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

Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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

Originally Issued: December 1, 2009

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 November 19, 2009
Sequence IV Surveillance Panel Meeting
held in Warren, MI

A copy of the Agenda is included as Attachment 1

The signed attendance sheet is included as Attachment 2.

Eric Liu replaces Bill Buscher as voting member for Southwest Research.

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

Minutes from May 6, 2009 Surveillance panel meeting were approved with no changes.

Action Item Review

Motions and Action Items

November 19, 2009 IV Minutes
Warren, MI

As Recorded at the Meeting by Bill Buscher

1. Action Item – SwRI to provide information (schematic and equipment list) on how they monitor injector pulse width and ignition timing.

Done. SwRI to submit today. To be included in 11/19/09 meeting minutes.

2. Action Item – SwRI to provide information on their load cell enclosure and blanket heater.
   Open. SwRI working on. To be included in 11/19/09 meeting minutes.

3. Action Item – Severity task force to evaluate the load cell range specification currently included in the Sequence IVA test procedure.
   Done. Dropped at last severity task force meeting.

4. Action Item – Labs to start conducting ICP analysis on the Flush 1 and Flush 2 oil samples, for all reference tests, and report in comment section of test report. Evaluate data at next surveillance panel meeting.
   Open. Anyone bring data to review at today's meeting? Lubrizol has been doing, other labs have not. Other labs will start doing this.

5. Action Item –Sequence IVA SAE paper number to be included in 5/6/09 meeting minutes.
   Done.

6. Motion – Modify Sequence IVA test procedure to remove the requirement to conduct valve spring free length and squareness measurements and to require vacuum checks of the cylinder head after assembly. Effective 5/6/09.

Bill Buscher / Al Lopez / Passed Unanimously
   Done. TMC issued Sequence IVA Information Letter 09-1 on 6/18/09.

7. Motion – Considering that the oil cooler assembly (p/n 21305-03E00) and distributor assembly (p/n 22100-40F00RE) are no longer available from Nissan, modify Sequence IVA test procedure to eliminate the number of allowed runs criteria on these two parts and to allow for replacement of distributor caps (p/n 22162-40F00) and rotors (p/n 22157-21E01). Effective 5/6/09.

   Bill Buscher / Greg Seman / Passed Unanimously
   Done. TMC issued Sequence IVA Information Letter 09-1 on 6/18/09.

8. Motion – Modify Sequence IVA test procedure to add record only measurements for fresh air flow rate to the front cover, rocker cover coolant in temperature, rocker cover coolant out temperature, and to add coolant system

pressure measurement and control to 70±5kPa (in a manner similar to the Sequence VG and VIB). Modify test report forms and data dictionary accordingly. Implement by 8/1/09.

Al Lopez / Bill Buscher / Passed 10-0-1
Done. TMC issued Sequence IVA Information Letter 09-1 on 6/18/09. Report forms issued on 8/1/09.

9. Motion – Modify Sequence IVA test procedure to allow for 32 (from 20) runs per engine assembly and 16 (from 10) runs per cylinder head assembly. Effective 5/6/09.

   Bill Buscher / Al Lopez / Passed 8-0-3
   Done. TMC issued Sequence IVA Information Letter 09-1 on 6/18/09.

10. Motion – Modify Sequence IVA test procedure to require the 1/8" needle valve (as per SwRI's set-up) in the PVC system and to allow for both blowby measurement methods, using either the Sequence III or Sequence V blowby cart (a previous motion that never made it into the test procedure). Test procedure to indicate that the valve position is to be wide open for all test conditions except when a blowby measurement is being taken.

    Tabled for refinement, and will Eballot by 6/1/09.
    Open. Refine motion and vote on at today's meeting.

11. Action Item – Chairman to contact Todd Dvorak to see if he would be available to perform similar analysis on KA24E Green fuel data as he did on EEE fuel data.
    Done. To review at May 2010 SP meeting.

Fuel Suppliers Report.
Results of analysis from previous batches were reviewed and are found to be acceptable. Batches are blended when ever orders are placed by lab(s). Copy of the report is included as attachment 3

TMC Report
Rich Grundza reviewed sections of his report for the panel. There were no questions or comments. A copy of Rich's report is included as attachment 4.

ACC Report.
Jeff Clark presented sections of the ACC report. A copy of the report is available at the ACC website. There were no questions on the report.

Test Hardware Report
Bill Buscher reviewed the hardware status to date. A copy of Bill's report is included as attachment 5. There appear to be no hardware shortages and review of the TMC data base indicates that 2004, 2007 and 2008 are being used currently. Bill noted that most recent kits are not identified with a batch code. He has

contacted Nissan and is awaiting a disposition to this issue. Bill was advised by OHT that harnesses are no longer available from Nissan. The panel gave OHT an action item to determine and advise the panel of how many harnesses are on hand at OHT.

Camshaft Measurement Round Robin
Rich Grundza gave a report on the camshaft measurement round robin exercise. The results looked very good and there were no questions on the report. A copy is included as attachment 6.

Severity Task Force Report
Al gave a presentation on the work that had been done to date, which is included as attachment 7. The panel agreed to disband the task force and thanked Al for his efforts. There are a couple of items that are left to be resolved. The first is the schematic showing the PCV system has not been updated to include the 1/8" valve. Also, the procedure was never revised to reflect the use of either the VG or III blowby carts for measurement. Bill Buscher and Rich Grundza were given an action item to generate an information letter to address this. The panel then discussed driveline modeling and other driveline issues. It was agreed that driveline couplings and engine mounts replacement frequency needs to be defined and all labs are to review their procedures and device a frequency for replacement. Also, the panel agreed to require that driveline design changes be proved out with a reference oil test.

Under new business the panel reviewed some recent results on 1006-2 which indicate that it may be shifting severe. The panel elected to suspend the use of reference oil 1006-2, pending analysis of samples from the TMC, by the supplier. The panel elected to continue to use reference oil 1007 and 1009 for current referencing activities. The panel also asked the TMC to contact the suppliers of VID oils A,B,C,D and X to determine if any IVA results are available for these oils, so that they may be used as reference oils for the Sequence IVA.

Attachment 8 is a listing of the motions and action items from this meeting.

Schematics from Southwest Research are included as attachment 9.

The meeting was adjourned at 2:40 pm.

Attachment 1

Sequence IVA Surveillance Panel

Warren, MI
GM Technical Center
November 19, 2009
1:00 p.m. - 3:00 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 5/6/2009	All
6.	Review action items from last meeting	Buscher
7.	Fuel supplier report – KA24E Green Fuel	Carter
8.	TMC report	Grundza
9.	ACC report	Clark
10.	Test hardware report	Buscher
11.	2009 camshaft wear measurement round-robin review	Grundza
12.	Severity task force report	Lopez
13.	Round table discussion on engine mounts and driveline specifications/maintenance	All
14.	Review Scope & Objectives	All
15.	Old business	
16.	New business	
17.	Next meeting	

18. Adjourn

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

November 19, 2009

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	
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	
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	via telecon line
Buscher III, Bill	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	WAB III
Buscher, Jr., Bill	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	
Carter, James	Haltermann Products 2296 Hulett Okemos, MI 48864 Phone No.: 517-347-3021 Fax No.: 517-347-1024 Email: jecarter@dow.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	
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	

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

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NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
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	
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	
~~Linden, James~~	~~GM Powertrain~~ ~~Mail Code 483-730-322~~ ~~823 Joslyn Rd.~~ ~~Pontiac, MI 48340-2920~~ ~~Phone No.: 586-986-1888~~ ~~Fax No.: 248-857-4425~~ ~~Email: james.l.linden@gm.com~~	REMOVE; RETIRED FROM GM.
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	
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	
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	via telecon
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	
Mabuchi, Yutaka	Nissan Motor Co., Ltd. Email: y-mabuchi@mail.nissan.co.jp	

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

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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	
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	
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	via telecon line
Buscher III, Bill	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	WAB III
Buscher, Jr., Bill	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	
Carter, James	Haltermann Products 2296 Hulett Okemos, MI 48864 Phone No.: 517-347-3021 Fax No.: 517-347-1024 Email: jecarter@dow.com	JRC
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	
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	

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NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
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	
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	
~~Linden, James~~	~~GM Powertrain~~ ~~Mail Code 483-730-322~~ ~~823 Joslyn Rd.~~ ~~Pontiac, MI 48340-2920~~ ~~Phone No.: 586-986-1888~~ ~~Fax No.: 248-857-4425~~ ~~Email: james.l.linden@gm.com~~	REMOVE; RETIRED FROM GM.
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	
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	
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	via telecon
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	
Mabuchi, Yutaka	Nissan Motor Co., Ltd. Email: y-mabuchi@mail.nissan.co.jp	

