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: March 8, 2013

Reply to: Richard Grundza
ASTM Test Monitoring Center
6555 Penn Avenue
Pittsburgh, PA 15206
Phone: 412-365-1031
Fax: 412-365-1047
Email: reg@astmtmc.cmu.edu

Unapproved Minutes of the February 28, 2013
Sequence IV Surveillance Panel Meeting held in San Antonio, TX.

A copy of the Agenda is included as Attachment 1

The attendance sheet is included as Attachment 2. Also in attendance via teleconference line were Andy Ritchie and Mike McMillen representing Infineum, Tim Miranda representing Castrol and Jerry Brys and George Szappanos representing Lubrizol. Membership changes noted during the meeting were Tracey King replaces Jim Carter for Haltermann and Zack Bishop has Clayton Knight's proxy, Robert Stockell has Bruce Matthews and Sagawa proxy was given to Teri Kowalski. 18 members were present in person or via teleconference.

Bill Buscher agreed to be the motion and action item recorder for the meeting.

Minutes from the January 24, 2013 Conference call were approved.

Review of Action Items;

The following is a status of action items from the previous meeting

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

1) Action Item – Surveillance panel chair to solicit suppliers for a GF-5 technology reference oil with ACW performance in the 50 to 90 µm range, preferably closer to 50 µm. Supplier has come forward with a 49 um 5W-30 Reference oil

2) Action Item – SP chair to inform Nissan that cylinder head components will not be necessary to include in the upcoming Nissan hardware solicitation to the ASTM labs. Nissan has been

3) Motion – Lab A to issue a detailed report to be included in the meeting minutes of today's meeting, on the regrinding process of Sequence IVA test camshafts, including a timeline and a dataset including camshaft lot numbers and quantities reground, by January 31, 2013. If available differentiate LTMS data within a camshaft lot by reground and non-reground camshafts. Completed, 2/19/13

   Dave Glaenzer / Jim Linden / Passed 12 – 0 – 1

4) Motion – Modify the Sequence IVA test procedure to allow the OHT non-nickel plated oil cooler (p/n OHTKA24-006-1), in conjunction with an OHT adapter plate (p/n OHTKA24-005-1), as an acceptable replacement for the Nissan oil cooler. The OHT oil cooler and adapter plate will be introduced at a test lab with an official calibration test, including appropriate notes in the test report comments section, on each stand. Once a lab switches from the Nissan to the OHT oil cooler on a stand, that lab will not switch that stand back to the Nissan oil cooler. Addressed with Information 13-2

   Bill Buscher / Jerry Brys / Passed 12 – 0 – 1

5) Motion – Modify Sequence IVA test procedure to allow for 48 (from 32) runs per engine assembly and 24 (from 16) runs per cylinder head assembly. Effective 1/24/12. Addressed via IL 13-2

   Al Lopez / Jerry Brys / Passed 12 – 0 – 1

6) Action Item – Southwest Research Institute to issue procedures for refurbishing Nissan throttle bodies, intake manifolds and exhaust manifolds.

7) Action Item – Lubrizol to issue information on suppler for remanufactured Nissan ECUs. Completed included in the 1/24/13 minutes

8) Action Item – Labs to check for supply of damaged Nissan wiring harnesses. If available, return damaged wiring harnesses to OHT for potential refurbishing. On going.

9) Action Item – Keep RO 1006-2 targets constant at N = 25, but review and update targets at N = 30. No Action needed today.

10) Motion – Modify section 6.4.1.3 to add a sentence to state "do not modify or alter critical test parts without surveillance panel approval".

Rich Grundza / Jason Bowden / Passed Unanimously
Addressed via IL 13-1.

Review of Convex Lobe Report

Bill Buscher took the opportunity to apologize to the panel for not addressing the regrinding issue with the panel. Bill also apologized for not making the panel aware of the issue as the surveillance panel chair. Ben Weber discussed actions to be taken to prevent recurrence of this type of situation. A manager/director from an area not associated with that type of testing will review the procedure changes and determine the magnitude of change and what type of data and notifications will be required. Additional item discussed was the impact of the TGC documents and how they impact test methods. Dwight Bowden discussed the development of the TGC guidelines. Dwight gave background on a Sequence III issue that was resolved by a unified engine build and the TGC document and the parts control issues were addressed by Sequence III information letter 60, issued in 1990. Dwight pointed out that many procedures do not address hardware control. Dwight pointed out that GM was the driving force behind the information letter and hardware control. Teri Kowalski of Toyota indicated that they intend to provide strong OEM support for the IVB and intend to use a CPD for the IVB as well. An action item was generated to create a task force to review industry documents and develop a recommendation for tying these documents into existing and future test methods. Bill reviewed the report to the panel. Copy of the report presented at the meeting is included as attachment 3. Bill explained that they noted a higher iron content at end of test that wasn't consistent with the wear. Initial inspection of the nose did not identify any cam with a 10 um variation, as referenced in section 9.6.2.3 of Test Method D6891. Nissan's main concern was with the taper. A micrometer won't address taper and it can't see visually. Bill pointed out that a human hair is about 70μm, so it is unlikely that anyone would note a 10 μm anomaly by visual inspection alone. In the SWRI report, what constitutes a lot # was identified, which is essentially the date packaged and manufacturing plant. At this point, a presentation from Nakamura Sagawa was presented by Bill Buscher, regarding the planned purchase of hardware to meet testing needs through 2016. This presentation is included as Attachment 4. It was Sagawa's recommendation that since these cams are service hardware, they may be from varied sources and may or may not exhibit the convexity. It was Sagawa's recommendation that these cams be reground to meet the Nissan manufacturing specs by OHT. Labs will be responsible for getting these cams to OHT. Dave Glaenzer questioned whether traces are made to same parameters on the PDI machine. Several panel members noted

that the Gaussian filter and cut off are the same. It was suggested that one can't tell any variability from trace. Further discussions identified that the cam lot designation is not the same as the Sequence III. Dwight Bowden suggested that the dressing of grinding wheel is responsible for the discrepancy. Generally, the grinding wheel is dressed at the end of the cycle. Al Lopez noted that 5 of the NK05190 lot were measured in his lab and he found these cams to be flat and has successfully referenced on this lot. Dwight indicated that to make sure the lobes are flat, you must dress the grinding wheel more frequently. Additional discussion took place regarding measurements and industry round robins regarding post test measurements. George Szappanos pointed out that the degree and shape of convexity will determine the error and the total error is based on the level of wear. Al noted that with a flat cam and flat follower, the wear dynamic may not be the same as using a pretest measure to correct the total wear may. The total wear may not be convexity summed with measured result. Jim Linden suggested that labs dispose of 10 um cam. Al Lopez identified that his lab makes no pretest measurement, exclusive of the nose measurement prior to test. Al claimed to not see the convexity at Intertek, and Intertek is on severe side of target. Bill noted his lab focus on taper was to conduct a pretest micrometer measurement. If it shows 10μm or greater taper, then measure the cam with PDI. He found they have rejected ~6-12 cams using this approach and other labs suggested taper is rare. Jerry Brys noted Lubrizol conducts a nose trace and has not had any taper rejects, generally only rejecting cams for bend or pits, resulting in only 2-3 rejects over the past 10 years. Dwight Bowden mentioned that the metallurgy is not the same as the Sequence III. This cam is chilled cast, while the Sequence III is not. Al noted that the cam has Rockwell of 50 and the pads have a Rockwell of 60. Bill mentioned that previous analysis of cams showed the hardness depth appeared to be greater 10 um and SwRI plans to have destructive analysis on several cams to be disseminated later. SwRI noted that they could have identified the offset technique better and discussed the method for offset measurement. SwRI felt the offset may have added subjectivity by technician. Lubrizol and Intertek noted they are not experiencing cam wear with convexities, if they exist. SwRI thinks the hardware may be different. Intertek feels they are not seeing low wear on 2009 cams. A considerable discussion took place regarding the history of cam batches and orders placed by labs and consumption of these batches. The panel then reviewed a Nissan Presentation regarding the use of hardware. Considerable discussion took place regarding the motion for implementing regrinding of cams, which is included as attachment 5. Concerns raised about this motion were that it may make usable hardware unusable. Jeff Clark mentioned that the report provided by SwRI provides a hypothesis that has only data from one lab. Rich Grundza also presented pooled s and severity data comparing the reground results with the lab's previous history as well as the historical data from the other two currently calibrated labs. Rich noted that the severity was essentially on or near target historically for the lab and that the reground results were also on or near target. Rich also calculated the variance, pooled by oil for the same labs and compared that to the reground data, which suggested higher variability with the reground data set. These data are included in attachment 5. Other members of the panel tended to agree that data from one lab may not be sufficient, but other labs had not expressed a desire to provide data on reground cams. After reviewing the motion, a number of concerns were raised on the proposal. Were all existing cams going to be measured, are all labs measuring cams the same, will all labs be able to successfully calibrate on the re ground hardware. Dwight Bowden provided a flow chart to the group to better understand how the motion was to work. Dwight also discussed the situation which led to the generation of Sequence III information letter 60, which addressed hardware control and led to the Technical Guidance Committee Hardware Control Guidelines and suggested all panel members become familiar with these two documents. An action item was assigned to OHT or the Panel Chair to request the KA24E cam manufacturing information. After more discussion, Teri Kowalski, by proxy from Nakamura Sagawa, made the

motion detailed in attachment 6, which was seconded by Andy Ritchie. After additional discussion, this motion was approved 13-1-1, with the Test Monitoring Center voting negative. Rich Grundza indicated his negative was based on the use of reverse engineered specifications for the grinding of cams and that if the motion used the specifications from Nissan he would no longer vote negative. Rich felt that using specifications based on data obtained from measurements in one lab might not match the hardware that is being run in other labs, but using the Nissan specifications for surface finish would assure that at least all the data were to print. A revised motion, included as attachment 7, was made by Jim Linden, holding Toyota's proxy and Nissan's proxy as well, and was seconded by Andy Ritchie. The motion was approved 14-0-2.

Reference Oil Review

Rich Grundza indicated that a supplier has come forward with an oil in the 50 to 60 micron range. This oil is a Group II 5W-30 with a performance of 49 µm. The TMC was given an action item, by motion from Bill Buscher, seconded by Al Lopez, to obtain a 5 year supply of this oil.

Test Method Discrepancies

Rich gave a presentation regarding discrepancies noted in the current version of the test method. The panel agreed to modify the test method via information letter to address these items. Procedural discrepancies are included in attachment 8.

Plan to Sustain Test through 2016.

Discussion centered on procurement of additional hardware to allow continuous testing through 2016. At the previous meeting, the panel agreed to inform Nissan that cylinder heads and components for cylinder heads will not be required, which has been done. During the previous meeting, an action item was assigned to provide a procedure for rework of throttle bodies. This procedure for rework, written by Eric Liu of SwRI, is included as attachment .Al Lopez asked if additional cams and rocker shafts will be available to be purchased to allow use of the rockers and other components from abandoned lots, to which Bill responded that Nissan indicated these components should be available for purchase. It was also noted that Nissan will only deliver to the purchasing organization and the cams were to go to OHT for regrinding, which would delay the process. OHT indicated they may be willing to do a coordinated purchase and repackage all the components, as the boxes many components are shipped are not conducive to rough handling during shipping. Bill Buscher was assigned an action item to conduct a conference call with the labs, OHT and TMC, to finalize the hardware purchase plan.

Scope and Objectives

The chair updated the scope and objectives. The updated Panel Scope and objectives are included as attachment 9.

The next meeting will be at the call of the chair.

A copy of the motions and action items from this meeting is included as 10.

With a motion to adjourn from Bill and a second from Rich, the meeting was adjourned at 4:30 PM.

Attachments

Attachment 1

Sequence IVA Surveillance Panel

San Antonio, TX
Southwest Research Institute, Building 209
February 28, 2013
9:00 a.m. – 5:00 p.m.

