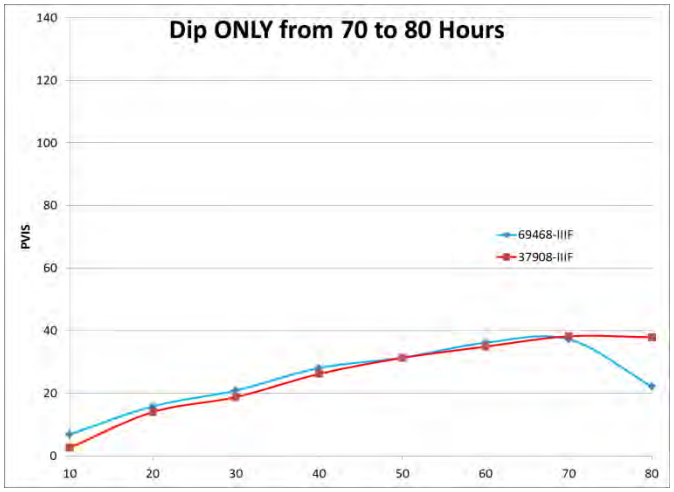




*verified dip

Calculating HOURS for RO433 (3)

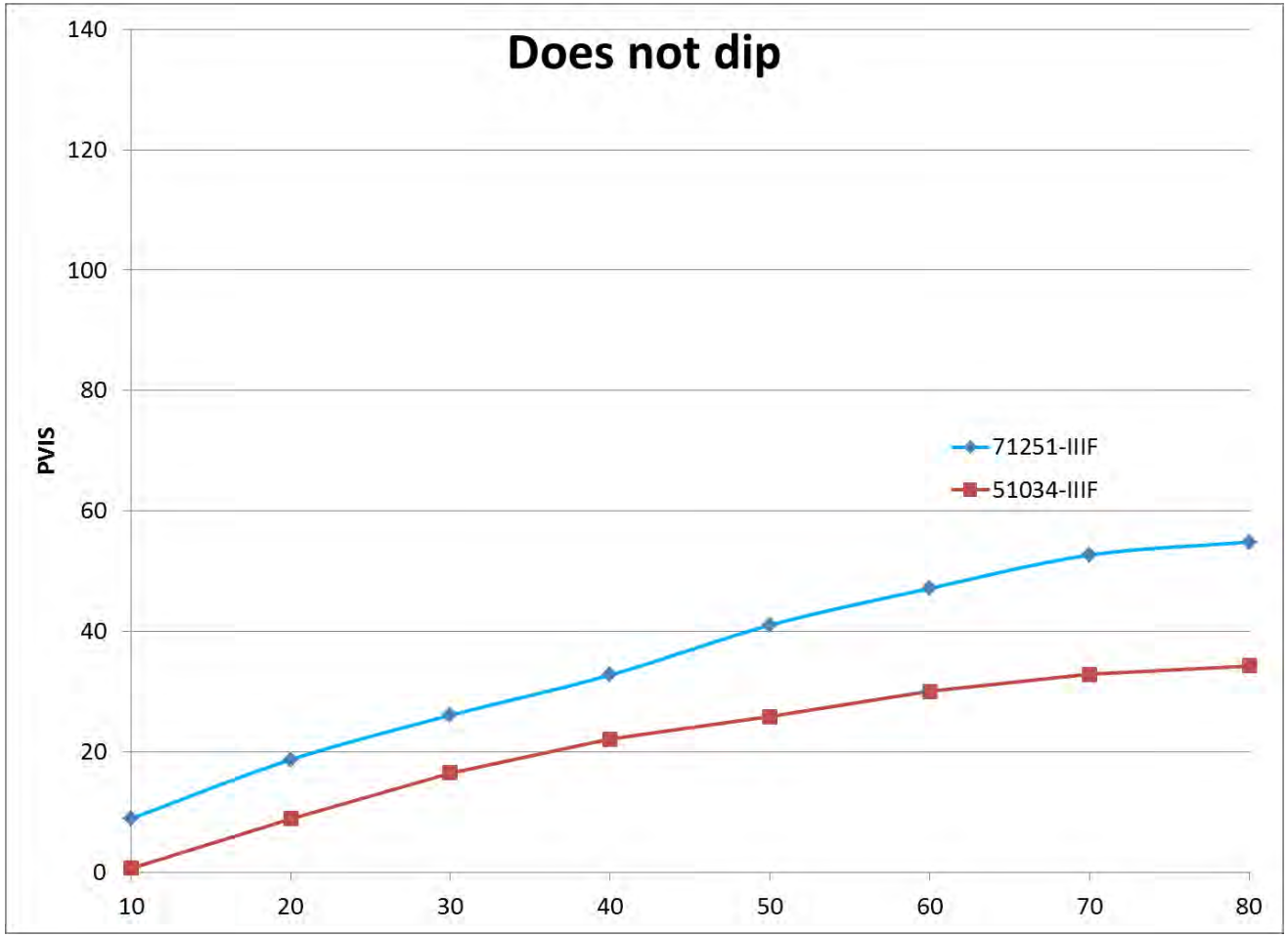
- Dip (negative slope) at 70 to 80 hours **only**
  - Calculate test hours for the bottom out slope of -0.15
    - AH = AdditionalHours = $\frac{(-0.15-MAX(-0.15, SLOPE_{7080}))}{-0.015}$
  - Calculate the PVIS at the bottom out point
    - $\sqrt{PVIS}$ = $\sqrt{PVIS_{80}}$ + (AH) x (-0.15)
  - Extrapolate HOURS as $\frac{\sqrt{275}-\sqrt{PVIS}}{r} + 80 + AH$ r = 0.42