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

June 7, 2006

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Romano, Ron	Ford Motor Company Email: rromano@ford.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	AR
Seman, Greg	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092 Phone No.: 440-347-2153 Fax No.: 440-347-4096 Email: greg.seman@lubrizol.com	
Sutherland, Mark	Chevron Oronite Company LLC 4502 Centerview Dr., #210 San Antonio, TX 78228 Phone No.: 210-867-8357 cell Fax No.: 210-731-5699 Email: msut@chevron.com	
Smolenski, Don	General Motors Rod D Phone No.: 248-255-7892 Fax No.: 586-986-1910 Email: donald.j.smolenski@gm.com	
Matthews, Bruce (not in attendance, but please add to Membership)	General Motors, LLC 823 Joslyn Ave. Pontiac, MI 48340 Mail Code: 485-730-472 Phone No.: 248-830-9197 Fax No.: 248-857-4441 Email: bruce.matthews@gm.com	
	Phone No.: Fax No.: Email:	
	Phone No.: Fax No.: Email:	

NON-MEMBER MAILING LIST
ASTM IVA SURVEILLANCE PANEL

November 19, 2009

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Ayutsede, Jonathan	Infineum USA L.P. 1900 E. Linden Avenue Linden, NJ 07036-0536 Phone No.: 908-474-2916 Fax No.: 908-474-3637 Email: jonathan.ayutsede@infineum.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, 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	
Bryant, Don	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092 Phone No.: 440-943-1200 Fax No.: 440-943-9013 Email:	
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	
Clark, Sid	~~GM Powertrain~~ SWRI. Mail Code 483-730-322 50481 Peggy Lane ~~823 Joslyn Rd.~~ ~~Pontiac, MI 48340-2920~~ Chesterfield ~~Phone No.: 248-857-9959~~ MI. 48047 ~~Fax No.: 248-857-4425~~ 586-873-1255 ~~Email: sidney.l.clark@gm.com~~	Sid Sidney.L.Clark@swrglobal -NOT.
Farber, Frank	ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 Phone No.: 412-365-1030 Fax No.: 412-365-1047 Email: fmf@astmtmc.cmu.edu	

NON-MEMBER MAILING LIST
ASTM IVA SURVEILLANCE PANEL

November 19, 2009

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
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	
Ferner, Mark	Pennzoil / Quaker State Company 1520 Lake Front Circle The Woodlands, TX 77380 Phone No.: 713-363-8190 Fax No.: 713-363-8002 Email:	
Galbraith, Robert	Imperial Oil Limited 453 Christina St. South P.O. Box 3002 Sarnia, Ontar, Canada N7T8C8 Phone No.: Fax No.: Email: rob.galbraith@iol.sprint.com	
Hsu, Jeffery	Pennzoil / Quaker State Company 1520 Lake Front Circle (77380) P.O. Box 7569 The Woodlands, TX 77387 Phone No.: 281-363-8177 Fax No.: 281-363-8002 Email: JefferyHsu@PZLQS.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	
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	

NON-MEMBER MAILING LIST
ASTM IVA SURVEILLANCE PANEL

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NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Olree, Robert	GM Powertrain Mail Code 483-730-322 823 Joslyn Rd. Pontiac, MI 48340-2920 Phone No.: 248-857- Fax No.: 248-857-4425 Email: robert.olree@gm.com	
Roby, Stephen	Chevron Oronite Company LLC 100 Chevron Way P.O. Box 1627 Richmond, CA 94802-0627 Phone No.: 510-242-1273 Fax No.: 510-242-3173 Email: hrby@chevrontexaco.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	
Simkins, Russell	Conoco Inc. 1000 South Pine, 6617RW P.O. Box 1267 Ponca City, OK 74602-1267 Phone No.: 580-767-6758 Fax No.: 580-767-4534 Email: russell.e.simkins@usa.conoco.com	
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	
Thompson, Hap	Phone No.: 908-287-9596 Fax No.: Email: Hapjthom@aol.com	
Weber, Ben	Southwest Research Institute 6220 Culebra Road P.O. Drawer 28510 San Antonio, TX 78228-0510 Phone No.: 210-522-5911 Fax No.: 210-684-7523 Email: benjamin.weber@swri.org	

NON-MEMBER MAILING LIST
ASTM IVA SURVEILLANCE PANEL

November 19, 2009

NAME	COMPANY-ADDRESS-PHONE-FAX-EMAIL	SIGNATURE
Zalar, John	ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 Phone No.: 412-365-1005 Fax No.: 412-365-1047 Email: jlz@astmtmc.cmu.edu	Retired
Zaweski, Ed	BP Amoco Oil 150 W. Warrenville Rd. Mail Code C-6 Naperville, IL 60563 Phone No.: 630-420-5026 Fax No.: 630-420-4866 Email: ed_f_zaweski@amoco.com	
Jeff Clark	ASTM Test Monitoring Center 6555 Penn Ave Pittsburgh, PA Phone No.: 412 365 1032 Fax No.: 412 365 1047 Email: : jac@astmtmc.cmu.edu	
Art Andrews	Exxon Mobil Research Phone No.: 908 730 3089 Fax No.: Email: : arthur.landrews@exxonmobil.com	
Todd Dvorak	todd.dvorak@aftonchemical.com Afton Chemical 500 Spring St. / Richmond, VA 23219 Phone No.: 804-788-6567 Fax No.: Email: :	
Bob Campbell	AFTON Chemical Bob.Campbell@Aftonchem.cal.com Phone No.: 804 788 5340 Fax No.: 6358 Email: :	
SNIDER, MATTHEW	GENERAL MOTORS, LLC 823 JOSLYN AVE PONTIAC, MI 48340 MAIL CODE: 483-730-472 Phone No.: 248-672-3563 Fax No.: Email: Matthew.j.Snider@gm.com.	
	Phone No.: Fax No.: Email: :	

PRODUCT: **KA24E TEST FUEL**
Seg. IV & VIII

PRODUCT CODE: **HF0008**
HALTERMANN

Batch No.:	XH1721GP01	XG1321GP01	XB1721GP01
TMO No.:	800388	800321	800138
Tank No.:	27	58	52
Analysis Date:	8/19/2009	7/15/2009	2/26/2009

TEST	METHOD	UNITS	SPECIFICATIONS			RESULTS	RESULTS	RESULTS
			MIN	TARGET	MAX			
Distillation - IBP	ASTM D86	°F	75		95	94	91	88
5%		°F				119	112	114
10%		°F	120		135	130	124	126
20%		°F				150	145	147
30%		°F				175	171	172
40%		°F				204	201	202
50%		°F	200		230	221	221	221
60%		°F				230	230	230
70%		°F				237	239	239
80%		°F				253	255	255
90%		°F	300		325	313	312	316
95%		°F				339	339	342
Distillation - EP		°F	385		415	410	405	389
Recovery		vol %		Report		98.8	97.4	98.2
Residue		vol %		Report		1.0	1.0	1.1
Loss		vol %		Report		0.2	1.6	0.7
Gravity	ASTM D4052	°API	58.7		61.2	59.7	59.9	60.0
Density	ASTM D4052	kg/l	0.734		0.744	0.740	0.739	0.739
Reid Vapor Pressure	ASTM D5191	psi	8.8		9.2	9.1	9.0	8.9
Carbon	ASTM E191	wt fraction	0.8580		0.8667	0.8602	0.8606	0.8622
Carbon	ASTM D3343	wt fraction		Report		0.8660	0.8642	0.8676
Sulfur	ASTM D2622	wt %	0.01		0.04	0.013	0.015	0.011
Lead	ASTM D3237	g/gal			0.05	<0.01	<0.01	0.013
Oxygen	ASTM D4815	wt %			0.2	<0.01	<0.01	<0.01
Composition, aromatics	ASTM D1319	vol %			35.0	30.8	27.5	33.9
Composition, olefins	ASTM D1319	vol %	5.0		10.0	5.8	5.8	10.0
Composition, saturates	ASTM D1319	vol %		Report		63.4	66.7	56.1
Oxidation Stability	ASTM D525	minutes	1440			>1440	>1440	>1440
Copper Corrosion	ASTM D130				1	1a	1a	1a
Gum content, washed	ASTM D381	mg/100ml			5	<0.5	<0.5	<0.5
Research Octane Number	ASTM D2699		96.0		97.5	97.5	96.7	97.2
Motor Octane Number	ASTM D2700			Report		87.5	87.7	87.9
R+M/2	D2699/2700			Report		92.5	92.2	92.6
Sensitivity	D2699/2700		7.5			10.0	9.0	9.3
Net Heat of Combustion	ASTM D240	btu/lb		Report		18325	18299	18318
Color	Visual			Green		Green		Green