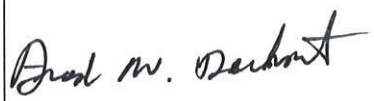
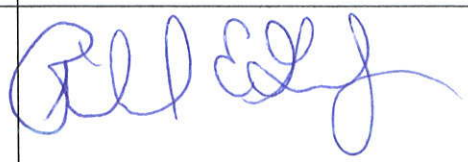
A G E N D A

1.	Chairman comments	
2.	Attendance sign-in sheet distribution	
3.	Membership changes	
4.	Motion and Action recorders	
5.	Approval of minutes for 1/24/2013	All
6.	Action item review	Chairman – Buscher
7.	Presentation of SwRI's Sequence IVA convex camshaft lobe report	SwRI – Buscher
8.	Test hardware status and plan to sustain test through 2016 • Future industry hardware order from Nissan • Current industry hardware	All
9.	New GF-5 reference oil	All
10.	Test procedure discrepancies review a. Carryover from 1/24/13 meeting	Grundza
11.	Update on Sequence IVB test development	Kowalski
12.	Review Scope & Objectives	Chairman – Buscher
13.	Old business	
14.	New business	

15. Motion and action item review
16. Next Meeting

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

February 28, 2013

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Bowden, Jason	OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 Phone No.: 440-354-7007 Fax No.: 440-354-7080 Email: jhbowden@ohtech.com	
Brys, Jerome	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092 Phone No.: 440-347-2631 / 440-943-1200 Fax No.: 440-943-9013 Email: jabs@lubrizol.com	
Buscher III, William	Southwest Research Institute 6220 Culebra Road P.O. Drawer 28510 San Antonio, TX 78228-0510 Phone No.: 210-522-6802 or 210-240-8990 cell Fax No.: 210-684-7523 Email: william.buscher@swri.org	
Buscher, Jr., William	Buscher Consulting Services P.O. Box 112 Hopewell Jct., NY 12533 Phone No.: 914-897-8069 Fax No.: 914-897-8069 Email: buschwa@aol.com	
Caudill, Timothy	Ashland Inc. 22nd & Front Streets Ashland, KY 41114 Phone No.: 606-329-1960 x5708 Fax No.: 606-329-2044 Email: tlcaudill@ashland.com	
Gerhart, Fred	Southwest Research Institute 6220 Culebra Road P.O. Drawer 28510 San Antonio, TX 78228-0510 Phone No.: 210-522-3842 or 210-317-8303 cell Fax No.: 210-684-7523 Email: fred.gerhart@swri.org	
Glaenzer, Dave	Afton Chemical Corporation 500 Spring Street P.O. Box 2158 Richmond, VA 23217-2158 Phone No.: 804-788-5214 Fax No.: 804-788-6358 Email: dave.glaenzer@aftonchemical.com	
Grundza, Rich	ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 Phone No.: 412-365-1031 Fax No.: 412-365-1047 Email: reg@astmtmc.cmu.edu	

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

February 28, 2013

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Hsu, Jeffery	Shell Global Solutions 3333 Highway 6 South Houston, TX 77082 Phone No.: Fax No.: Email: J.Hsu@shell.com	
King, Tracey	Haltermann Solutions 2296 Hulett Okemos, MI 48864 Phone No.: 947-517-4107 Fax No.: Email: tking@jhaltermann.com	
Knight, Clayton Zack Bishop for	Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249 Phone No.: 210-862-5987 cell Fax No.: 210-690-1959 Email: cknight@tei-net.com	Zack Bishop
Kowalski, Teri	Toyota Motor North America, Inc. 1555 Woodridge Ann Arbor, MI 48105 Phone No.: 734- 995-4032 or 734-355-8082 cell Fax No.: 734- 995-9049 Email: teri.kowalski@tema.toyota.com	
Lopez, Al	Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238-1993 Phone No.: 210-862-7935 Fax No.: 210-523-4607 Email: al.lopez@intertek.com	
Martinez, Jo	Chevron Oronite Company LLC 100 Chevron Way, 60-1211 P.O. Box 1627 Richmond, CA 94802-0627 Phone No.: 510-242-5563 Fax No.: 510-242-1930 Email: jogm@chevrontexaco.com	
Matthews, Bruce	GM Powertrain Mail Code 483-730-322 823 Joslyn Rd. Pontiac, MI 48340-2920 Phone No.: 248-830-9197 Fax No.: 248-857-4425 Email: bruce.matthews@gm.com	Robert Stockwell for Bruce
Miranda, Timothy	BP Castrol 1500 Valley Road Wayne, NJ 07470 Phone No.: 973-305-3334 Fax No.: 973-686-4039 Email: timothy.miranda@bp.com	

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

March 29, 2012

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Mosher, Mark	ExxonMobil Research & Engineering Co. 600 Billingsport Road P.O. Box 480 Paulsboro, NJ 08066-0480 Phone No.: 856-224-2132 Fax No.: 856-224-3628 Email: mark.r.mosher@exxonmobil.com	
Ritchie, Andrew	Infineum USA L.P. 1900 E. Linden Avenue Linden, NJ 07036-0536 Phone No.: 908-474-2097 Fax No.: 908-474-3637 Email: andrew.ritchie@infineum.com	
Romano, Ron	Ford Motor Company 1800 Fairlane Drive Allen Park, MI 48101 Phone No.: 313-845-4068 Fax No.: 313-323-8042 Email: rromano@ford.com	
Sagawa, Takumaru	Nissan Motor Co., Ltd. 560-2, Okatsukoku, Atsugi city Kanagawa 243-0192 Phone No.: 046-270-1515 Fax No.: 046-270-1585 Email: t-sagawa@mail.nissan.co.jp	
Tang, Haiying	Chrysler Group LLC 800 Chrysler Drive Auburn Hills, MI Phone No.: Fax No.: Email: HT146@Chrysler.com	
Ray Seitz Jr	Infineum San Antonio Phone No.: 210 - 867-9773 Fax No.: Email:	
MARTIN CHADWICK	INTERTEK Phone No.: 210.706.1543 Fax No.: Email: MARTIN.CHADWICK@INTERTEK.COM	
	Phone No.: Fax No.: Email:	

NON-MEMBER MAILING LIST
ASTM IVA SURVEILLANCE PANEL

February 28, 2013

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Altman, Ed	Afton Chemical Corporation 500 Spring Street P.O. Box 2158 Richmond, VA 23217-2158 Phone No.: 804-788-5279 Fax No.: 804-788-6358 Email: ed.altman@aftonchemical.com	
Boese, Doyle	Infineum USA L.P. 1900 E. Linden Avenue Linden, NJ 07036-0536 Phone No.: 908-474-3176 Fax No.: 908-474-3637 Email: doyle.boese@infineum.com	
Bowden, Adam	OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 Phone No.: 440-354-7007 Fax No.: 440-354-7080 Email: adbowden@ohtech.com	
Bowden, Dwight	OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 Phone No.: 440-354-7007 Fax No.: 440-354-7080 Email: dhbowden@ohtech.com	
Bowden, Matt	OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 Phone No.: 440-354-7007 Fax No.: 440-354-7080 Email: mbowden@ohtech.com	
Carlson, Jon	Lubrizol Corporation 14602 Huebner, Suite 116-PMB 198 San Antonio, TX 78230 Phone No.: 210-391-8838 cell Fax No.: 210-522-0391 Email: jomc@lubrizol.com	
Carter, James	Haltermann Solutions 2296 Hulett Okemos, MI 48864 Phone No.: 517-347-3021 Fax No.: 517-347-1024 Email: jecarter@jhaltermann.com	
Castanien, Chris	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092 Phone No.: 440-347-2973 / 440-943-1200 Fax No.: 440-943-9013 Email: cca@lubrizol.com	

NON-MEMBER MAILING LIST
ASTM IVA SURVEILLANCE PANEL

February 28, 2013

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Clark, Sid	Southwest Research Institute 50481 Peggy Lane Chesterfield, MI 48047 Phone No.: 586-873-1255 Email: sidney.clark@swri.org	
Clark, Jeff	ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 Phone No.: 412-365-1032 Fax No.: 412-365-1047 Email: jac@astmtmc.cmu.edu	
Dvorak, Todd	Afton Chemical Corporation 500 Spring Street P.O. Box 2158 Richmond, VA 23217-2158 Phone No.: 804-788- Fax No.: 804-788-6358 Email: todd.dvorak@aftonchemical.com	
Farnsworth, Gordon	Infineum USA L.P. 1900 E. Linden Avenue Linden, NJ 07036-0536 Phone No.: 570-934-2776 Fax No.: 908-474-3637 Email: gordon.farnsworth@infineum.com	
Hsu, Jeffery	Shell Global Solutions 1520 Lake Front Circle (77380) P.O. Box 7569 The Woodlands, TX 77387 Phone No.: 281-363-8177 Fax No.: 281-363-8002 Email: j.hsu@shell.com	
Ishikawa, Masa	Infineum USA L.P. 1900 East Linden Avenue Linden, NJ 07036 Phone No.: 908-474-2384 Fax No.: 908-474-3597 Email: masa.ishikawa@infineum.com	
Kelly, Jack	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092 Phone No.: 216-943-1200 Fax No.: Email: jack@lubrizol.com	
Lang, Patrick	Southwest Research Institute 6220 Culebra Road P.O. Drawer 28510 San Antonio, TX 78228-0510 Phone No.: 210-522-2820 or 210-240-9461 cell Fax No.: 210-684-7523 Email: patrick.lang@swri.org	

NON-MEMBER MAILING LIST
ASTM IVA SURVEILLANCE PANEL

February 28, 2013

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Liu, Eric	Southwest Research Institute 6220 Culebra Road P.O. Drawer 28510 San Antonio, TX 78228-0510 Phone No.: 210-522-5937 or 210-416-9024 cell Fax No.: 210-684-7523 Email: eric.liu@swri.org	
McMillan, Mike	Infineum Phone No.: Fax No.: Email: mmcmillan123@comcast.net	
Porter, Christian	Afton Chemical Corporation 500 Spring Street P.O. Box 2158 Richmond, VA 23217-2158 Phone No.: 804-788-5837 Fax No.: 804-788-6358 Email: christian.porter@aftonchemical.com	
Rutherford, Jim	Chevron Oronite Company LLC 100 Chevron Way, 60-1211 P.O. Box 1627 Richmond, CA 94802-0627 Phone No.: 510-242-3410 Fax No.: 510-242-1930 Email: jaru@chevrontexaco.com	
Scinto, Phil	Lubrizol Corporation 29400 Lakeland Blvd. Mail Drop 152-A Wickliffe, OH 44092 Phone No.: 440-347-2161 Fax No.: 440-347-9031 Email: prs@lubrizol.com	
Smolenski, Don	 Phone No.: Fax No.: Email:	
Sutherland, Mark	Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249 Phone No.: 210-867-8357 cell Fax No.: 210-690-1959 Email:	
Sutherland, Robert	Shell Global Solutions 3333 Highway 6 South Houston, TX 77082 Phone No.: 281-544-8620 Fax No.: 281-544-8150 Email: r.sutherland@shell.com	

ON PHONE

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

February 28, 2013

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Bowden, Jason	OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 Phone No.: 440-354-7007 Fax No.: 440-354-7080 Email: jhbowden@ohtech.com	
Brys, Jerome	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092 Phone No.: 440-347-2631 / 440-943-1200 Fax No.: 440-943-9013 Email: jabs@lubrizol.com	✓
Buscher III, William	Southwest Research Institute 6220 Culebra Road P.O. Drawer 28510 San Antonio, TX 78228-0510 Phone No.: 210-522-6802 or 210-240-8990 cell Fax No.: 210-684-7523 Email: william.buscher@swri.org	
Buscher, Jr., William	Buscher Consulting Services P.O. Box 112 Hopewell Jct., NY 12533 Phone No.: 914-897-8069 Fax No.: 914-897-8069 Email: buschwa@aol.com	✓
Caudill, Timothy	Ashland Inc. 22nd & Front Streets Ashland, KY 41114 Phone No.: 606-329-1960 x5708 Fax No.: 606-329-2044 Email: tlcaudill@ashland.com	
Gerhart, Fred	Southwest Research Institute 6220 Culebra Road P.O. Drawer 28510 San Antonio, TX 78228-0510 Phone No.: 210-522-3842 or 210-317-8303 cell Fax No.: 210-684-7523 Email: fred.gerhart@swri.org	
Glaenzer, Dave	Afton Chemical Corporation 500 Spring Street P.O. Box 2158 Richmond, VA 23217-2158 Phone No.: 804-788-5214 Fax No.: 804-788-6358 Email: dave.glaenzer@aftonchemical.com	
Grundza, Rich	ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 Phone No.: 412-365-1031 Fax No.: 412-365-1047 Email: reg@astmtmc.cmu.edu	

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

February 28, 2013

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Hsu, Jeffery	Shell Global Solutions 3333 Highway 6 South Houston, TX 77082 Phone No.: Fax No.: Email: J.Hsu@shell.com	
King, Tracey	Haltermann Solutions 2296 Hulett Okemos, MI 48864 Phone No.: 947-517-4107 Fax No.: Email: tking@jhaltermann.com	
Knight, Clayton	Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249 Phone No.: 210-862-5987 cell Fax No.: 210-690-1959 Email: cknight@tei-net.com	
Kowalski, Teri	Toyota Motor North America, Inc. 1555 Woodridge Ann Arbor, MI 48105 Phone No.: 734- 995-4032 or 734-355-8082 cell Fax No.: 734- 995-9049 Email: teri.kowalski@tema.toyota.com	
Lopez, Al	Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238-1993 Phone No.: 210-862-7935 Fax No.: 210-523-4607 Email: al.lopez@intertek.com	
Martinez, Jo	Chevron Oronite Company LLC 100 Chevron Way, 60-1211 P.O. Box 1627 Richmond, CA 94802-0627 Phone No.: 510-242-5563 Fax No.: 510-242-1930 Email: jogm@chevrontexaco.com	
Matthews, Bruce	GM Powertrain Mail Code 483-730-322 823 Joslyn Rd. Pontiac, MI 48340-2920 Phone No.: 248-830-9197 Fax No.: 248-857-4425 Email: bruce.matthews@gm.com	✓
Miranda, Timothy	BP Castrol 1500 Valley Road Wayne, NJ 07470 Phone No.: 973-305-3334 Fax No.: 973-686-4039 Email: timothy.miranda@bp.com	✓