Calculating HOURS for RO433 (4)

- Have not dipped by 80 hours
  - Use EAD Equation to get the next estimate of the slope
    - $SLOPE_{8090}$ = 0.0408*LN(MAX(0.002, $SLOPE_{7080}$)) + 0.1022
  - Use the next estimate of the slope to calculate $PVIS_{90}$
    - $\sqrt{PVIS_{90}} = \sqrt{PVIS_{80}} + 10 * SLOPE_{8090}$
  - Calculate test hours for the bottom out slope of -0.15
    - AH = AdditionalHours = $\frac{(-0.15 - MAX(-0.15, SLOPE_{8090}))}{-0.015}$
  - Calculate the PVIS at the bottom out point
    - $\sqrt{PVIS}$ = $\sqrt{PVIS_{90}}$ + (AH) x (-0.15)
  - Extrapolate HOURS as $\frac{\sqrt{275} - \sqrt{PVIS}}{r} + 90 + AH$ r = 0.42

Calculating HOURS for RO433 (4)



HOURS Summary Statistics

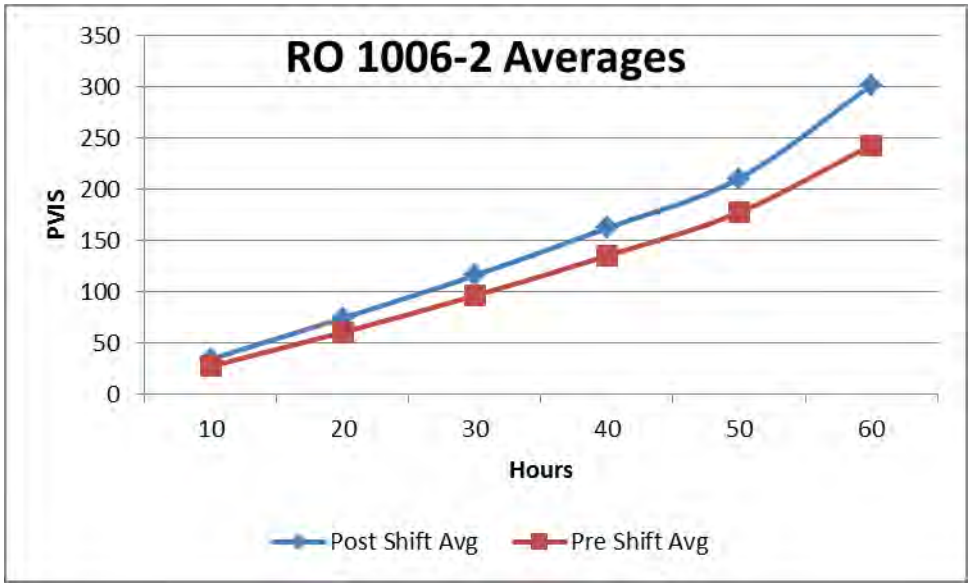
- Test Results on 433-1 before June 13, 2010
  - All
    - Mean = 120.12
    - Standard Deviation = 6.167
  - First 30
    - **Mean = 121.09**
    - Standard Deviation = 5.752
- Test Results on 433-1 after June 13, 2010
  - All
    - Mean = 109.10
    - Standard Deviation = 7.853
  - First 30
    - Mean = 110.25
    - **Standard Deviation = 7.701**