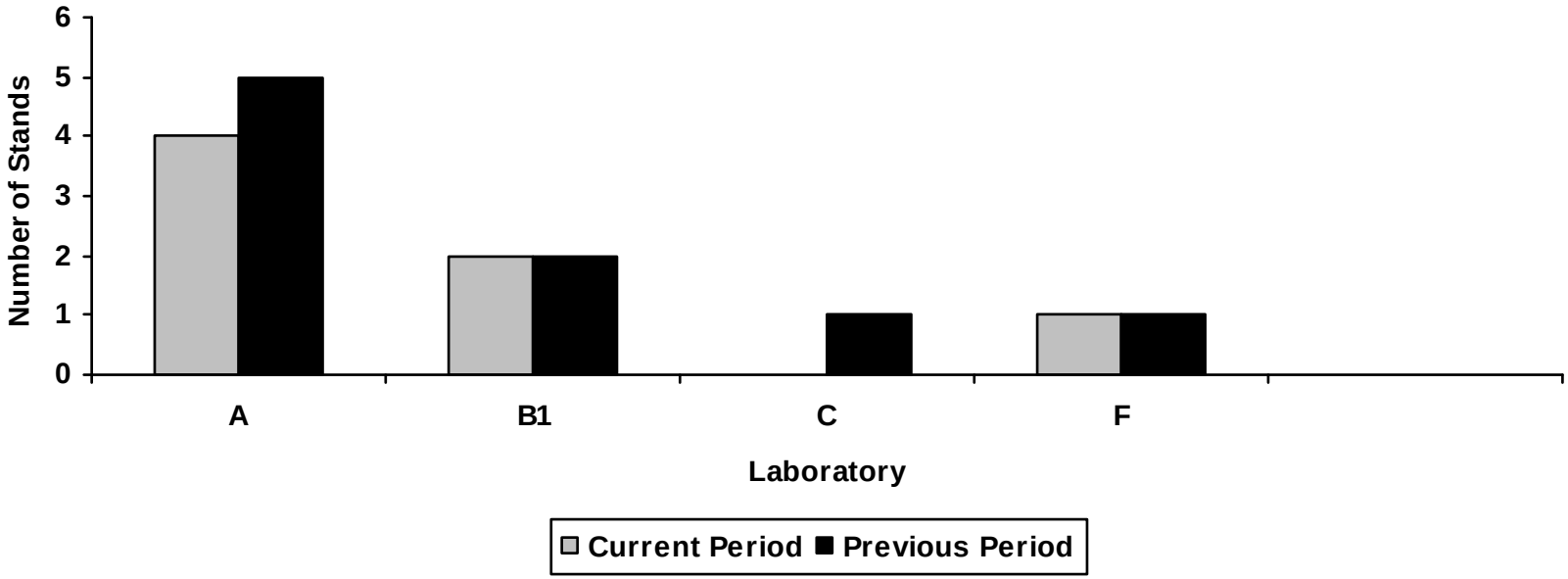
Sequence IVA

November 19, 2009

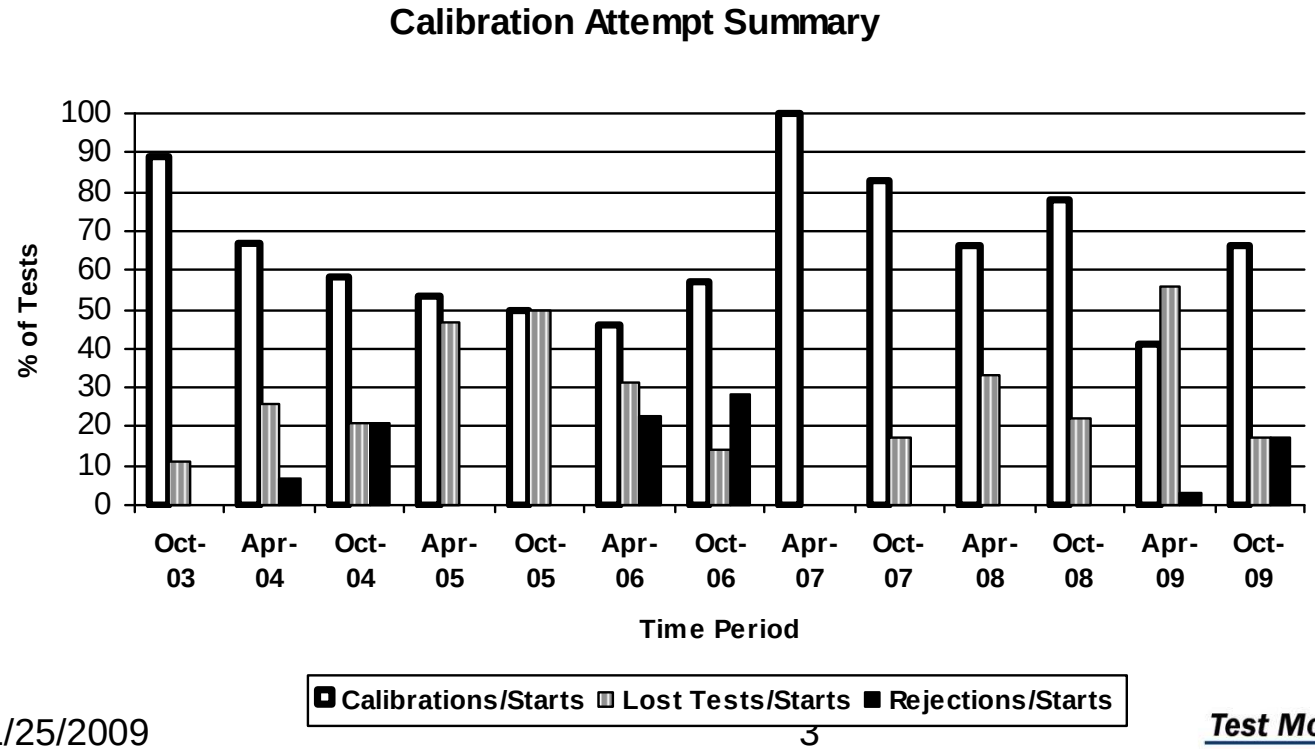
Warren, MI

	Reporting Data	Calibrated as of September 30, 2009
Number of Laboratories:	3	3
Number of Test Stands:	7	6