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February 28, 2013

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Liu, Eric	Southwest Research Institute 6220 Culebra Road P.O. Drawer 28510 San Antonio, TX 78228-0510 Phone No.: 210-522-5937 or 210-416-9024 cell Fax No.: 210-684-7523 Email: eric.liu@swri.org	
McMillan, Mike	Infineum Phone No.: Fax No.: Email: mmcmillan123@comcast.net	
Porter, Christian	Afton Chemical Corporation 500 Spring Street P.O. Box 2158 Richmond, VA 23217-2158 Phone No.: 804-788-5837 Fax No.: 804-788-6358 Email: christian.porter@aftonchemical.com	
Rutherford, Jim	Chevron Oronite Company LLC 100 Chevron Way, 60-1211 P.O. Box 1627 Richmond, CA 94802-0627 Phone No.: 510-242-3410 Fax No.: 510-242-1930 Email: jaru@chevrontexaco.com	
Scinto, Phil	Lubrizol Corporation 29400 Lakeland Blvd. Mail Drop 152-A Wickliffe, OH 44092 Phone No.: 440-347-2161 Fax No.: 440-347-9031 Email: prs@lubrizol.com	
Smolenski, Don	 Phone No.: Fax No.: Email:	
Sutherland, Mark	Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249 Phone No.: 210-867-8357 cell Fax No.: 210-690-1959 Email:	
Sutherland, Robert	Shell Global Solutions 3333 Highway 6 South Houston, TX 77082 Phone No.: 281-544-8620 Fax No.: 281-544-8150 Email: r.sutherland@shell.com	

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	Phone No.: Fax No.: Email:	
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	Phone No.: Fax No.: Email:	
	Phone No.: Fax No.: Email:	
	Phone No.: Fax No.: Email:	
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Attachment 3

SOUTHWEST RESEARCH INSTITUTE®

Report On the Discovery of Convex Camshaft Lobes in the Sequence IVA Test and the Development and Implementation of Corrective Actions

Prepared by:
William A. Buscher III

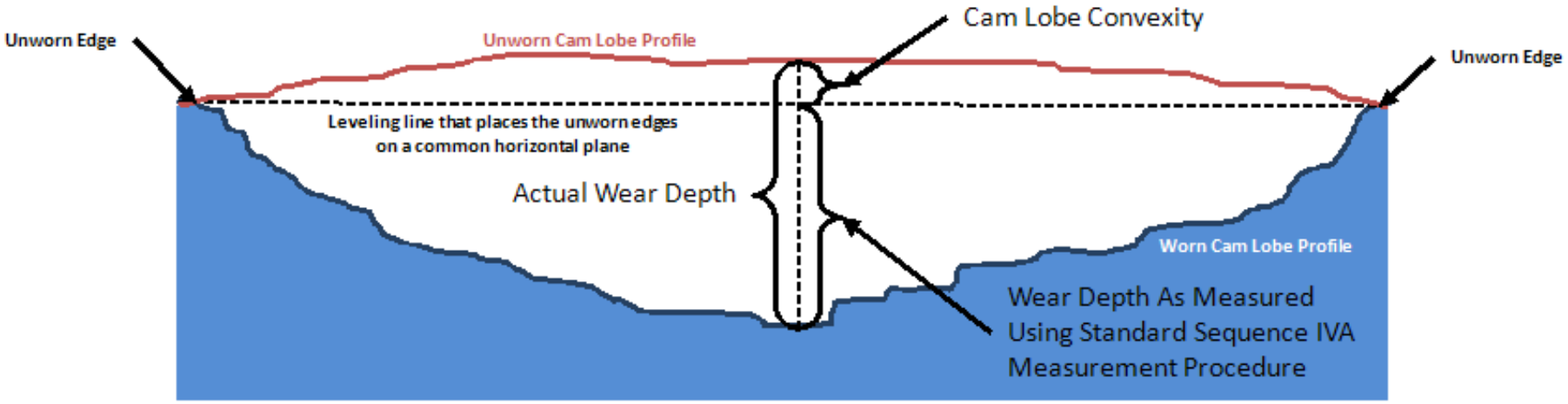
February 28, 2013

Outline

- Description of the Anomaly
- History of the Discovery
- Review of the Standard Wear Measurement Method
- Concern with the Convex Camshaft Lobe Surface
- Development of the Pre-Test/Post-Test Overlay Wear Measurement Method
- Concern with the Pre-Test/Post-Test Overlay Wear Measurement Method
- Restoration of the Flat Camshaft Lobe Profile
- Review of the OHT Regrinding Process
- SwRI Implementation of Reground Camshafts
- Review of the Tests Involved
- Severity Comparison
- Summary
- Recommendations?

Description of the Anomaly

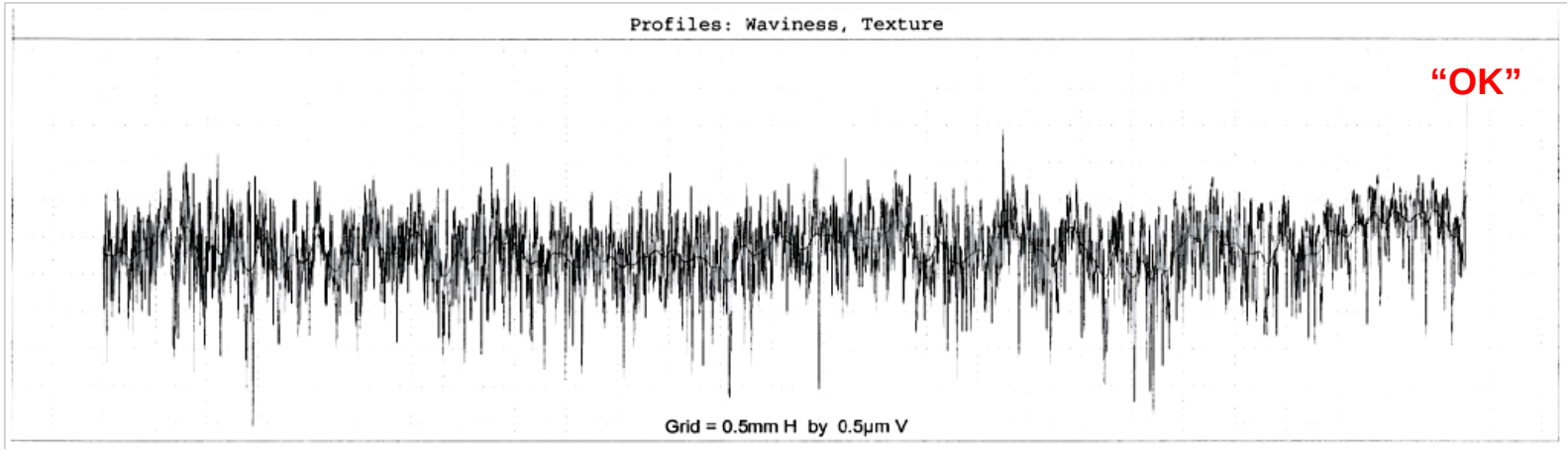
- Convex lobes exhibit a crown that protrudes up to 7µm above the flat surface that normally is used as the baseline to calculate the wear value
- Undetected and/or uncorrected convex lobe would lead to an incorrect wear measurement that is milder than the actual wear on a camshaft lobe



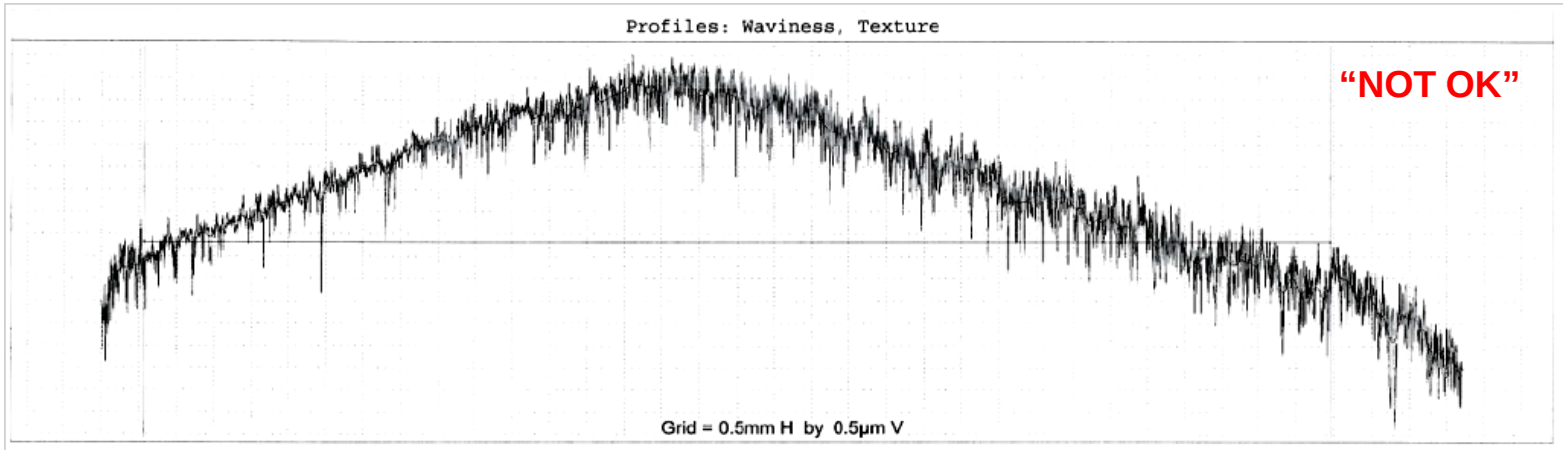
History of the Discovery

- Starting with camshaft lot 080730 (Dec. 2009), camshaft lobe surfaces were found with the convex lobe condition
- This was first discovered while taking profilometer traces of the base circle profile in cases where a post-test lobe is missing a discrete non-worn edge
- Camshaft lobe surfaces from lots manufactured in 2008 and later were progressively non-linear, and the peak of the curve progressively increased
- Not a single camshaft, from any of these lots, measured greater than the camshaft rejection criteria indicated in Section 9.6.2.3 of ASTM D 6891 (*reject any camshaft that exhibits taper, concavity, or convexity of more than the 10µm variation*)