Industry Correction Factor

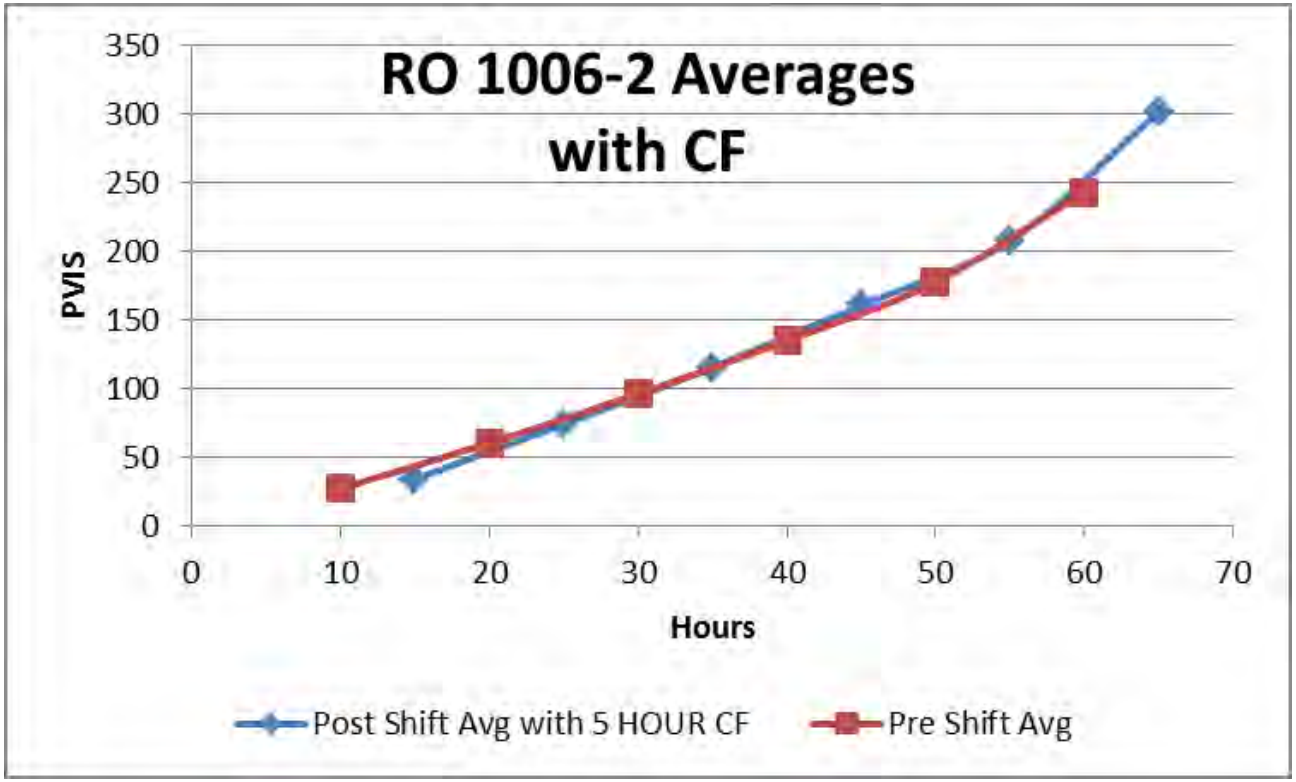
- Test Results on 433-1
  - First 30
    - Mean before June 13, 2010 = 121.09
    - Mean after June 13, 2010 = 110.25
    - Difference = 121.09 - 110.25 = 10.84
  - All
    - Mean before June 13, 2010 = 120.12
    - Mean after June 13, 2010 = 109.10
    - Difference = 120.12 - 109.10 = 11.02
  - **Industry Correction Factor = 10 HOURS**
    - Supported by study of candidate pass rates