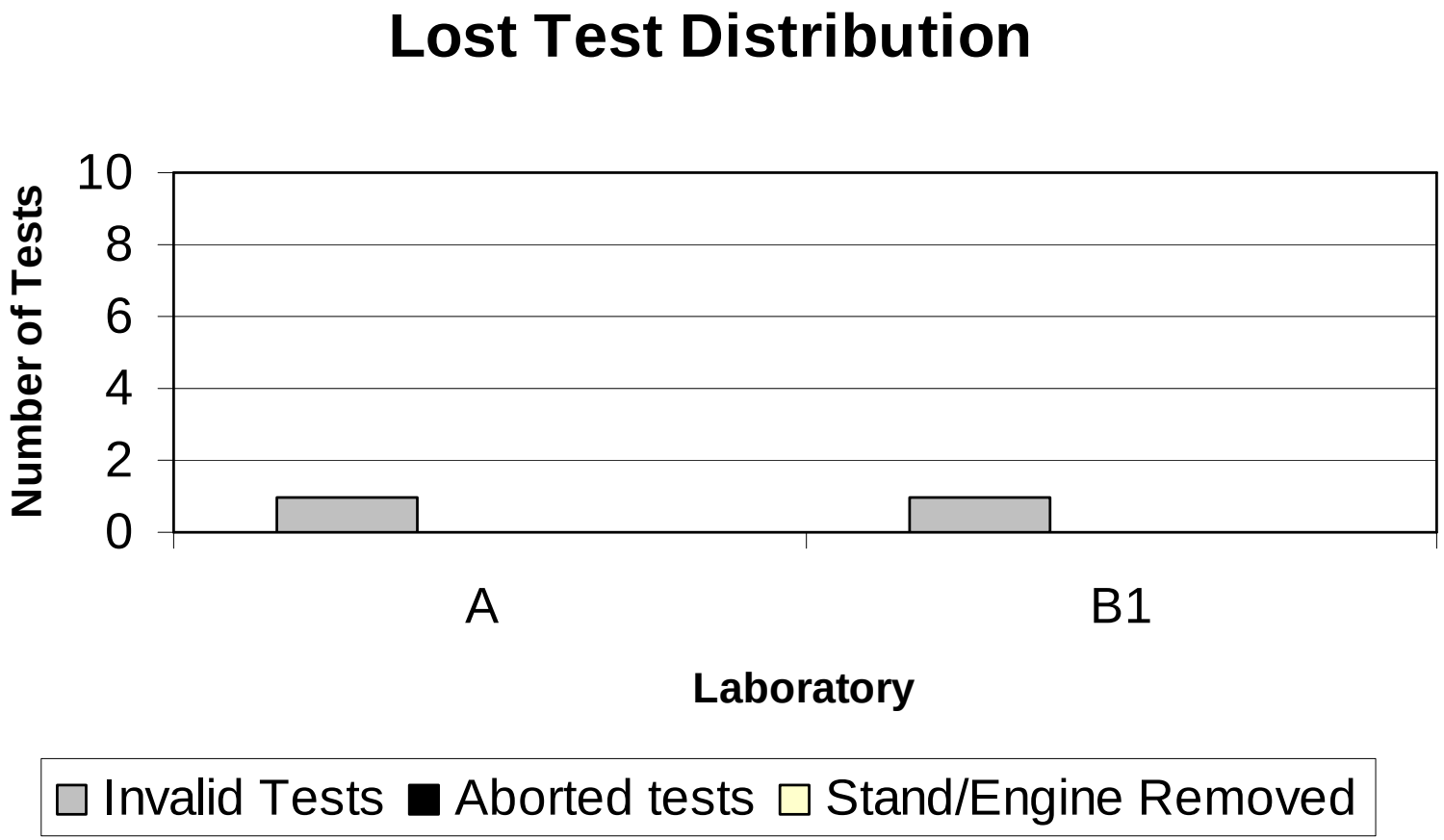
Laboratory/Stand Distribution

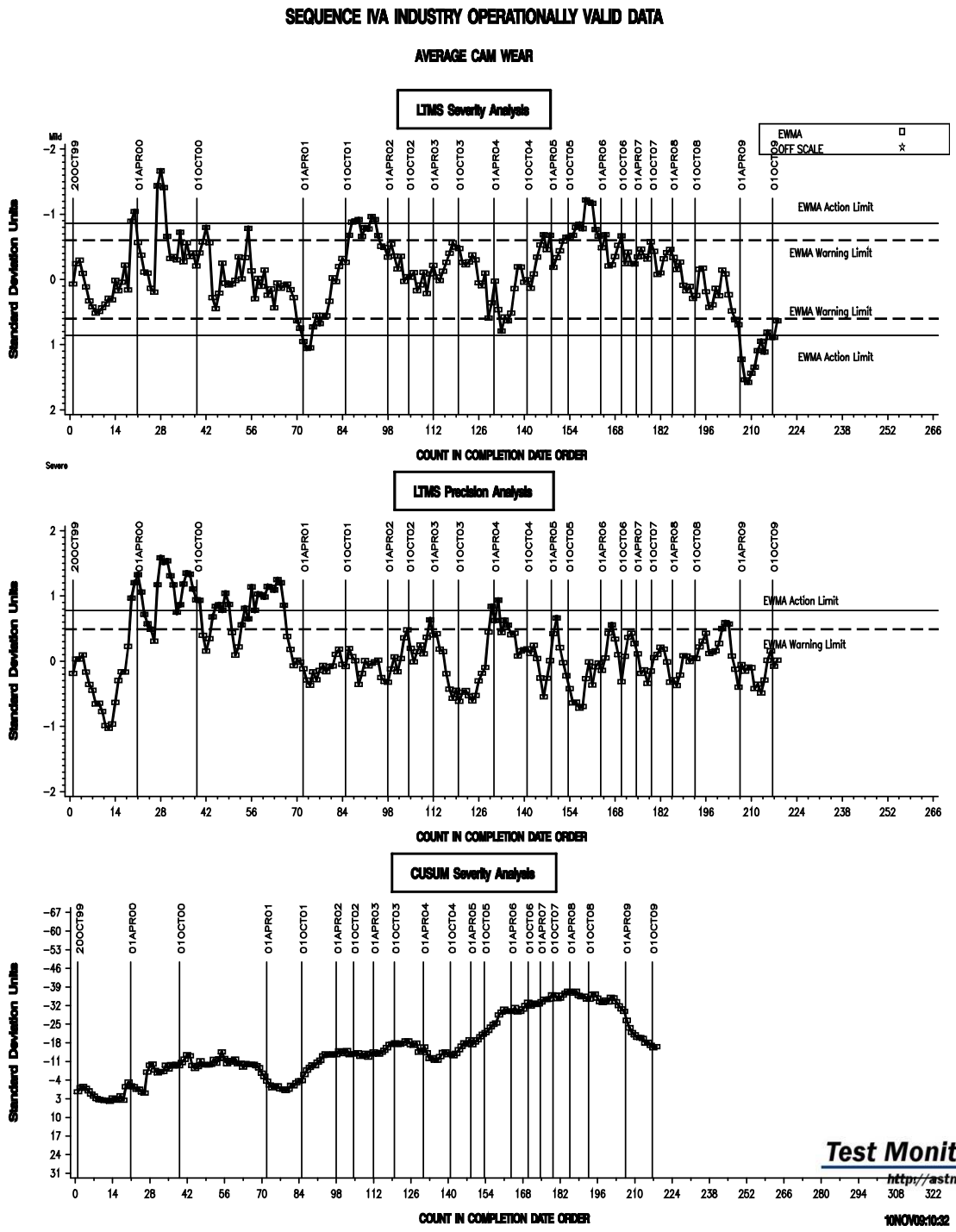


Calibration Start Outcomes	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	8
Operationally Valid, Statistically Unacceptable	OC	2
Operationally Invalid, Laboratory Judgement	LC	2
Total		12



- Two tests failed, both for Shewhart severity alarms in the severe direction.
- Two lost tests, both declared invalid by lab





Industry severe by 10.60 µm

Industry pooled precision 8.33 µm

Test Monitoring Center
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Other Items

- Information letters 09-1 and 2 issued
- One lab visit conducted, no discrepancies
- Sufficient oil quantities available for foreseeable future

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Attachment 5

Sequence IVA

Test Hardware Report

Prepared by:
William A. Buscher III

November 19, 2009
Warren, Michigan

Test Hardware Report

- Hardware Status:
  - No shortage of test hardware
  - Industry currently using mixture of 2004, 2007 and 2008 test kits
  - Status of 2008 Nissan hardware order:
    - Submitted in September 2008
    - Large orders placed by two labs
    - All engines, cylinder heads, gaskets, oil coolers and distributors have been received

Test Hardware Report

- Hardware Status Cont'd:
  - Status of 2008 Nissan hardware order:
    - To-date Lab A received 120 of 360 test kits
    - To-date Lab B received 135 of 135 test kits
    - On 11/11/09 NNA indicated 65 test kits were shipped to Lab A
    - 175 test kits have not shipped yet
    - On 11/11/09 NNA indicated additional test kits will be shipping from NML this month

Test Hardware Report

- Hardware Status Cont'd:
  - Camshafts are missing lot codes from all test kits received in 2008 Nissan hardware order
    - Stephen Fields is currently inquiring with NML and will advise once NNA obtains a response
  - Survey conducted earlier in 2009 indicated 2 labs were interested in a final buy
    - Labs indicate the need for ≈ 400 test kits in a final buy
    - All other components secured by labs through 2015

Test Hardware Report

- Hardware Status Cont'd:
  - Final Nissan hardware order has been submitted in November 2009.
    - Based on survey results, NNA only offered test kits
    - Large orders placed by two labs
    - NNA placed final buy order with NML on 11/12/09
    - NML indicated lead time is at least 6 months
  - OHT indicated that the engine wiring harness is no longer available from Nissan