Lobe Surface Comparison



Example from Lot 080317

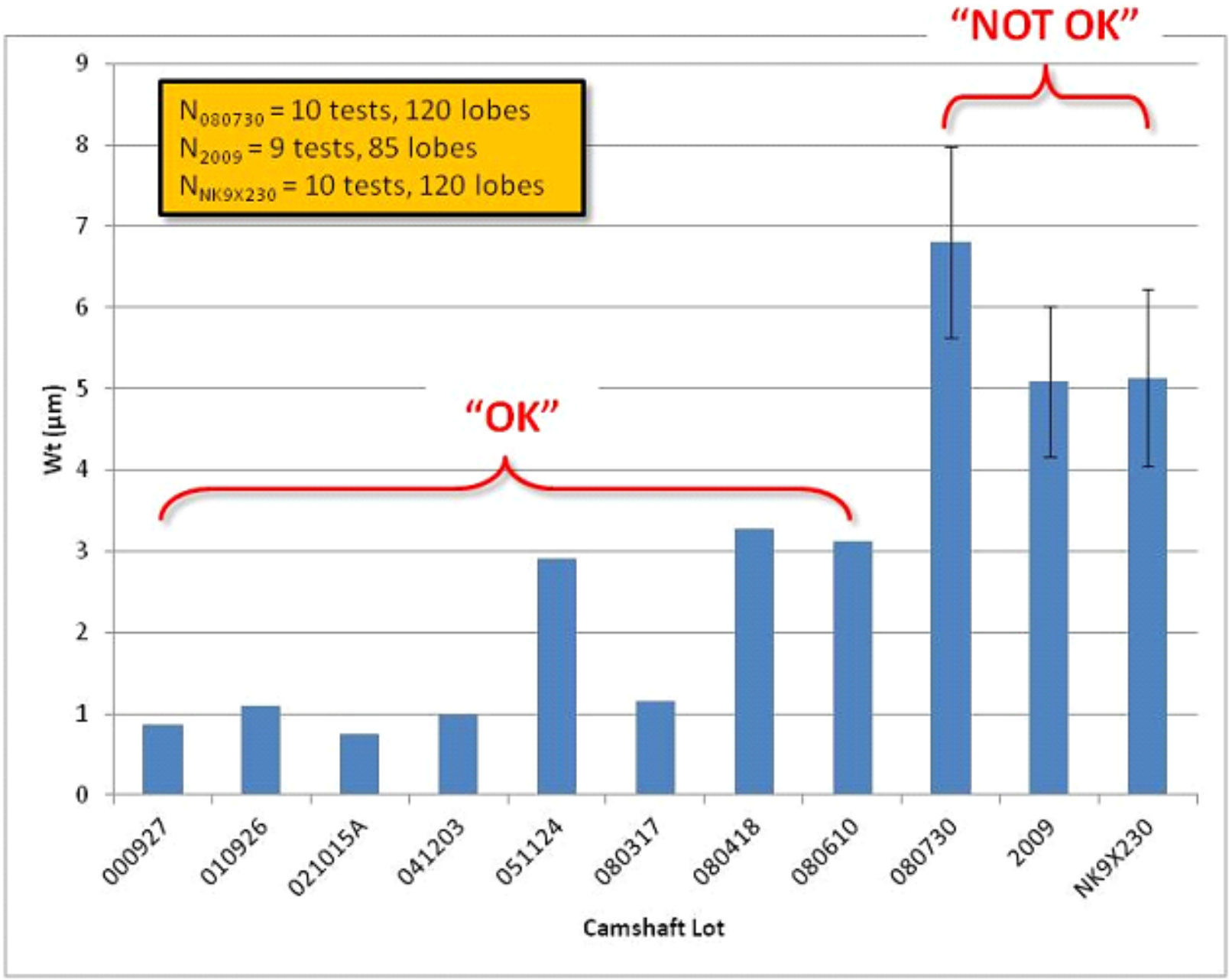


Example from Lot NK9X230

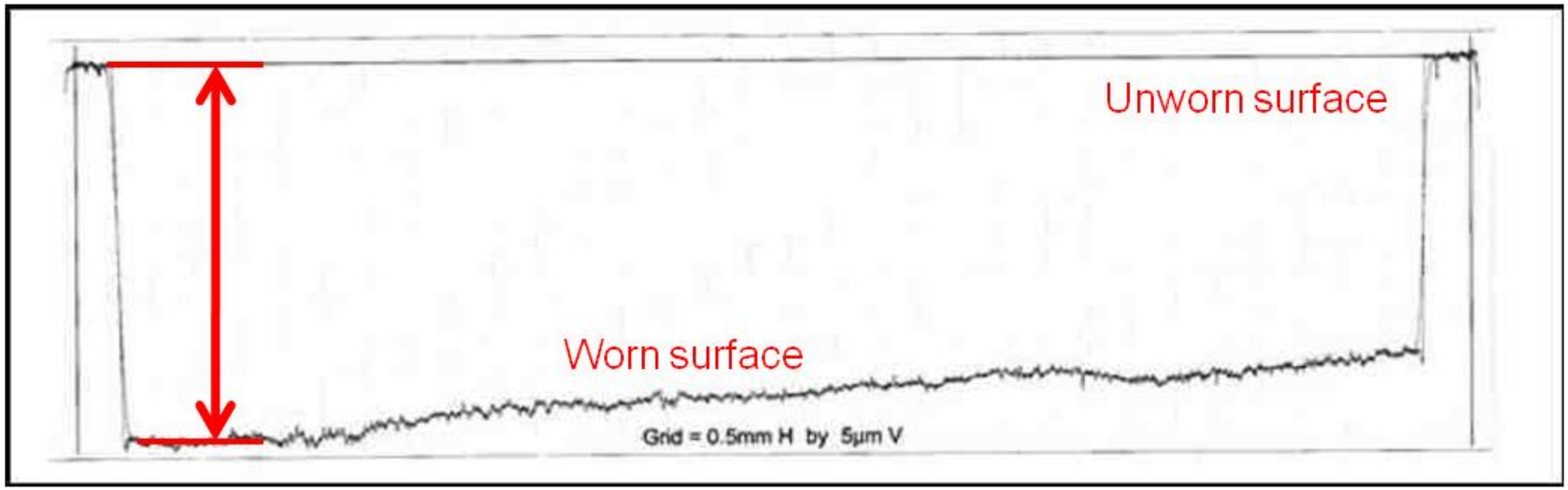
Definition of a Nissan Lot Code

- The Nissan lot code identifies a packaging date for the hardware component
- Later lot codes also include a manufacturing plant code
- 080730 = Packaged on 2008, July, 30th
- NK9X230 = NK Plant, Packaged 2009, October, 23rd
- NK05190 = NK Plant, Packaged on 2010, May, 19th

Convexity of Lobe Surfaces from Multiple Lots



Standard Wear Measurement Method



- The maximum wear depth is the greatest distance between the unworn surface and the worn surface of the camshaft lobe
- The accuracy of this measurement method is based on the assumption that the original surface of the camshaft lobe could be properly represented by a flat line that connects the two unworn surfaces at the edge of each camshaft lobe

Concern with Convex Camshaft Lobe Surface

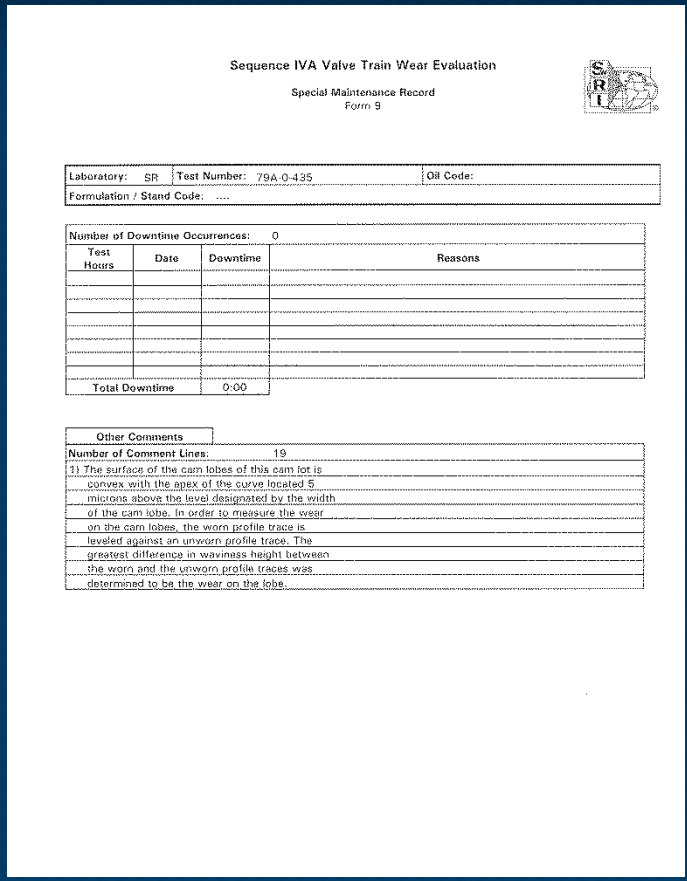
- The convex camshaft lobe surface undermines the assumption of a flat camshaft lobe profile in the standard wear measurement method
- The pre-test camshaft lobe profile can no longer be defined by a reference line connecting just two points on the two unworn edges
- The integrity of the measurement of maximum wear depth is jeopardized due to insufficient definition of the original camshaft lobe profile
- If left uncorrected or not measured properly post-test, the cumulative summation of the error has potential to skew results, thus allowing a borderline failing oil to become a passing oil

Development of the Pre-Test/Post-Test Overlay Wear Measurement Method

- **Guidelines indicated in Section 11.5.3.12 of ASTM D 6891**
  - **Section 11.5.3.12 states *"It will rarely occur that the above techniques provide a wear measurement that appears unreasonable (for example, a known unworn area that is not displayed as the highest point on a trace). When this occurs, consult the test engineer for the proper leveling and wear interpretation of that trace. Document the process utilized to make this wear measurement evaluation in the test report."***

Development of the Pre-Test/Post-Test Overlay Wear Measurement Method

- The pre-test camshaft lobe profile was overlaid with the post-test camshaft lobe profile
- The maximum wear depth was determined by taking the largest difference between the pre-test and post-test camshaft lobe profiles
- Comments were added to all the final test reports, reflecting this action



Sequence IVA Valve Train Wear Evaluation

Special Maintenance Record
Form 9

Laboratory: SR	Test Number: 79A-0-435	Oil Code:
Formulation / Stand Code:		

Number of Downtime Occurrences: 0

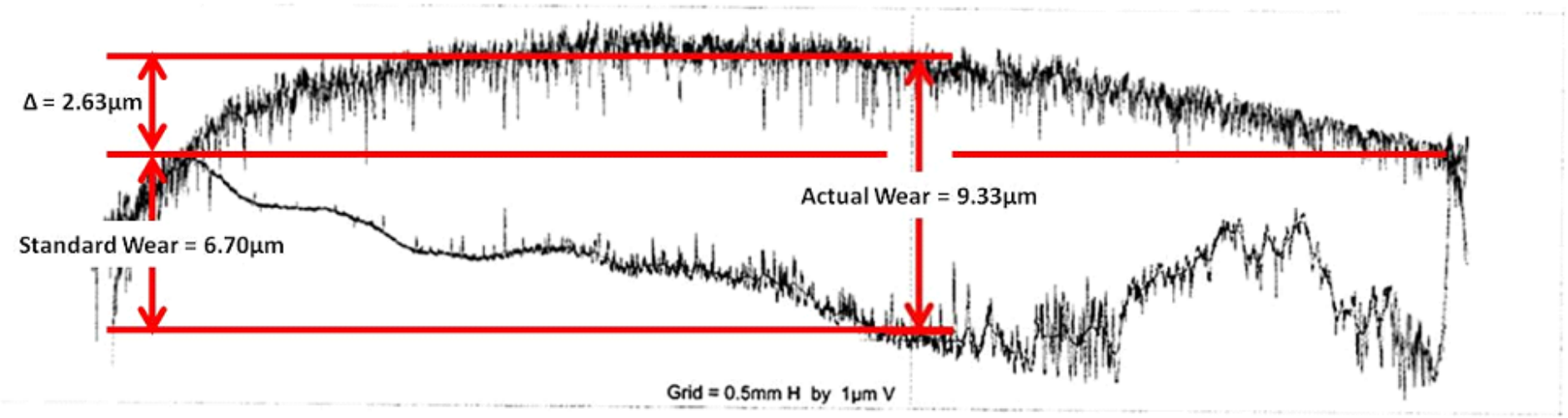
Test Hours	Date	Downtime	Reasons
Total Downtime		0:00	

Other Comments

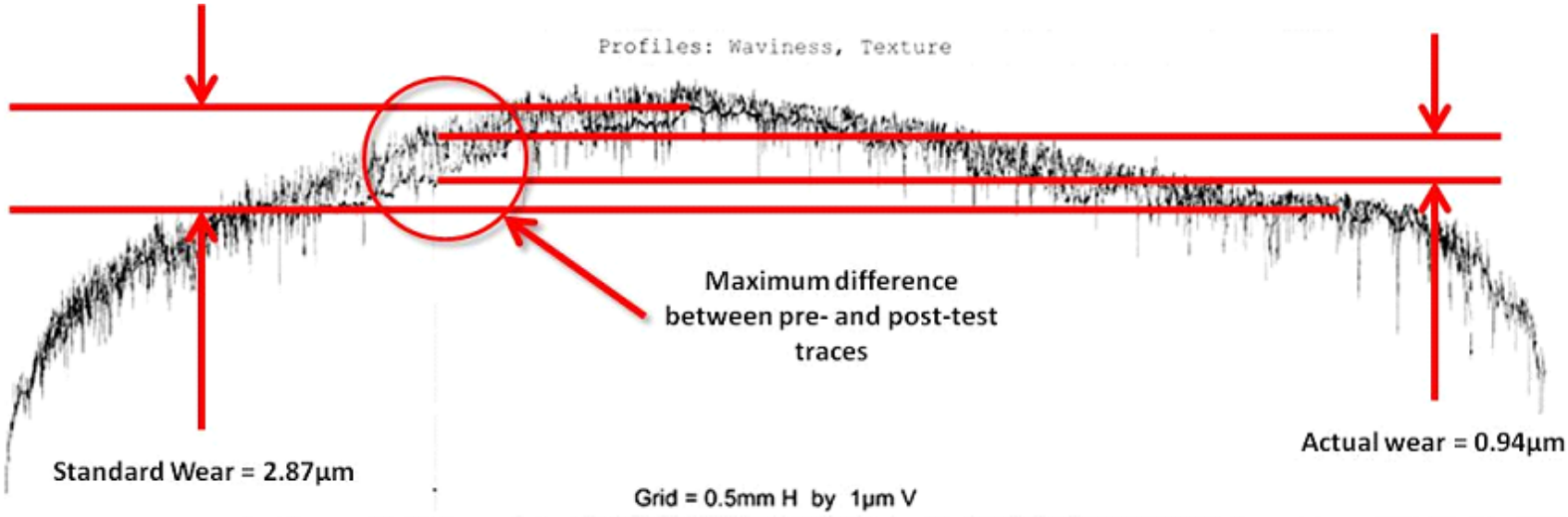
Number of Comment Lines: 19

1) The surface of the cam lobes of this cam lot is convex with the apex of the curve located 5 microns above the level designated by the width of the cam lobe. In order to measure the wear on the cam lobes, the worn profile trace is leveled against an unworn profile trace. The greatest difference in waviness height between the worn and the unworn profile traces was determined to be the wear on the lobe.