PV60

- Industry Correction Factor of 5 HOURS for PV60
  - A conservative estimate for the ICF and severity adjustments for PV60 were developed by multiplying correction factors for $PVIS_{80}$ by 0.5
    - Target for 1006-2 is 235.3% PVIS
    - Since the shift, PV60 is between 288% and 294% PVIS
      - 8 chartable tests
      - 6 operationally valid tests that were removed from control charts
    - Correction of 5 hours would bring PVIS to 245.3%
    - Severity Adjustments for PV60 = 50% of those for $PVIS_{80}$



PV60 Industry Correction Factor



Control charts

- Available from TMC
- Labs are responsible for calculating their own
- To recreate LTMS history use only 433-1 with the Yi's calculated using HOURS
  - Before June 13, 2010
    - Target Mean = 121.09, Standard Deviation = 5.752
    - Yi = (HOURS – 121.09)/ 5.752
  - After June 13, 2010
    - Target Mean = 121.09, Standard Deviation = 7.701
    - Industry Correction Factor = 10 HOURS
    - Yi = ((HOURS + 10) – 121.09)/ 7.701
  - Standard Deviation for Candidate Oil testing Severity Adjustments = 7.701

Other recommendations

- Surveillance Panel should update the IIIF LTMS such that severity adjustments for a lab ARE NOT updated after a failing reference
- Labs will be responsible for sending corrected data to the TMC
- Publish an analysis of HOURS severity annually
  - The IIIF Surveillance Panel Statistics Task Force

Other recommendations

- For labs that are mild and have a severity adjustment that would require measuring candidate PVIS beyond 80 hours even with the ICF but less than 85.03 hours
  - Notify TMC
  - Measure the candidate oil PVIS at 80 hours (or 60 hours in the case of a 60 hour test)
- For labs that are mild and have a severity adjustment that would require measuring candidate PVIS beyond 85.03 hours even with the ICF
  - The lab is operating in a manner for which the recommended calculations and corrections may not be applicable
  - The SP should agree upon what happens if this occurs
  - This situation is unlikely in the near future

Interpolation equation

- Step 1: Calculate the hours (h) at which candidate category specification PVIS is measured for candidate oils
  - h (for c hour test) = c – (ICF) – (SA)
    - c = 80 for 80 hour test and 60 for 60 hour test
- Step 2: Find t such that $(t - 10) < h \leq t$
- Step 3: Calculate candidate category specification PVIS for Candidate Oil
  - $w1 = (t - h)/10$
  - $w2 = (1 - w1)$
  - $PVIS_{Candidate} = (w2*PVIS_t^{0.5} + w1*PVIS_{t-10}^{0.5})^2$

Application to Candidates: Examples

Raw Candidate Data:

PVIS10	PVIS20	PVIS30	PVIS40	PVIS50	PVIS60	PVIS70	PVIS80
15	30	40	48	57	72	153	378

Example 1: $PVIS_{Candidate}$ for 80 hour test

Correction Factor = 10 hours
Severity Adjustment = 5.3 hours

Step 1: h = 80 – 10 – 5.3 = 64.7
Step 2: t = 70 and (t – 10) = 60
Step 3: w1 = (t – h)/10 = (70 – 64.7)/10 = 0.53
w2 = (1 – w1) = 0.47

$$PVIS_{Candidate} = (w2*PVIS_t^{0.5} + w1*PVIS_{t-10}^{0.5})^2$$

$$PVIS_{Candidate} = (0.47*(153)^{0.5} + 0.53*(72)^{0.5})^2 = \mathbf{106.3}$$

Note that calculations on candidate oil percent viscosity increase ($PVIS_{Candidate}$) such as STM and MTAC are still performed on the transformed scale of 1/sqrt(PVIS)

Application to Candidates: Examples

Raw Candidate Data:

PVIS10	PVIS20	PVIS30	PVIS40	PVIS50	PVIS60	PVIS70	PVIS80
15	30	40	48	57	72	153	378

Example 2: $PVIS_{Candidate}$ for 80 hour test

Correction Factor = 10 hours
Severity Adjustment = 0 hours

Step 1: h = 80 – 10 – 0 = 70
Step 2: t = 70 and (t – 10) = 60
Step 3: w1 = (t – h)/10 = (70 – 70)/10 = 0
w2 = (1 – w1) = 1

$$PVIS_{Candidate} = (w2*PVIS_t^{0.5} + w1*PVIS_{t-10}^{0.5})^2$$

$$PVIS_{Candidate} = (1*(153)^{0.5} + 0*(72)^{0.5})^2 = \mathbf{153}$$

Application to Candidates: Examples

Raw Candidate Data:

PVIS10	PVIS20	PVIS30	PVIS40	PVIS50	PVIS60	PVIS70	PVIS80
15	30	40	48	57	72	153	378

Example 3: $PVIS_{Candidate}$ for 80 hour test

Correction Factor = 10 hours
Severity Adjustment = -14 hours (mild)

Step 1: h = 80 – 10 – (-14) = 84

The hours at which candidate PVIS should be measured is 84. This is beyond 80, but less than 85.03

$PVIS_{Candidate} = PVIS_{80} =$ **378**
Lab should also notify the TMC. See slide 20.

Application to Candidates: Examples

Raw Candidate Data:

PVIS10	PVIS20	PVIS30	PVIS40	PVIS50	PVIS60
15	25	36	42	58	320

Example 4: $PVIS_{Candidate}$ for 60 hour test

Correction Factor = 10*0.5 = 5 hours
Severity Adjustment = 5.3*0.5 = 2.65 hours

Step 1: h = 60 – 5 – 2.65 = 52.35
Step 2: t = 60 and (t – 10) = 50
Step 3: w1 = (t – h)/10 = (60 – 52.35)/10 = 0.765
w2 = (1 – w1) = 0.235

$$PVIS_{Candidate} = (w2*PVIS_t^{0.5} + w1*PVIS_{t-10}^{0.5})^2$$

$$PVIS_{Candidate} = (0.235*(320)^{0.5} + 0.765*(58)^{0.5})^2 = \mathbf{100.6}$$

Note that calculations on candidate oil percent viscosity increase ($PVIS_{Candidate}$) such as STM and MTAC are still performed on the transformed scale of NaturalLog(PVIS)

Calculating HOURS for RO433 (1): Example

Raw RO 433-1 Data:

PVIS10	PVIS20	PVIS30	PVIS40	PVIS50	PVIS60	PVIS70	PVIS80
5.87	30	50	80	100	150	225	300

- RO reaches 275% PVIS before 80 hours
- Interpolate HOURS on square root scale

Step 1: t = 80 and (t – 10) = 70

Step 2: Distance = $((275^{0.5} - PVIS_{70}^{0.5})/((PVIS_{80}^{0.5} - PVIS_{70}^{0.5})/10)) = 6.8$

Step 3: HOURS = (t – 10) + Distance = **76.8**

Calculating HOURS for RO433 (2): Example

Raw RO 433-1 Data:

	PVIS10	PVIS20	PVIS30	PVIS40	PVIS50	PVIS60	PVIS70	PVIS80
2A	4.21	13.2	19.78	23.51	24.45	8.3	38.4	123.53
2B	1.65	7.81	13.71	18.54	22.36	24.26	21.88	16.36

Slopes:

	SLOPE3040	SLOPE4050	SLOPE5060	SLOPE6070	SLOPE7080
2A	0.0401	0.0096	-0.2064	0.3316	0.4918
2B	0.0603	0.0423	0.0197	-0.0248	-0.0633

- Has already dipped (negative slope) before 70 to 80 hours
- Extrapolate HOURS as $\frac{\sqrt{275}-\sqrt{PVIS80}}{r}+80$ r = MAX(0.42, $SLOPE_{7080}$)

2A: $HOURS = \frac{(\sqrt{275}-\sqrt{123.53})}{0.4918}+80 = \mathbf{91.1}$

2B: $HOURS = \frac{(\sqrt{275}-\sqrt{16.36})}{0.42}+80 = \mathbf{109.9}$

Calculating HOURS for RO433 (3): Example

Raw RO 433-1 Data:

PVIS10	PVIS20	PVIS30	PVIS40	PVIS50	PVIS60	PVIS70	PVIS80
2.6	14	18.8	26.2	31.1	34.9	38.2	37.9

Slopes:

SLOPE3040	SLOPE4050	SLOPE5060	SLOPE6070	SLOPE7080
0.0783	0.0476	0.0313	0.0273	-0.0024

- Negative slope at 70 to 80 hours only
- Calculate additional hours to bottom out point

$$\text{AH} = \frac{-0.15-(-0.0024)}{-0.015} = 9.84$$

- Calculate the PVIS at the bottom out point

$$\sqrt{PVIS} = \sqrt{PVIS_{80}} + (9.84) * (-0.15) = 4.68$$

- Extrapolate HOURS as $\frac{\sqrt{275}-\sqrt{PVIS}}{r} + 80 + AH$ r = 0.42

$$HOURS = \frac{\sqrt{275}-4.68}{0.42} + 80 + 9.84 = \mathbf{118.18}$$

Calculating HOURS for RO433 (4): Example

Raw RO 433-1 Data:

PVIS10	PVIS20	PVIS30	PVIS40	PVIS50	PVIS60	PVIS70	PVIS80	SLOPE7080
0.66	8.9	16.5	22.08	25.81	30.01	32.83	34.3	0.0127

- Has not dipped by 80 hours
- Get the next estimate of the slope

  $SLOPE_{8090}$ = 0.0408*LN(MAX(0.002, $SLOPE_{7080}$)) + 0.1022 = -0.076
- Calculate $PVIS_{90}$ and additional hours to bottom out point

  $PVIS_{90} = (\sqrt{PVIS_{80}} + 10 * SLOPE_{8090})^2 = 25.98$

  $AH = \frac{-0.15-(-0.076)}{-0.015} = 4.93$
- Calculate PVIS at the bottom out point

  $\sqrt{PVIS} = \sqrt{PVIS_{90}} + (4.93 * -0.15) = 4.36$
- Extrapolate HOURS as $\frac{\sqrt{275}-\sqrt{PVIS}}{r} + 90 + AH$ r = 0.42

  $\frac{\sqrt{275}-4.36}{0.42} + 90 + 4.93 = \mathbf{124.03}$

Intertek Automotive Research

ATTACHMENT 7

IIIF SACLW Reference Limits

Martin Chadwick

3/27/2013

SACLW for IIIF Reference Acceptance

- **Currently IIIF SACLW is judged against the same limits that candidates are judged against.**
  - **SACLW <=20 is an acceptable reference**
- **A review of IIIF charted tests finds that failing SACLW results are likely formulation related.**

	433	**1006**	1008	**1006-2**	1008-1	**433-1**
SACLW>20	5%	**0%**	5%	**0%**	5%	**16%**
N Size	19	**42**	57	**76**	40	**143**

Early Test Cam Wear and 433-1

- **Early in the life of the IIIF test it was determined that high SACLW results were often caused by cam lobe failures during the timing run. A review of timing run iron indicates this could be the case for 433-1.**

	SACLW<=20	SACLW>20
433-1 Timing Run Iron Average	4	13

- **Additional review of the cam and lifter wear on failing tests finds that the failure is a result of cam lobe failures on 27 of 29 failing tests.**