Sequence IVA Round Robin Report

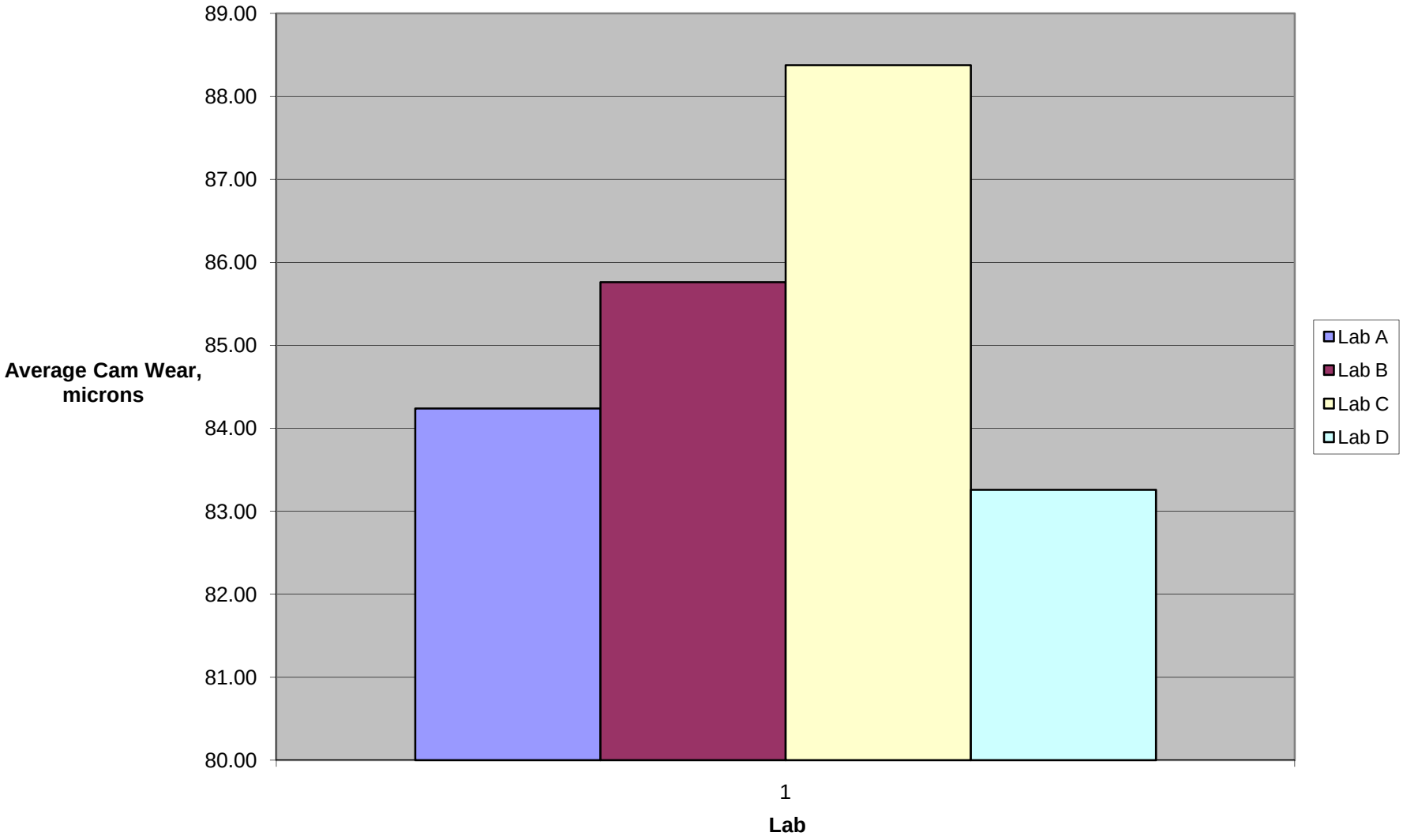
November 19, 2009

Warren, MI

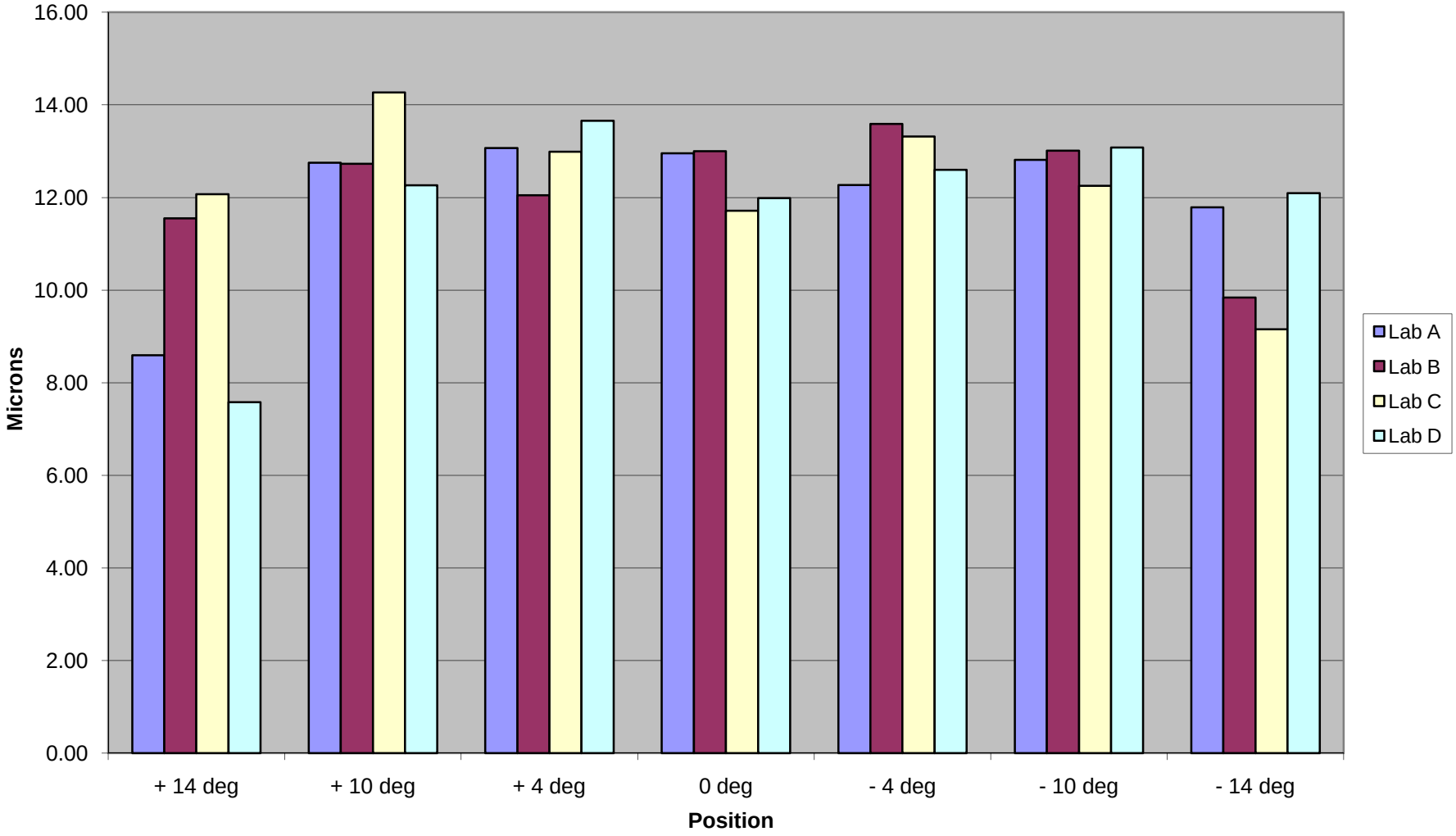
Participation

- Four Labs measured one cam
- Results fell within ½ sigma (pooled s)
- No significant discrepancies