Comparison of Overlay and Standard Wear Measurement Methods



Moderate Wear Example

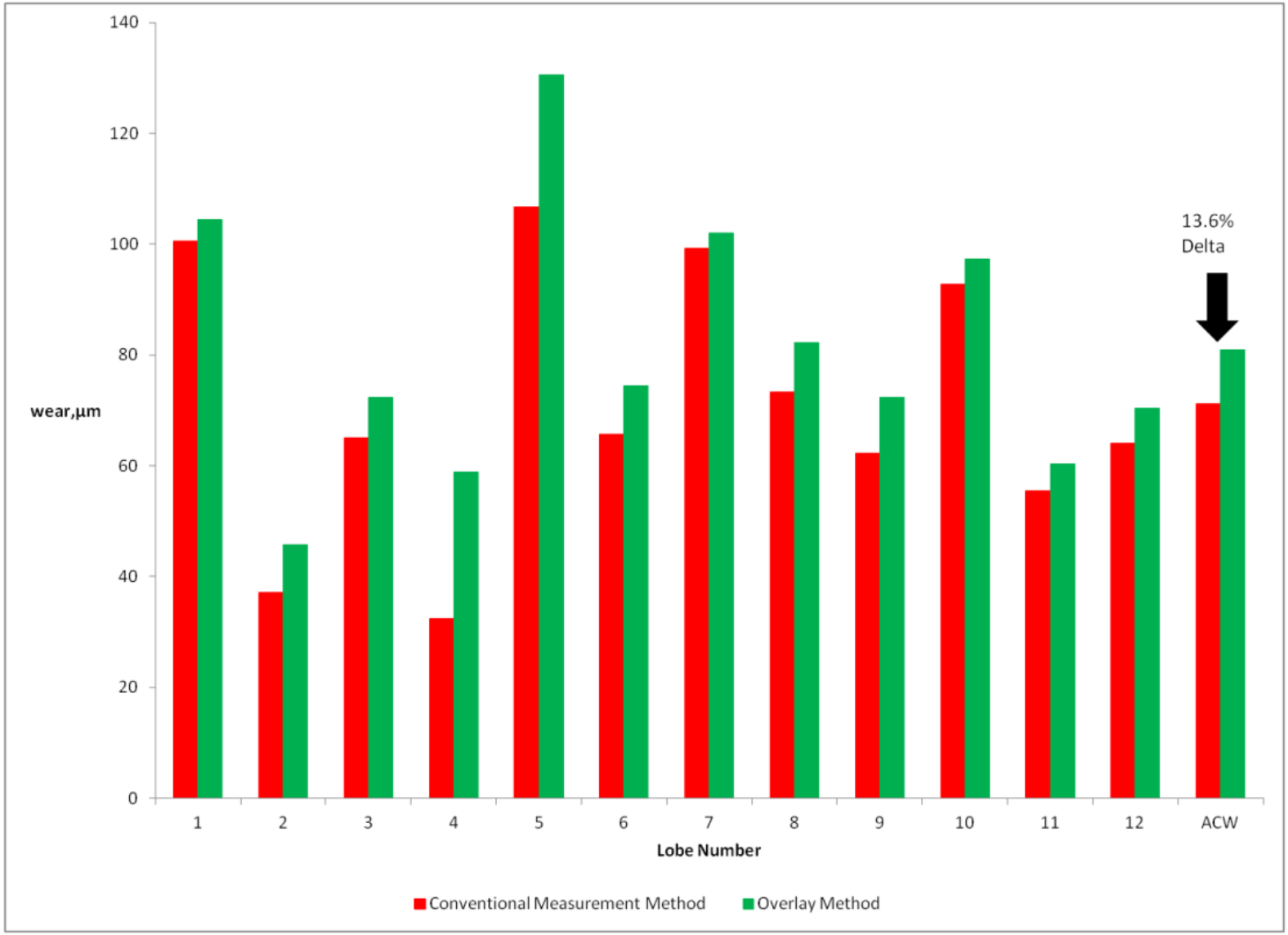


Low Wear Example

Example of the Pre-Test/Post-Test Overlay Wear Measurement Method

- An example of a post-test camshaft measured by both wear measurement methods is included on the following slide
  - The conventional method produces ACW of 71.23µm and the overlay method produces ACW of 80.89µm
  - The discrepancy between the ACW values obtained from each measurement method is 13.6% for this example
- The discrepancy has the potential to be even greater depending on the height of the convexity and the severity of the wear

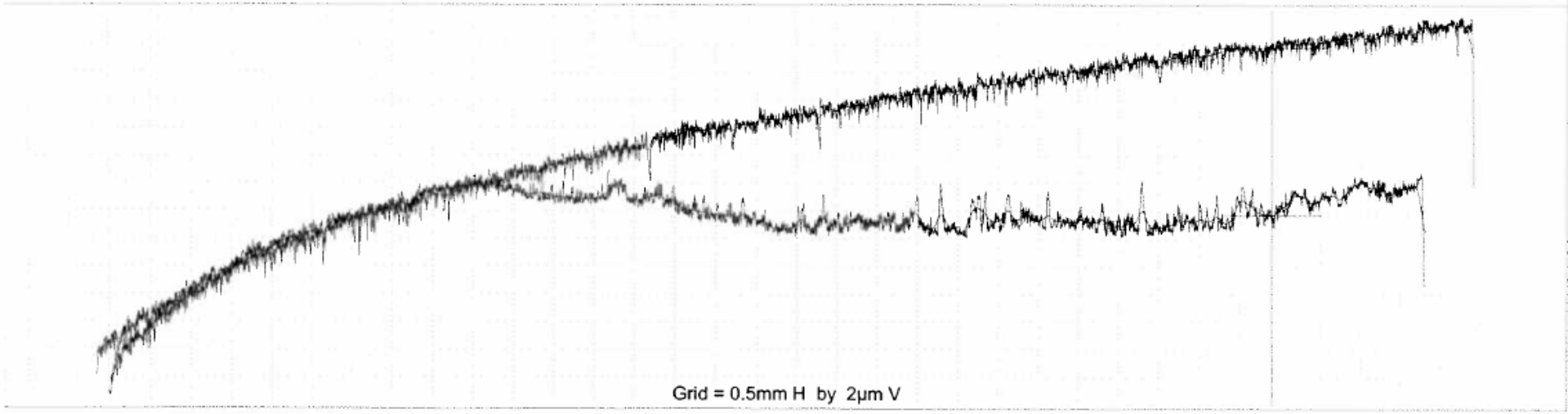
Comparison of ACW Result Using Overlay Method and Standard Method for Measurement of Camshaft Lobe Wear



Concern with Pre-Test/Post-Test Overlay Wear Measurement Method

- The pre-test/post-test overlay wear measurement method was proven as an effective way to address camshafts with the convex lobe anomaly
- But it has some drawbacks that led SwRI to consider additional solutions to the problem
- The primary drawbacks include:
  - Human subjectivity when overlaying the pre-test and post-test camshaft lobe profiles
  - The difficulty applying this method to a post-test lobe with the absence of a discrete non-worn edge

Overlay w/ No Form (Missing Non-Wear Edge)



Restoration of the Flat Camshaft Lobe Profile

- An alternative to conducting pre-test/post-test overlay wear measurement method was to restore the profile of the original camshaft lobe surface to be flat
- The surface of the camshaft lobe was reground to produce a flat surface profile as well as target the average roughness of the camshaft lobe surfaces of camshafts manufactured prior to 2008
- Average roughness (Ra), skew (Rsk), and waviness (Wt) of the base circle traces of previous camshaft lots were used as targets to restore the surface of the camshaft lobes

Ra, Rsk, and Wt of Camshaft Lobe Surfaces Prior to 2008

Cam Batch	Ra (µm)	Rsk	Wt (µm)
990628	0.25	-1.42	0.77
990628	0.29	-0.93	1.42
000927	0.35	-0.84	0.87
000927	0.32	-0.74	0.97
010926	0.42	-0.46	1.40
010926	0.22	-1.22	1.03
010926	0.31	-0.74	1.23
010926	0.32	-0.91	1.10
021015A	0.20	-0.62	0.75
041203	0.21	-0.40	1.02
041203	0.19	-0.61	0.98
051124	0.28	-0.89	2.91
Average	**0.28**	**-0.82**	**1.20**
St. Dev.	**0.07**	**0.29**	**0.58**

- **These Average Ra, Rsk, and Wt values were supplied to OHT as the surface finish targets for regrinding**

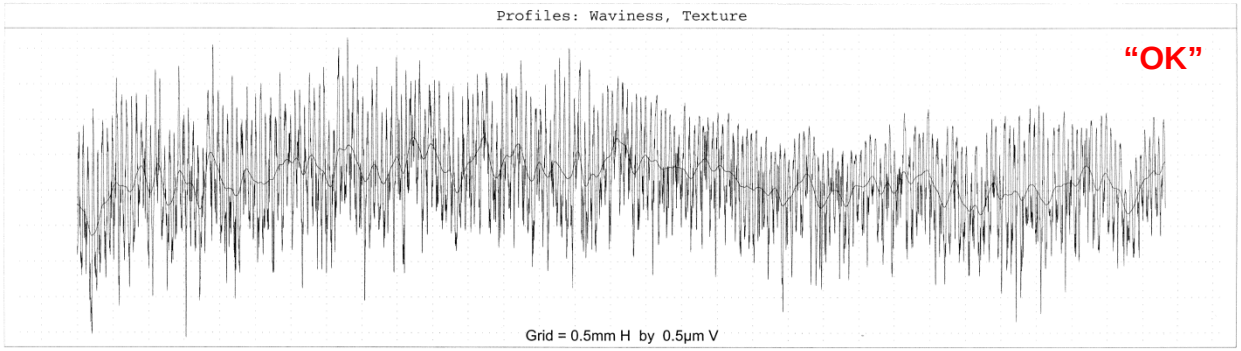
Restoration of the Flat Camshaft Lobe Profile

- SwRI discussed the manufacturing anomaly with a performance camshaft manufacturer
- The camshaft manufacturer was familiar with this anomaly, usually resulting from tool wear during a production run of camshafts, and indicated it was common to regrind camshafts if this anomaly was identified at the completion of the machining process
- The camshaft manufacturer recommended regrinding the Sequence IVA camshafts
- SwRI contacted OHT and inquired about the possibility of having OHT regrind a couple of example camshafts from lot 080730
- SwRI chose to use OHT for the regrinding

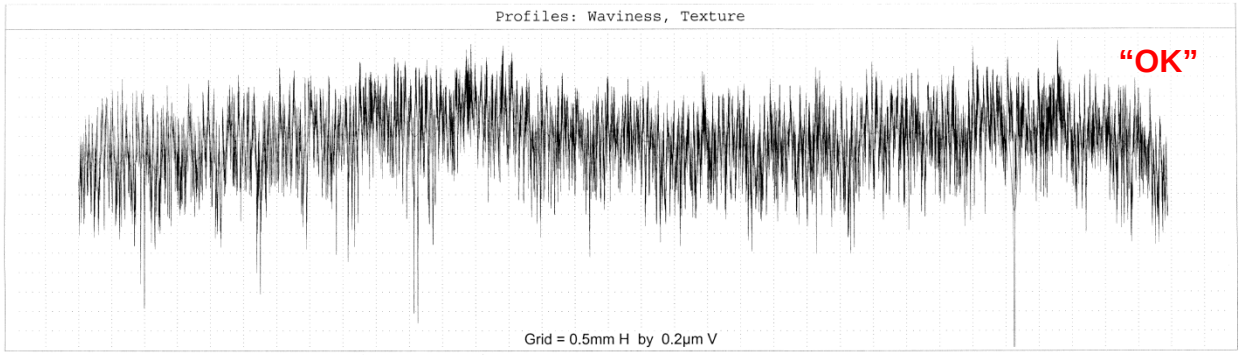
OHT Regrinding Process

- The details of the OHT regrinding process for all Sequence IVA camshafts reground to-date are included below:
  - Regrinding performed by supplier that manufactures Sequence IIIF and IIIG camshafts for OHT
  - Material removal limited to 5µm off of the lobe surface during the regrinding process
  - Production lobe profile maintained
  - Lobe profile of reground camshafts compared to an acceptable test camshaft example supplied by SwRI
  - Camshaft lobes reground to Ra, Rsk, and Wt targets supplied by SwRI (as shown on Slide 16)
  - 100% inspection of final product conducted by supplier
  - Post-grinding lobe profile traces conducted by supplier on a random sampling of final product

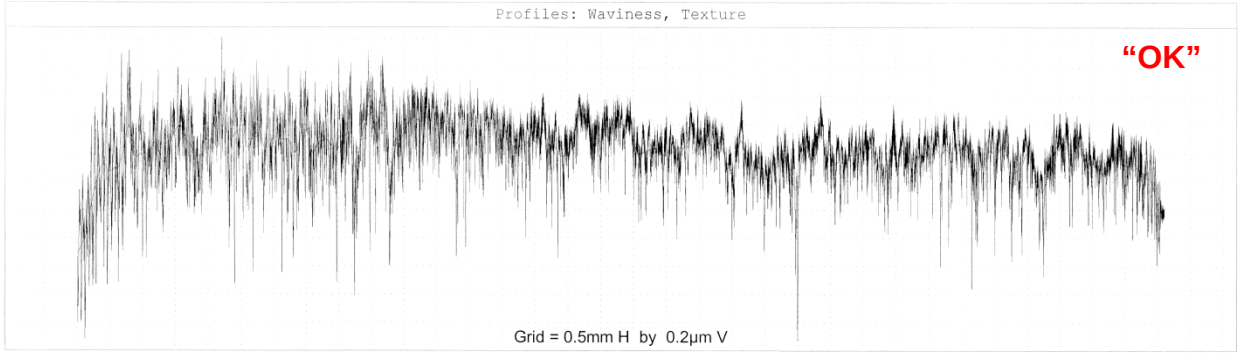
Camshaft Lobe Surfaces of Reground Camshafts