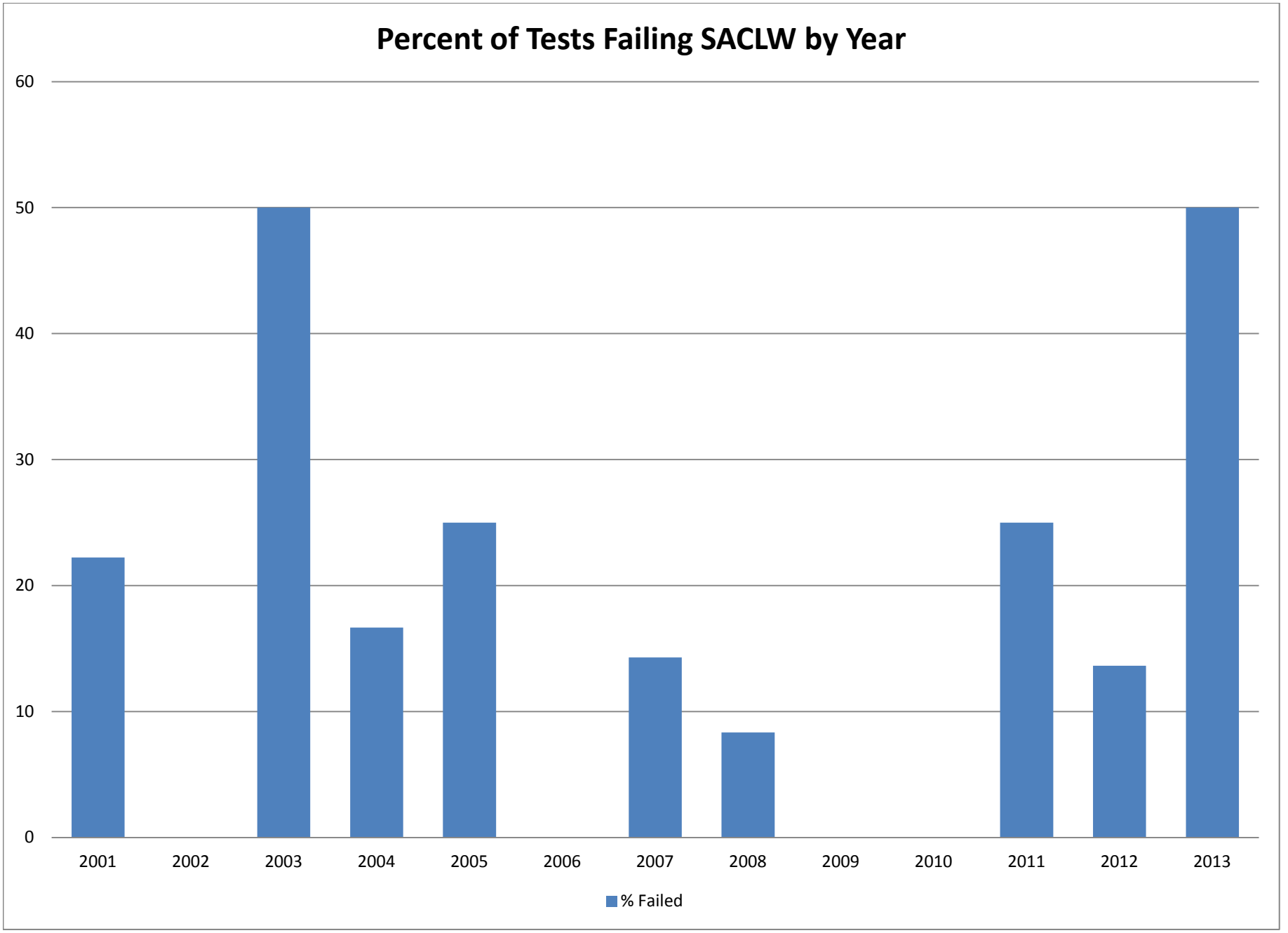
	SACLW<=20		SACLW>20	
	ACW	ALW	ACW	ALW
Average Wear	2.7	8.0	120.4	8.0

Going Forward

- **Reference acceptance for 433-1 should be modified for SACLW.**

- **Two suggested solutions**
  - **Remove SACLW acceptance limits for 433-1**
  - **Judge 433-1 lifter wear only against the limit of 20 max**

ATTACHMENT 8



ATTACHMENT 9

ASTM SEQUENCE III SURVEILLANCE PANEL

SCOPE & OBJECTIVES

SCOPE

The Sequence III Surveillance Panel is responsible for the surveillance and continual improvement of the Sequence IIIF and IIIFHD tests documented in ASTM Standard D6984 as update by the Information Letter System. The Sequence III Surveillance Panel is also responsible for the surveillance and continual improvement of the Sequence IIIG, IIIGA and IIIGB tests documented in ASTM Standard D7320 as updated by the Information Letter System. Data on test precision will be solicited and evaluated at least every six (6) months for Sequence III test procedures. The Surveillance Panel is to provide continual improvement of rating techniques, test operation, test monitoring and test validation through communication with the Test Sponsor, ASTM Test Monitoring Center, the Central Parts Distributor, Fuel Supplier, ASTM B0.01 Passenger Car Engine Oil Classification Panel, ASTM Committee B0.01, ACC Monitoring Agency and ASTM Deposit/Distress Workshop. Actions to improve the process will be recommended when appropriate based on input to the Surveillance Panel from one or more of the previously stated groups. This process will provide the best possible Sequence III Type Test Procedure for evaluating engine oil performance with respect to its ability to prevent oil thickening, varnish formation, oil consumption and engine wear.

OBJECTIVES	TARGET DATE
Monitor industry hardware inventory	Ongoing
Review IIIF PVIS severity	October,2013

David L. Glaenzer, Chairman
Sequence III Surveillance Panel

Updated 04/02/2013
San Antonio, TX