Sequence IVA Roundc Robin



Sequence IVA Round Robin
Plot of Wear Average by Position



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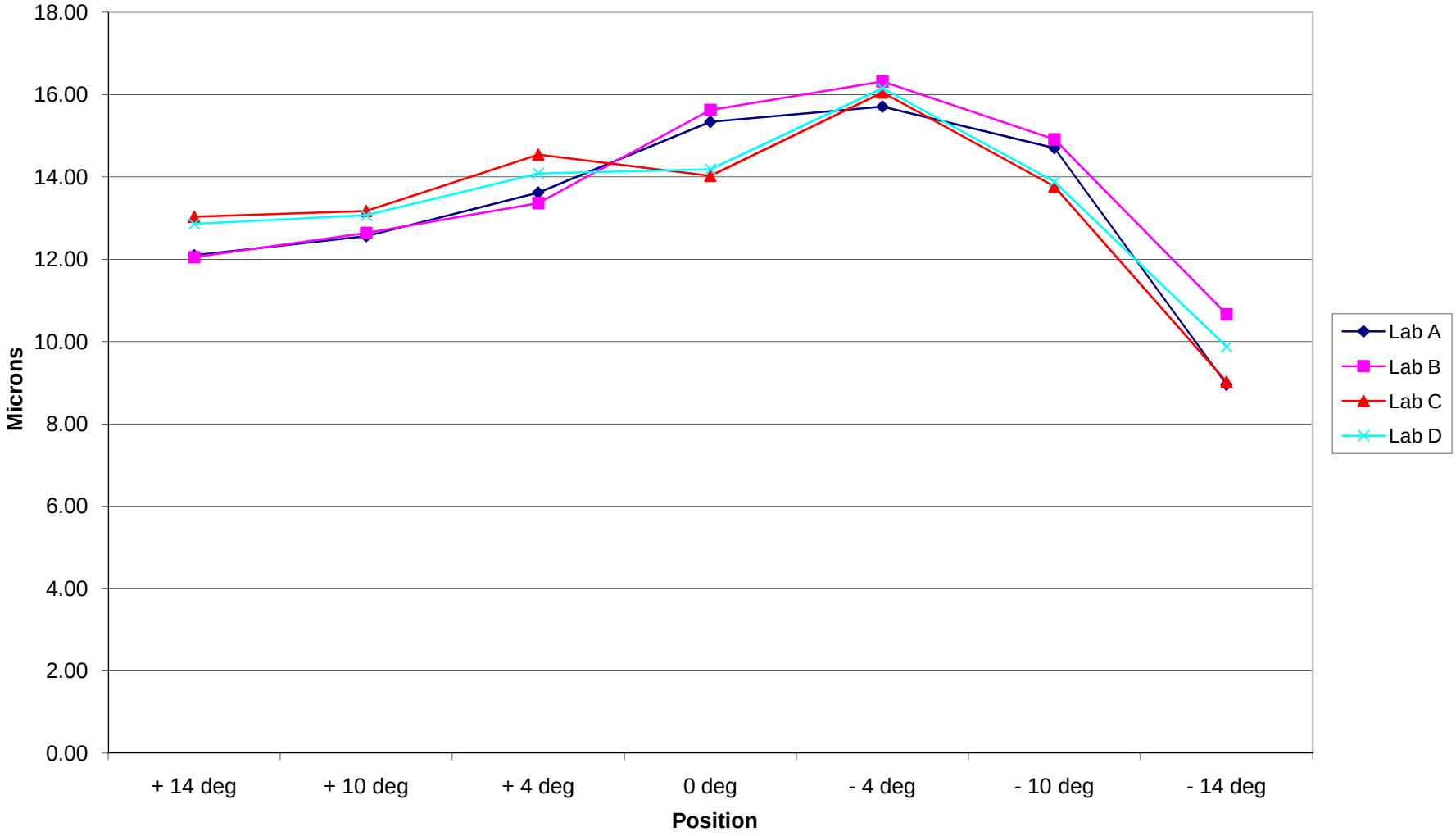
Sequence IVA Round Robin
Camshaft Wear Profiles, Avg Intake



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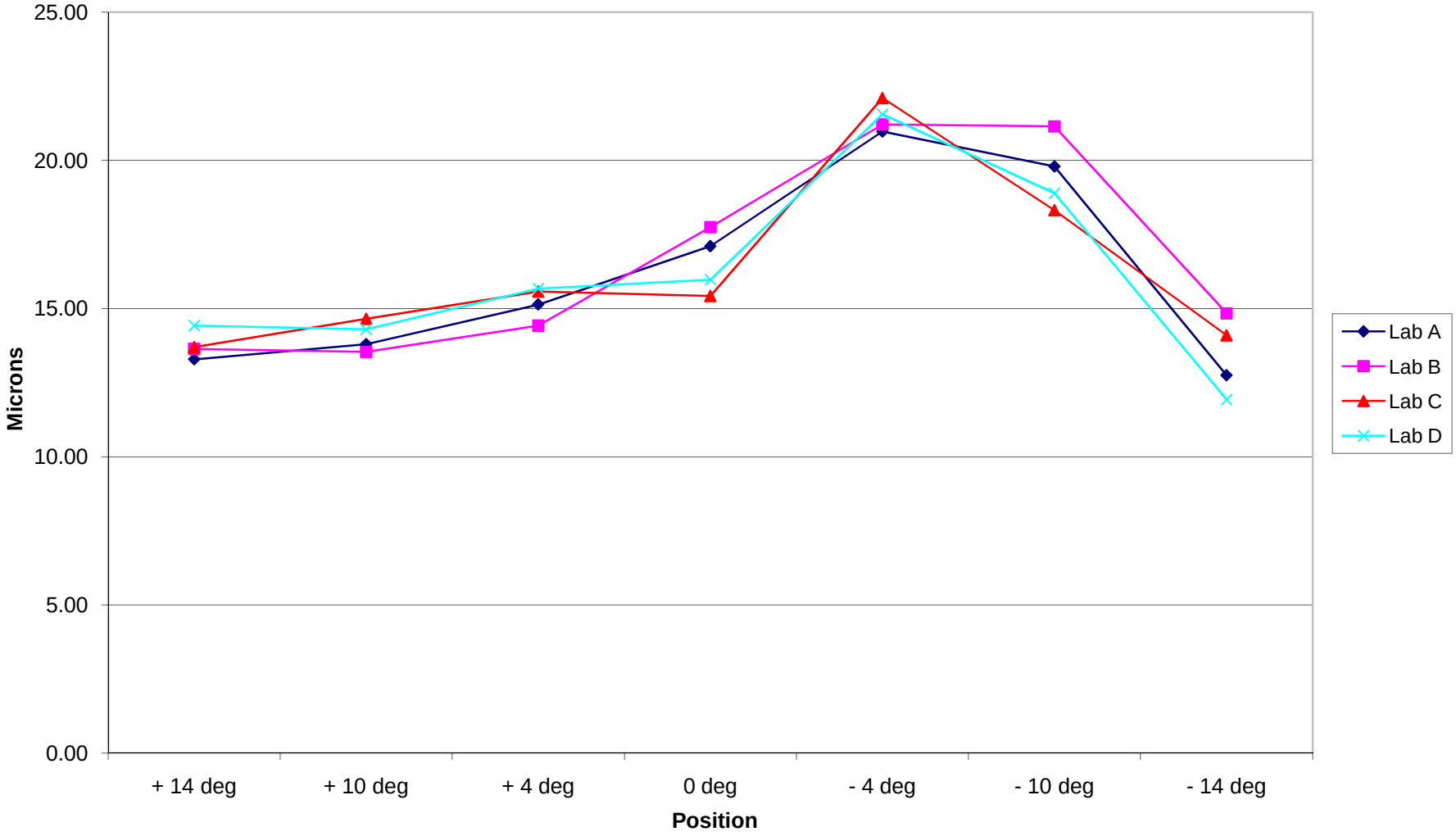
Sequence IVA Round Robin
Camshaft Wear Profiles, Max Intake



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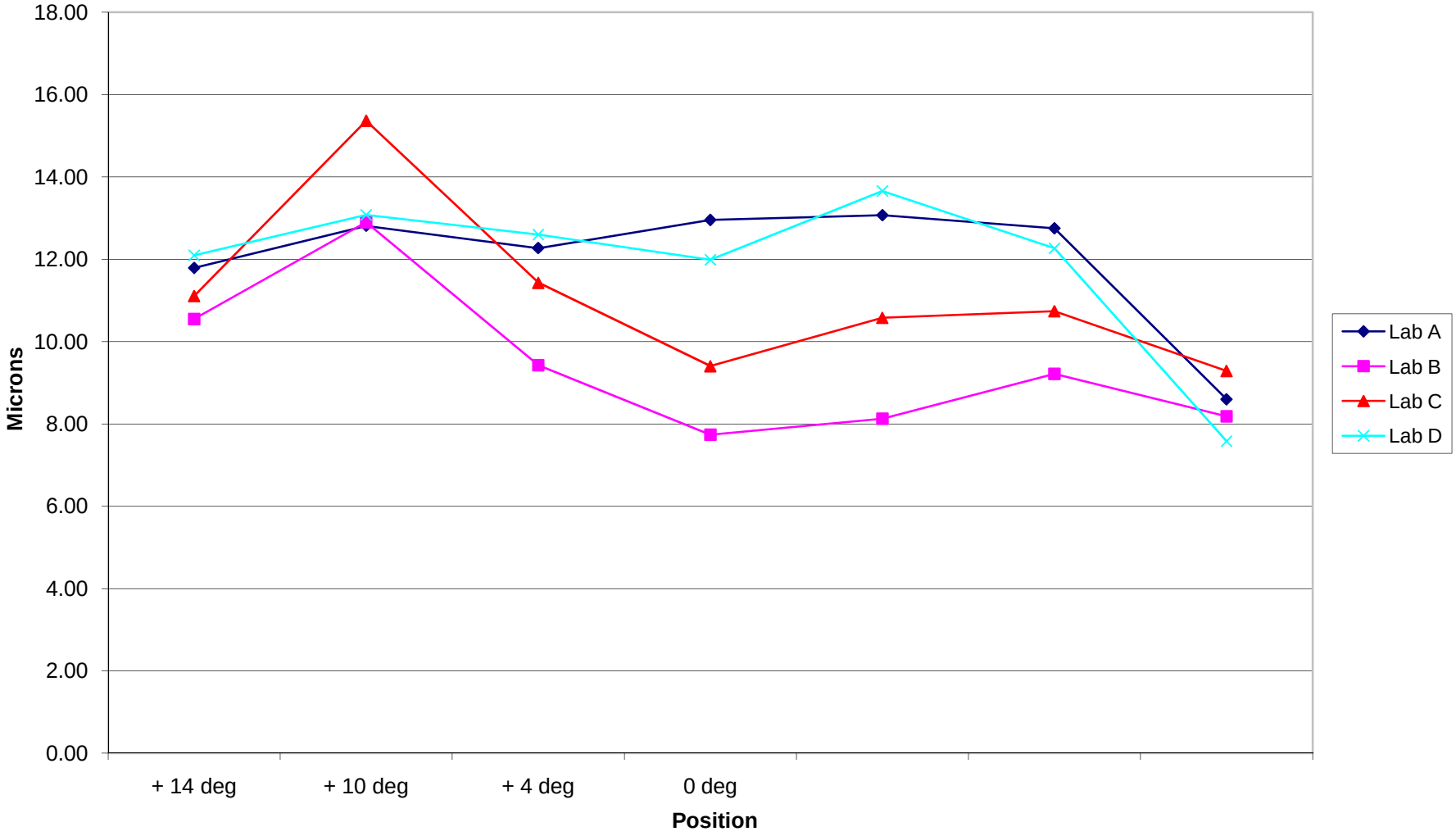
Sequence IVA Round Robin
Camshaft Wear Profiles, Avg Exhaust