080730 After Regrinding



NK04120 After Regrinding



NK05190 After Regrinding

Ra, Rsk, and Wt Values of Reground Camshafts

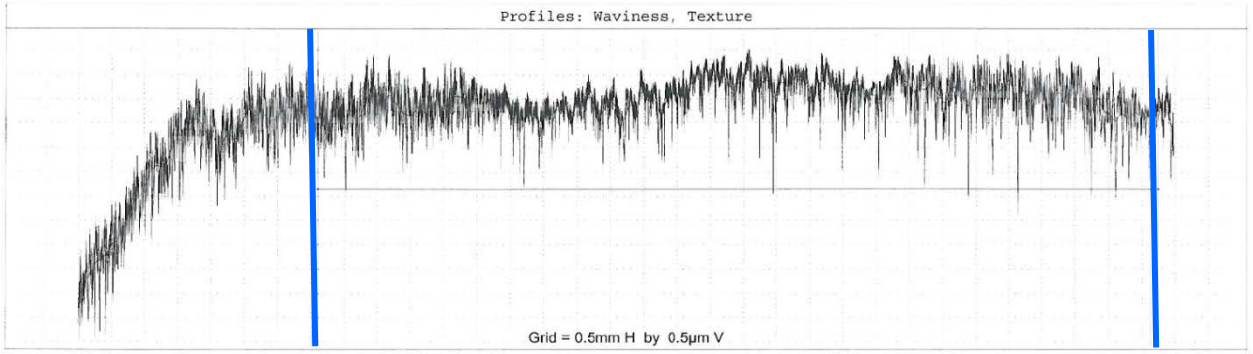
Parameter	Ra	Rsk	Wt
Target	0.28	-0.82	1.20
Target Std. Dev.	0.07	0.29	0.58
Measured Min.	0.18	-0.66	0.42
Measured Max.	0.56	0.39	1.26
Computed Avg.	0.31	-0.20	0.60
Computed Std. Dev.	0.11	0.24	0.14
Lobe (n size)	48		
Camshaft (n size)	4		

- **Using our PDI measurement data, average Ra is very close to target, Average Rsk is below target, and Average Wt is below target**

100% Inspection Data From Regrinding Supplier

Parameter	Reground Camshafts 100% Inspection Supplier Data		Reground Camshafts Sample of SwRI's PDI Data	
	Average	Std. Dev	Average	Std Dev
Ra	0.248	0.173	0.308	0.111
Rsk	-0.319	0.240	-0.198	0.235
Wt	2.946	0.603	0.596	0.136
N Count Individual Lobes	1738		48	
N Count Camshafts	145		4	

- **Supplier's Wt data includes any chamfer on lobe edges**
- **SwRI's PDI Wt data removes any chamfer on lobe edges as per Section 11.5.3.9 of ASTM D 6891**



SwRI Implementation

- Prior to running any official Sequence IVA reference and candidate tests, “in-house” testing, using reference oil retains, was conducted to prove comparability of the test results
- After successful in-house testing, reference tests were conducted
- Following successful reference tests, candidate tests were conducted
- 39 camshafts from lot 080730 were sent to OHT for regrinding in March 2010
- These reground camshafts were in service from June 2010 through October 2011

SwRI Implementation

- 230 camshafts, 185 from lot NK04120 and 45 from lot NK05190, were sent to OHT for regrinding in October 2011
- The reground NK04120 camshafts were in service from February 2012 through January 2013
- The reground NK05190 camshafts were in service from December 2012 through January 2013

Number of Tests Conducted with Pre-Test/Post-Test Overlay Wear Measurement Method

Total Reference Oil Tests:	22
Chartable Reference Tests:	13
Acceptable Reference Tests:	12
Non-Acceptable Reference Tests:	1
Successful Reference Periods	11
Total Candidate Oil Tests:	133
ACC-Registered Tests:	58
Passing	30
Failing	28
Invalid	0

- These tests include camshafts from three camshaft lots; 080730, 2009 and NK9X230

Number of Tests Conducted with Reground Camshafts

Total Reference Oil Tests:	33
Chartable Reference Tests:	18
Acceptable Reference Tests:	16
Non-Acceptable Reference Tests:	2
Successful Reference Periods	15
Total Candidate Oil Tests:	167
ACC-Registered Tests:	103
Passing	70
Failing	32
Invalid	1

- **These tests include camshafts from three camshaft lots; 080730, NK04120 and NK05190**

Reground versus Non-reground ACC-Registered Candidate Data

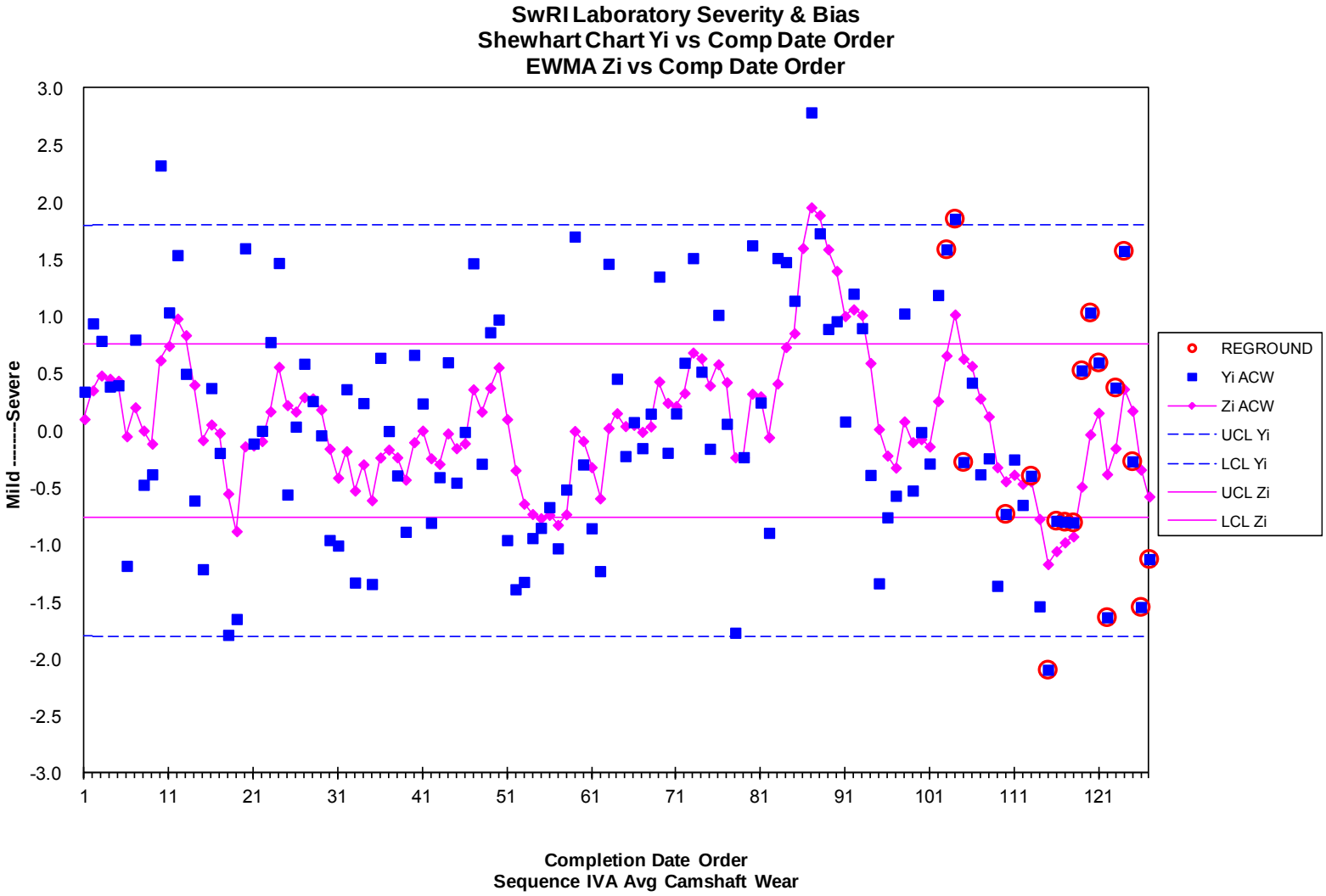
	Reground	Non-reground
ACC-Registered Tests:	103	129
Passing	70	99
Failing	32	30
Invalid	1	0

- **SwRI candidate data was reviewed in a time period from December 2009 to January 24, 2013**
- **These tests include camshafts from five camshaft batches; 080730 (mix), 2009 (non-reground), NK9X230 (non-reground), NK04120 (reground) and NK05190 (reground)**
- **The calculated pass percentages for this data set are as follows:**
  - **Non-reground = 99/129 = 77%**
  - **Reground = 70/102 = 69%**
  - **All = 169/231 = 73%**

Severity Comparison

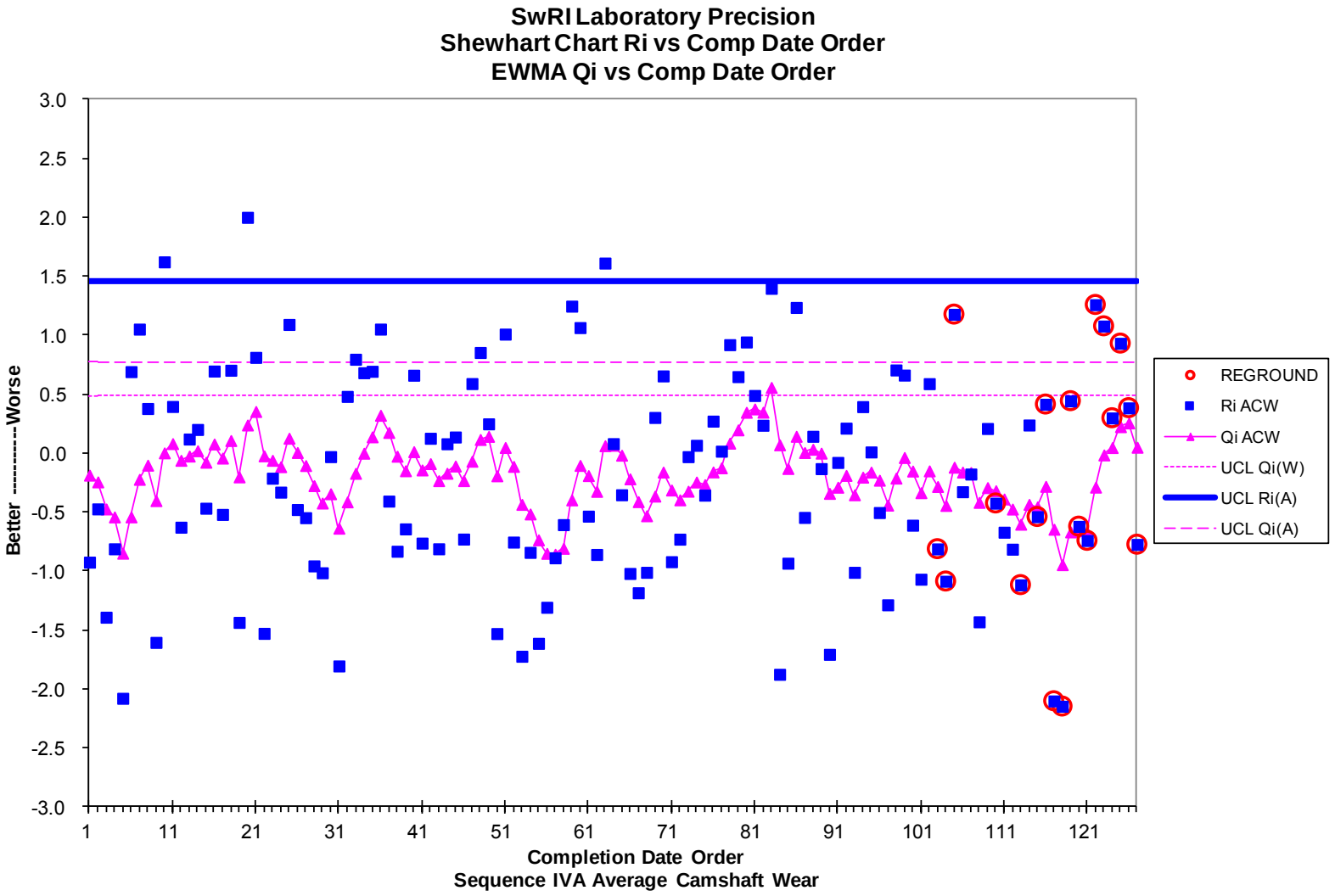
- SwRI conducted a severity comparison using reference oil test results from all chartable SwRI reference tests, starting in October 1999
- This includes 127 tests, a well represented mix of camshafts with no lobe anomalies, camshafts with convex lobe surfaces that were not reground, but had pre-test/post-test overlay wear measurements, and reground camshafts

Plot of ACW Yi and ACW Zi for SwRI Reference Tests



– This data indicates that the introduction of the reground camshafts did not shift the severity of the test

Plot of ACW Ri and ACW Qi for SwRI Reference Tests

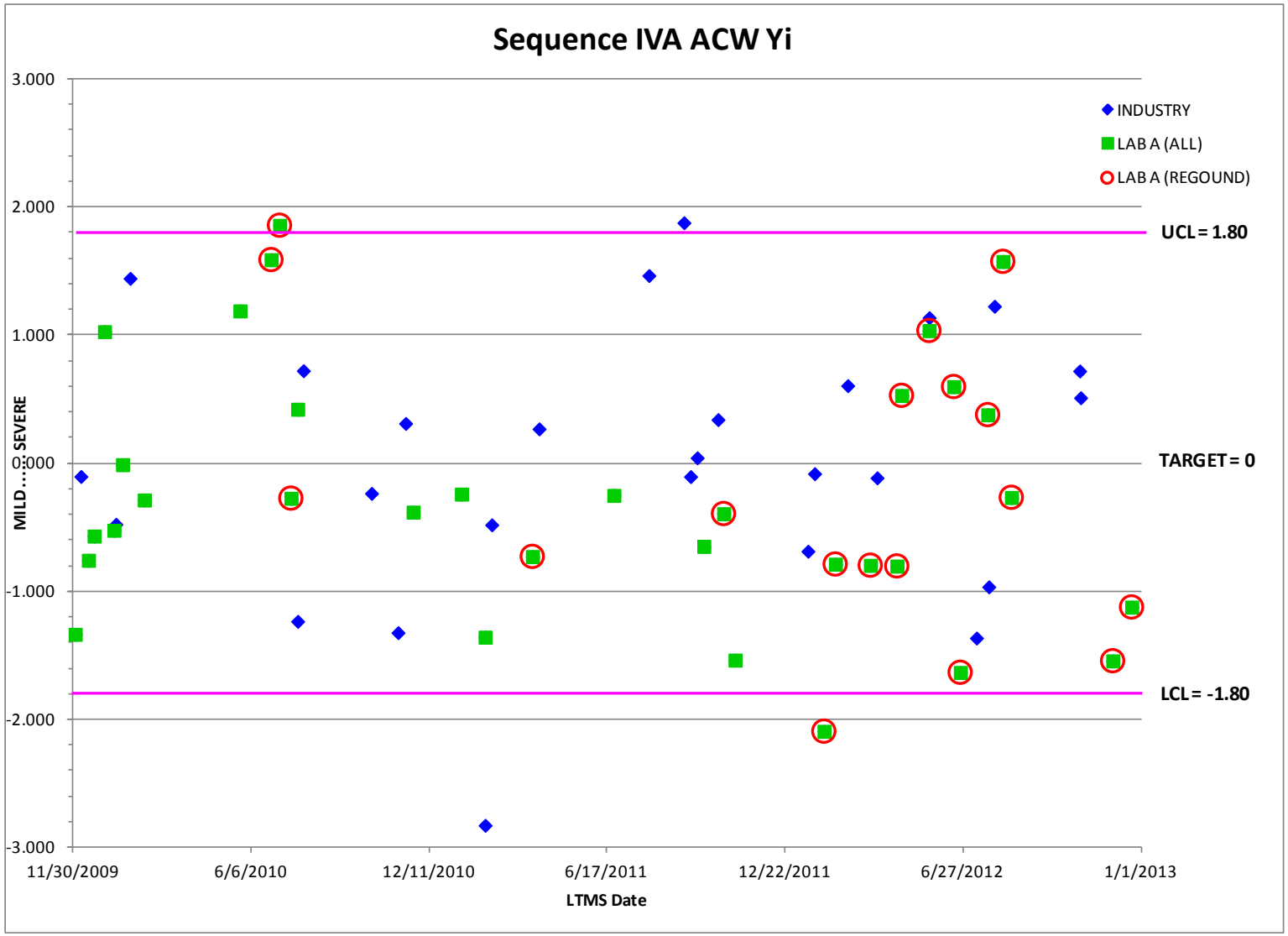


– This data indicates that the introduction of the reground camshafts did not shift the precision of the test

Severity Comparison

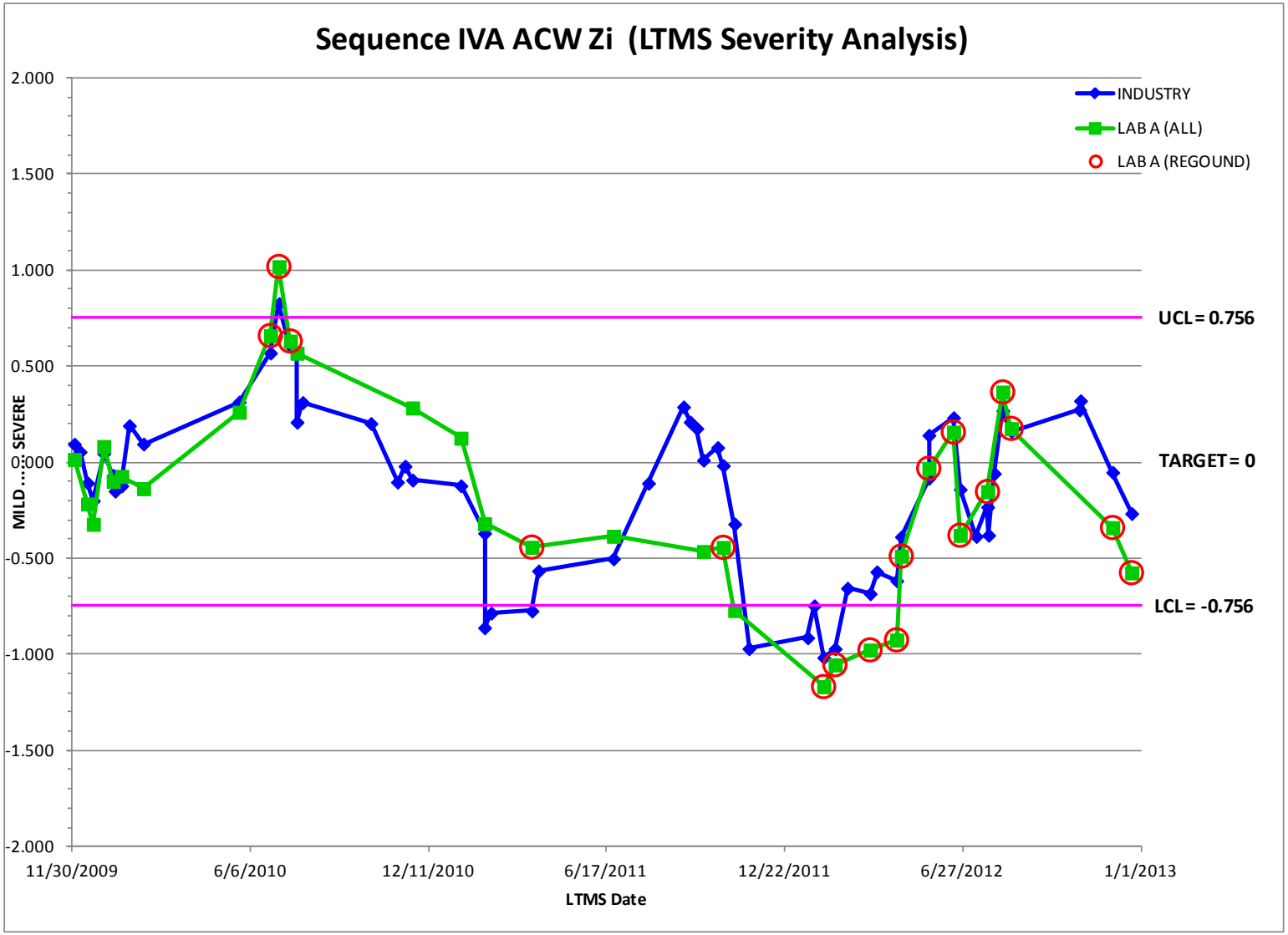
- SwRI conducted a severity comparison using industry and SwRI reference test results from December 2009 through January 2013
- ACW Yi data, an LTMS severity analysis plot and an LTMS precision analysis plot were analyzed

Plot of Yi vs. Date of Industry and SwRI Reference Oil Tests



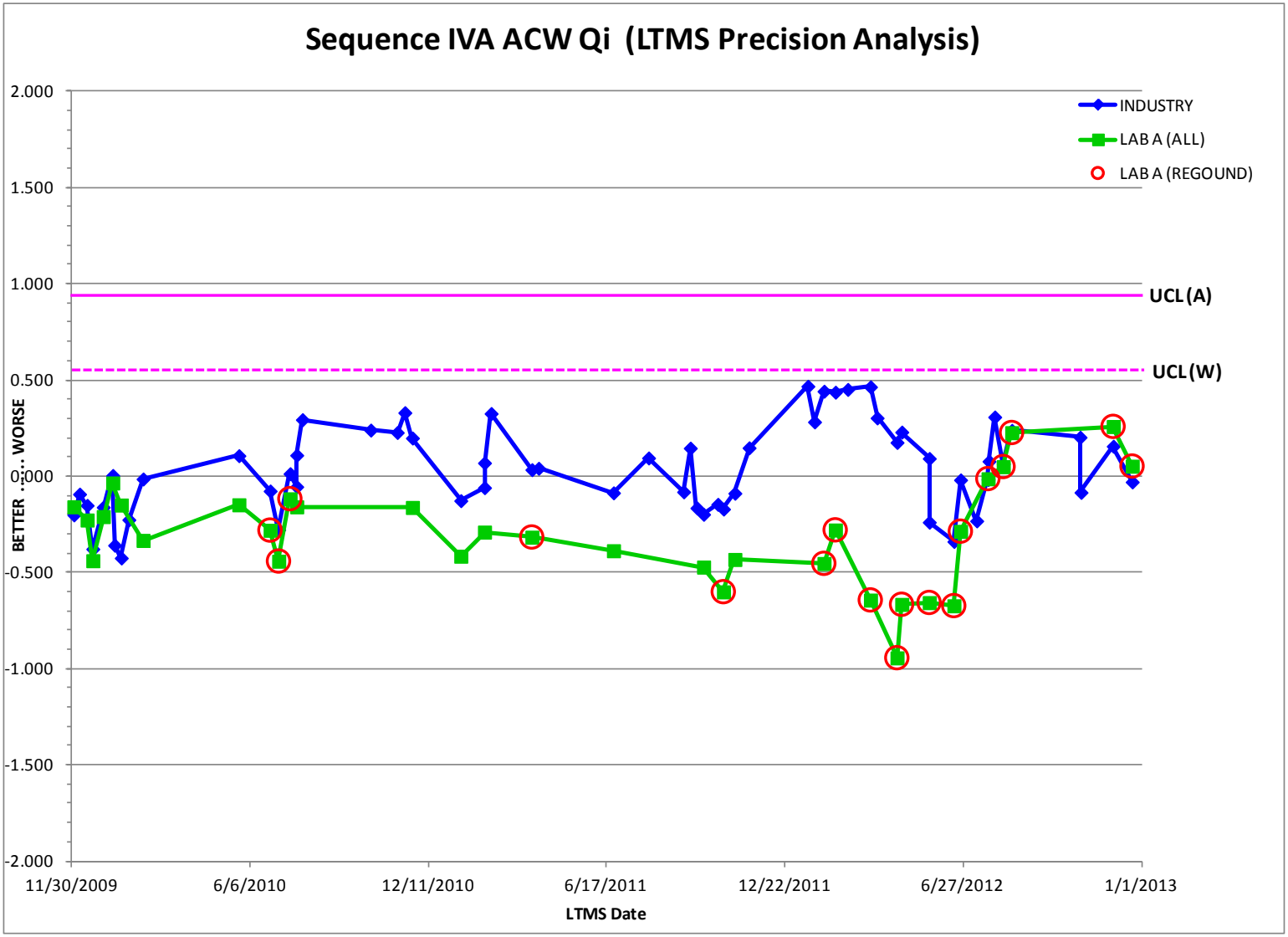
– **Within this timeframe the scatter for all data falls within similar boundaries**

Plot of Zi vs. Date of Industry and SwRI Reference Oil Tests



– Within this timeframe the trend of SwRI's lab severity and the industry's severity follow similar patterns

Plot of Qi vs. Date of Industry and SwRI Reference Oil Tests



– Within this timeframe the trend of SwRI's lab precision and the industry's precision follow similar patterns

Summary

- A borderline failing oil could become a passing oil when tested on a convex lobe camshaft, if left uncorrected or not measured properly post-test
- Regrinding camshafts that exhibit the convex lobe surface anomaly is necessary to produce accurate and repeatable ACW results when utilizing the standard wear measurement technique
- Pre-test/post-test overlay wear measurement method is a viable alternative to camshaft regrinding, but with some drawbacks
- SwRI believes we were taking the proper technical approach to address this problem

Summary

- Regrinding camshafts should be considered as an acceptable technical approach to sustain this test with the hardware currently in inventory at some laboratories
- Nissan cannot guarantee that future camshafts will not have the convex lobe surface anomaly
- Regrinding camshafts should be considered as an acceptable technical approach to sustain this test with the future hardware about to be ordered from Nissan
- In hindsight, SwRI recognizes that we should have informed the surveillance panel of this technical approach as it was being developed

Any questions?

Recommendations?