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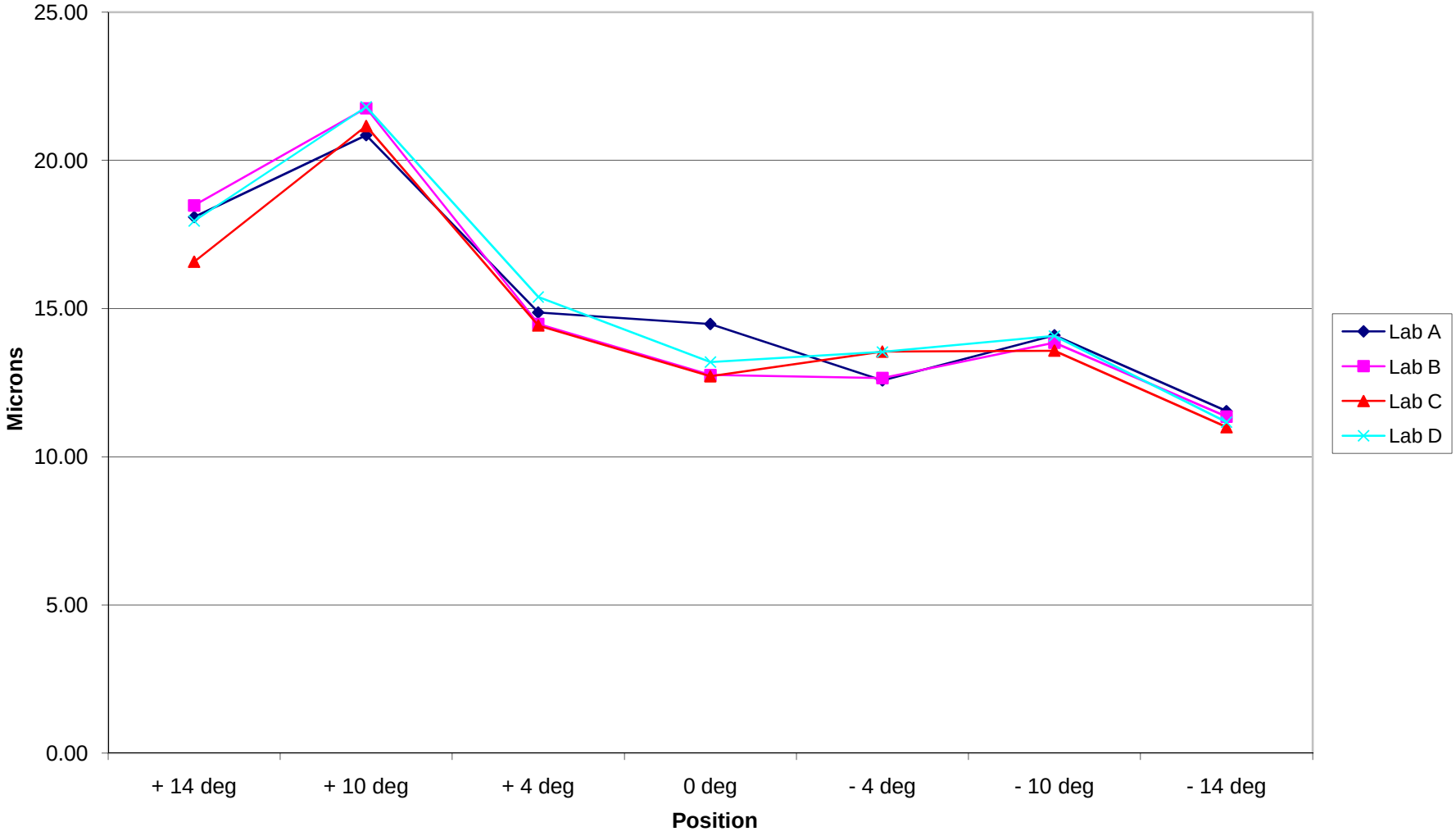
Sequence IVA Round Robin
Camshaft Wear Profiles, Max Exhaust



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Sequence IVA Mild Severity Shift Task Force

Surveillance Panel Report

November 19, 2009

Task Force Objectives

- Solve the mild severity shift seen at several labs.

- Observe technical details of solution and make recommendations to the Surveillance Panel.

Task Force Activity Summary

- Task Force formed in November of 2008
- History of meetings
  - January 8th, 2009 (Intertek)
  - March 26, 2009 (Teleconference)
  - May 6th, 2009 (SP meeting Detroit)
  - July 23rd, 2009 (Teleconference)

Motions Generated

1. Begin to monitor fresh air flow to the front cover

2. Begin to monitor RAC in and out coolant temperature

3. Pressurize the cooling system to 100 kpa, in a manner similar to the VG and VIB

4. Allow configuration of the PCV system similar to SWRI with the isolation valve and measure blowby using the IIIG cart

Major Findings

- Specific driveline vibration modes shift the test mild.
- The stiffness of the driveline coupling design is critical. There is evidence that operating the engine at the natural frequency of the driveline produces the mild ACW results.
- Further evidence of vibration affecting the test was seen in engine mounting.
- In general, both torsional and axial vibration have been linked to shifting ACW mild.

Task Force Recommendations

- Labs should adopt a standardized maintenance interval for the driveline damping element and the engine mounts.

- If a change in design of the driveline system is done in the middle of a reference period, another calibration test should be conducted.

Sequence IVA Surveillance Panel
November 19, 2009
1:00PM – 3:00PM
GM Technical Center
Warren, MI

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

1. Motion – Modify Sequence IVA test procedure to require the 1/8" needle valve (as per SwRI's set-up) in the PVC system and to allow for both blowby measurement methods, using either the Sequence III or Sequence V blowby cart (a previous motion that never made it into the test procedure). Test procedure to indicate that the valve position is to be wide open for all test conditions except when a blowby measurement is being taken. Bill and Rich to add documentation and schematics to test procedure. Effective 11/19/09.

   Bill Buscher / Al Lopez / Passed Unanimously 9-0-0

2. Action Item – OHT to report quantity of IVA engine wiring harnesses on hand to SP.

3. Motion – Consider the severity task force complete and disband the severity task force. Effective 11/19/09.

   Al Lopez / Eric Liu / Passed 8-0-1

4. Action Item – Labs to draft a maintenance procedure and interval for engine mounts and driveline.

5. Motion – If a change in design of the driveline system is done in the middle of a calibration period, another reference oil test shall be conducted.

   Al Lopez / Bill Buscher / Passed Unanimously 9-0-0

6. Action Item – Plan for an LTMS review at the May 2010 Surveillance Panel meeting, or preferably sooner, once the LTMS task force and TGC has met.

7. Action Item – To see if we have a potential GF-4 or GF-5 reference oil for the IVA, TMC to query suppliers of 5 primary VID reference oils (A, B, C, D and X) to see if data exists for these oils on the other GF-5 engine tests, or if they would be willing to generate data on the other GF-5 engine tests.