Attachment 4

Sequence IVA Hardware

Presented by

Takumaru Sagawa

NISSAN

Sequence IVA Hardware

- NISSAN understands that an estimated 570 test kits are needed to ensure the test life through 2016
- NISSAN has determined a way to provide this amount of hardware through our repair parts inventories
- This order must be placed soon to guarantee this amount of hardware for IVA test life
  - It is difficult to control production timing and it will take more than 6 months to send camshafts and rocker arms

Sequence IVA Hardware

- NISSAN cannot control critical parts quality
  - Camshafts for this industry order cannot be guaranteed to have flat camshaft lobes
- The work done by SwRI described in their report substantiates the need for regrinding to ensure proper test severity and precision
- NISSAN has the following requirements for this future hardware order

Sequence IVA Hardware Requirement

- Labs must submit their orders and payment to Nissan North America (Stephen Fields) by March 15, 2013
- Nissan North America will fill hardware orders and ship to each lab
- Labs must send all this hardware to OHT for regrinding using the same procedure OHT used for SwRI camshaft regrinding (details listed in SwRI report)
- NISSAN will support OHT with KA24E camshaft manufacturing information for regrinding purposes

Sequence IVA Hardware Requirement

- OHT will collect regrinding costs from each lab
- OHT will laser etch serial numbers on all reground camshafts, and all camshafts from this order will be considered to be from one lot
  - Labs to report this number in test report in place of the lot code
- OHT will distribute to each lab their reground camshafts
- Labs must use these reground camshafts from OHT for all reference and candidate tests

Sequence IVA Hardware

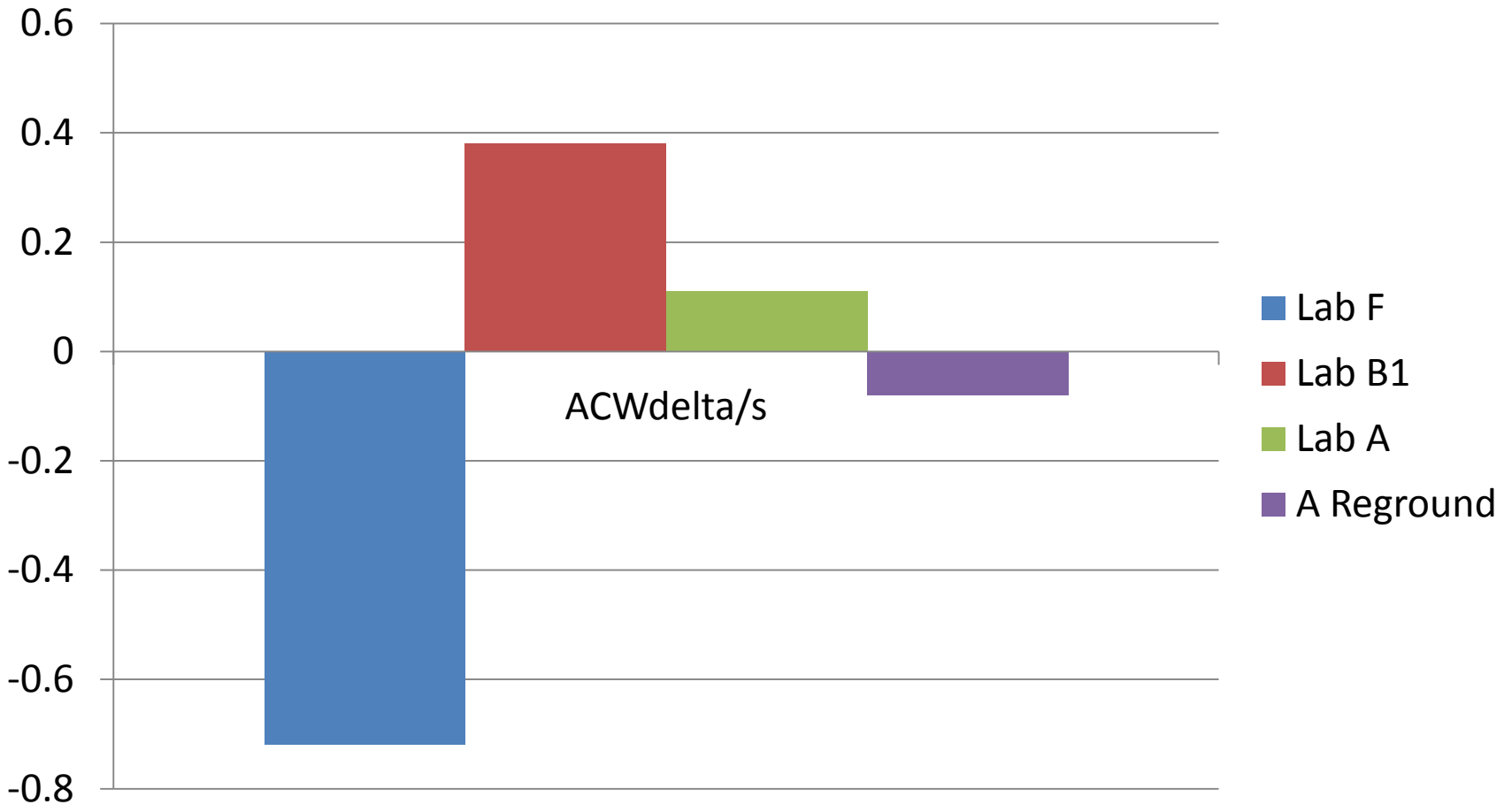
NISSAN would like to make this a *requirement* for all Sequence IVA tests utilizing hardware from this final industry order

Thank you for your consideration –

Takumaru Sagawa

Comparison of Reground Pooled s with Other Labs and Un-ground results

Comparison of Reground delta/s with Other Labs and Un-ground results



Attachment 6

Sequence IVA Procedure Changes Motion 1

Presented by

Takumaru Sagawa

NISSAN

Sequence IVA Procedure Change

Motion 1 Made By Takumaru Sagawa

- Modify Section 9.6.2.3 of ASTM D6891 as follows:
  - Check the pre-test camshaft for lobe concavity, convexity and taper using a profilometer to perform pre-test measurements across the nose of each camshaft lobe. Reject any camshaft that exhibits concavity or convexity of more than 4µm in height or depth, or taper of more than 10µm in variation. Any camshafts exceeding the above specification have the one time option of being sent to OHT for regrinding, using the same procedure OHT used for SwRI camshaft regrinding (details listed in SwRI report), and all those meeting the above specification may then be put into service.

Sequence IVA Procedure Change

Motion 1 Made By Takumaru Sagawa

- This motion would not apply to any non-reground camshaft lots currently calibrated within a laboratory.
- Effective Date = March 1, 2013

Attachment 7

Sequence IVA Procedure Changes Motion 2

Presented by

Takumaru Sagawa

NISSAN

Sequence IVA Procedure Change

Motion 2 Made By Takumaru Sagawa

- Modify Section 9.6.2.3 of ASTM D6891 as follows:
  - Check the pre-test camshaft for lobe concavity, convexity and taper using a profilometer to perform pre-test measurements across the nose of each camshaft lobe. Reject any camshaft that exhibits concavity or convexity of more than 4µm in height or depth, or taper of more than 10µm in variation. The test lab has the one time option of sending any camshaft, including camshafts rejected per the above criteria at their discretion, to OHT for regrinding, as per the Nissan supplied KA24E camshaft surface finish specifications. All camshafts meeting the above specification may then be put into service.

Sequence IVA Procedure Change

Motion 2 Made By Takumaru Sagawa

- This motion would not apply to any non-reground camshaft lots currently calibrated within a laboratory.
- Effective Date = March 1, 2013
- This motion supersedes the previous motion that passed 12 – 1 – 3 with one negative.

Test Method D 6891 Discrepancies

1) Section 6.3.11.8 was inadvertently deleted by information letter 05-3.
   6.3.11.8 *Rocker Cover Gas Temperature*—Insert the rocker cover gas temperature sensor through the rear cylinder head rubber gasket (half moon rubber plug). Drill a 2-mm diameter hole in the rear rubber plug, 4 mm down from the top, flat surface, centered horizontally. Press fit a 3.2-mm diameter closed tip type J thermocouple, 4 cm length, into the drilled hole so that the tip of the sensor is 12 mm from the inside surface of the rubber plug.

2) Section 7 defines a number of requirements to my knowledge have never been performed
   7.2.1 *Fuel Approval Requirements*—The TMC approves the fuel. Base the fuel batch acceptance upon the physical and chemical specifications given in Annex A4. Engine validation tests are not necessary for fuel batch acceptance.
   7.2.1.1 *Authorization*—The TMC issues a memorandum authorizing the use of a new Haltermann KA24E Green test fuel batch.

Procedure for rebuilding a Nissan KA24E throttle body for the Sequence IVA

1. Remove all sensors and electronics (throttle position sensor, mass air flow sensor, idle air control motor).
2. Remove all rubber hoses.
3. Remove the throttle spring mechanism.
4. Remove the coolant bypass valve. Be sure to keep the clip that holds the coolant bypass valve in place.
5. Remove the throttle plate.
6. Carefully set the throttle body in a vice on its side such that the shaft that actuates the throttle plate is pointed upwards with the threaded end up. Place a nut on the end of the threaded end to protect the threads.
7. Using a hammer, tap the nut on the end of the shaft until the shaft starts to come out. It should also push the washer, a rubber seal, and a sealed ball bearing from the side opposite of the side that the hammer is striking from.
8. Remove the washer, seal, and bearing from the shaft by placing the shaft in a vice and laying the washer against the flat surface of the top of the vice jaws. Tap the nut on the end of the shaft with a hammer until the shaft is dislodged from the bearing.
9. Place the shaft back into the other bearing that is still in the throttle body. Tap the non-threaded side of the shaft with a hammer until the other washer, seal, and bearing are dislodged.
10. The bearing and seal can be purchased from Bohls Bearings in San Antonio, Texas using the following part numbers:
    a. Sealed ball bearing: p/n 6000 2RS
    b. Rubber seal: TCM Dichtomatik Americas catalogue p/n 10x16x3PVC
11. The washer must be fabricated from aluminum. The blueprint is attached.
12. Clean the throttle body with Stoddard solvent to remove any grease or wet carbon deposits. Sand-blast the entire throttle body to remove any remaining solid deposits.
13. Press-fit the new bearings into the throttle body.
14. Install the new seal into the recess in the washer. Press-fit the washer into the throttle body. Be sure to notch the outer surface of the washer against the throttle body to ensure that the washer will not spin.
15. Press-fit the throttle shaft into the bearings by tapping on the non-threaded end of the shaft with a hammer. Be sure to set the washer on the threaded side of the shaft on a secure flat surface to prevent the washer from popping out of the press-fit.
16. Reinstall the throttle plate.
17. Reinstall the coolant bypass valve. Be sure to reinstall the clip that secures the coolant bypass valve.
18. Reinstall the throttle spring mechanism.
19. Reinstall all rubber hoses.
20. Reinstall all sensors and electronics.

Attachment 10

ASTM Sequence IVA Surveillance Panel

Scope and Objectives

Scope

The Sequence IVA Surveillance Panel is responsible for the surveillance and continued improvement of the Sequence IVA test documented in Test Method D 6891 as updated by the Information Letter system. Data on test precision and laboratory versus field correlation will be solicited and evaluated at least every six months. Improvements in wear measurement technique, test operation, test monitoring and test validation will be accomplished through continual communication with the Test Sponsor and Parts Distributor, ASTM Test Monitoring Center, ASTM Committee D02.B0.01 and the ASTM Passenger Car Engine Oil Classification Panel. Actions to improve the process will be recommended when deemed appropriate based on input from the proceeding. The Panel will review development and correlation of updated test procedures with previous test procedures. This process will provide a suitable test procedure for evaluating an automotive lubricant's effect on controlling cam lobe wear for overhead valvetrain equipped engines with sliding cam followers.

Objectives	**Target Date**
1. Secure hardware to sustain test through 2016.	*Dec 2013*
2. Pursue engine mounting and driveline identification, optimization and maintenance procedure and interval.	*June 2013*
3. Solicit suppliers for a GF-5 technology reference oil with ACW performance in the 50-90μm range.	*June 2013*

William A. Buscher III, Chairman
Sequence IVA Surveillance Panel

Updated: Feb. 2013

Attachment 11

Sequence IVA Surveillance Panel
February 28, 2013
9:00AM – 5:00PM
Southwest Research Institute
San Antonio, TX

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

1. Action Item – Create a task force that will review TGC and other industry documents, such as the *Standard Guide for Test Hardware Control* document, and develop a recommendation for tying these documents to existing and future engine test procedures.

2. Action Item – OHT or surveillance panel chair to contact Nissan requesting the KA24E camshaft manufacturing information as soon as possible.

3. Motion – Modify Section 9.6.2.3 of ASTM D6891 as follows: Check the pre-test camshaft for lobe concavity, convexity and taper using a profilometer to perform pre-test measurements across the nose of each camshaft lobe. Reject any camshaft that exhibits concavity or convexity of more than 4µm in height or depth, or taper of more than 10µm in variation. Any camshafts exceeding the above specification have the one time option of being sent to OHT for regrinding, using the same procedure OHT used for SwRI camshaft regrinding (details listed in SwRI report), and all those meeting the above specification may then be put into service. This motion would not apply to any non-reground camshaft lots currently calibrated within a laboratory. Effective March 1, 2013.

   Teri Kowalski / Andy Ritchie / Passed 12 – 1 – 3

4. Motion – Modify Section 9.6.2.3 of ASTM D6891 as follows: Check the pre-test camshaft for lobe concavity, convexity and taper using a profilometer to perform pre-test measurements across the nose of each camshaft lobe. Reject any camshaft that exhibits concavity or convexity of more than 4µm in height or depth, or taper of more than 10µm in variation. The test lab has the one time option of sending any camshaft, including camshafts rejected per the above criteria at their discretion, to OHT for regrinding, as per the Nissan supplied KA24E camshaft surface finish specifications. All camshafts meeting the above specification may then be put into service. This motion would not apply to any non-reground camshaft lots currently calibrated within a laboratory.

Effective March 1, 2013. This motion supersedes the previous motion that passed 12 – 1 – 3 with one negative.

Teri Kowalski / Andy Ritchie / Passed 14 – 0 – 2

5. Motion – Direct the TMC to procure a minimum 5 year supply of the GF-5 technology reference oil with ACW performance in the 50µm range, that has been offered to the Sequence IVA test.

   Bill Buscher / Al Lopez / Passed Unanimously

6. Motion – Approve the TMC recommended revisions to the Sequence IVA test procedure, ASTM D6891.

   Rich Grundza / Zack Bishop / Passed Unanimously

7. Action Item – Surveillance panel chair to schedule a conference call with the test laboratories, OHT and the TMC, to finalize the hardware order plan, prior to the 3/15/13 order deadline.