8. Action Item – TMC to send a sample of reference oil 1006-2 for their evaluation on whether this oil has changed or not.

9. Motion – Temporarily suspend reference oil 1006-2 and reintroduce reference oil 1009 for reference testing.

   Bill Buscher / Andy Ritchie / Passed 7-0-2

ASTM Sequence IVA Surveillance Panel

Scope and Objectives

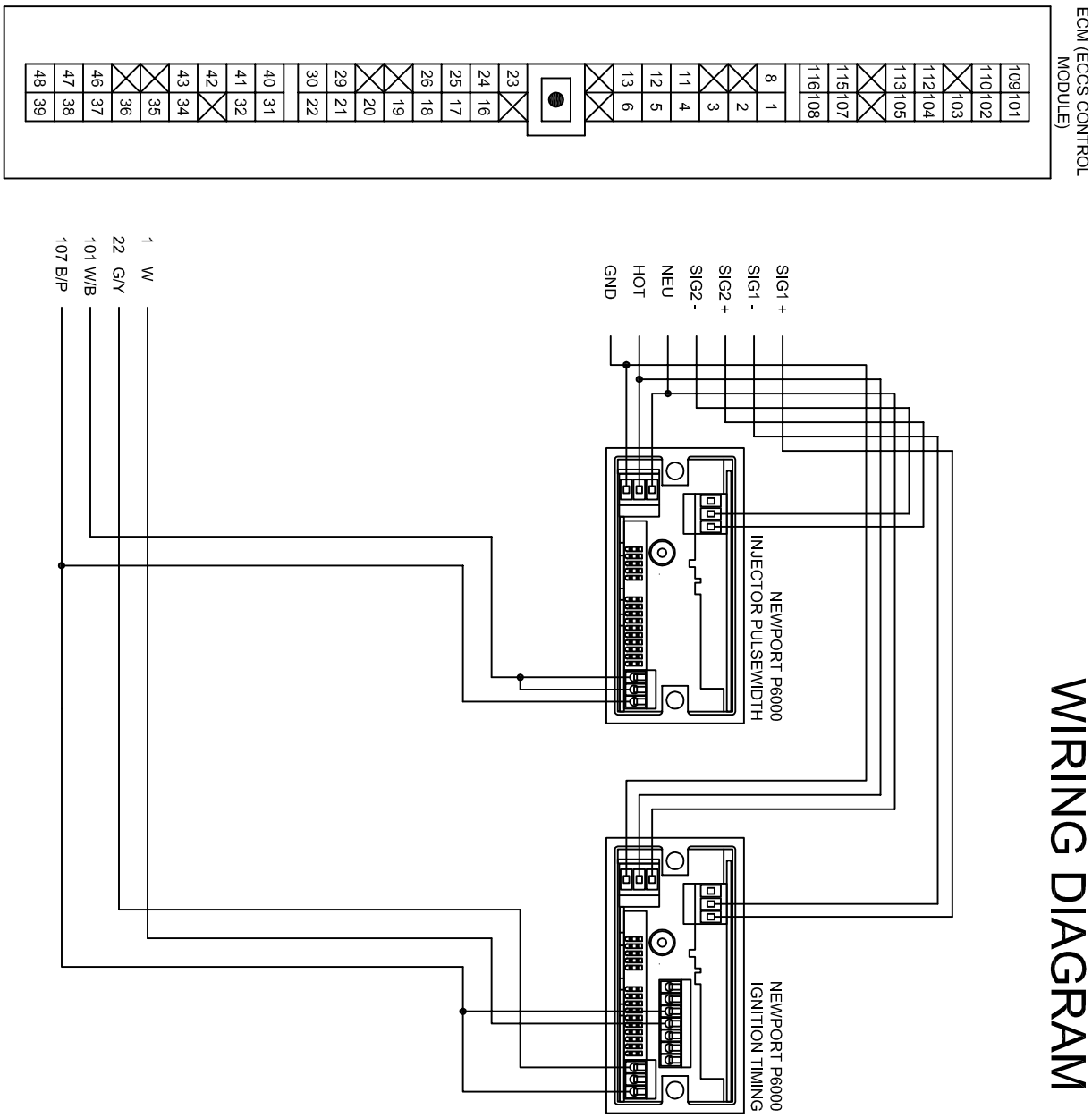
Scope

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.

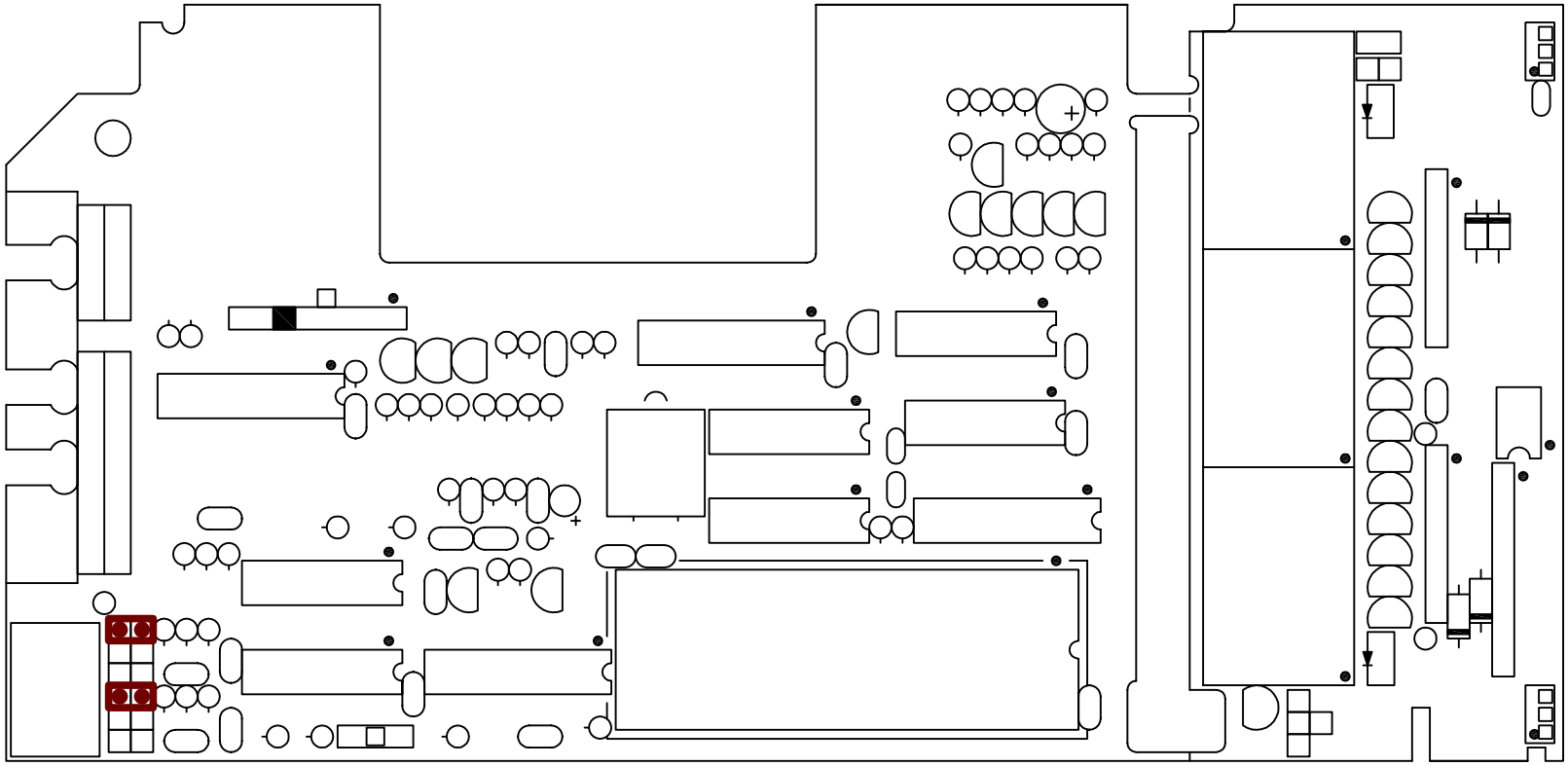
Objectives	**Target Date**
1. Ensure a secure supply of Nissan KA24E hardware is available to accommodate testing through GF-5, anticipating the need for additional parts solicitations from Nissan.	*On-going*
2. Review recommendations of the LTMS task force Once they are available.	*May 2010*
3. Solicit a GF-5 reference oil producing wear results around 50 microns.	*May 2010*

William A. Buscher III, Chairman
Sequence IVA Surveillance Panel

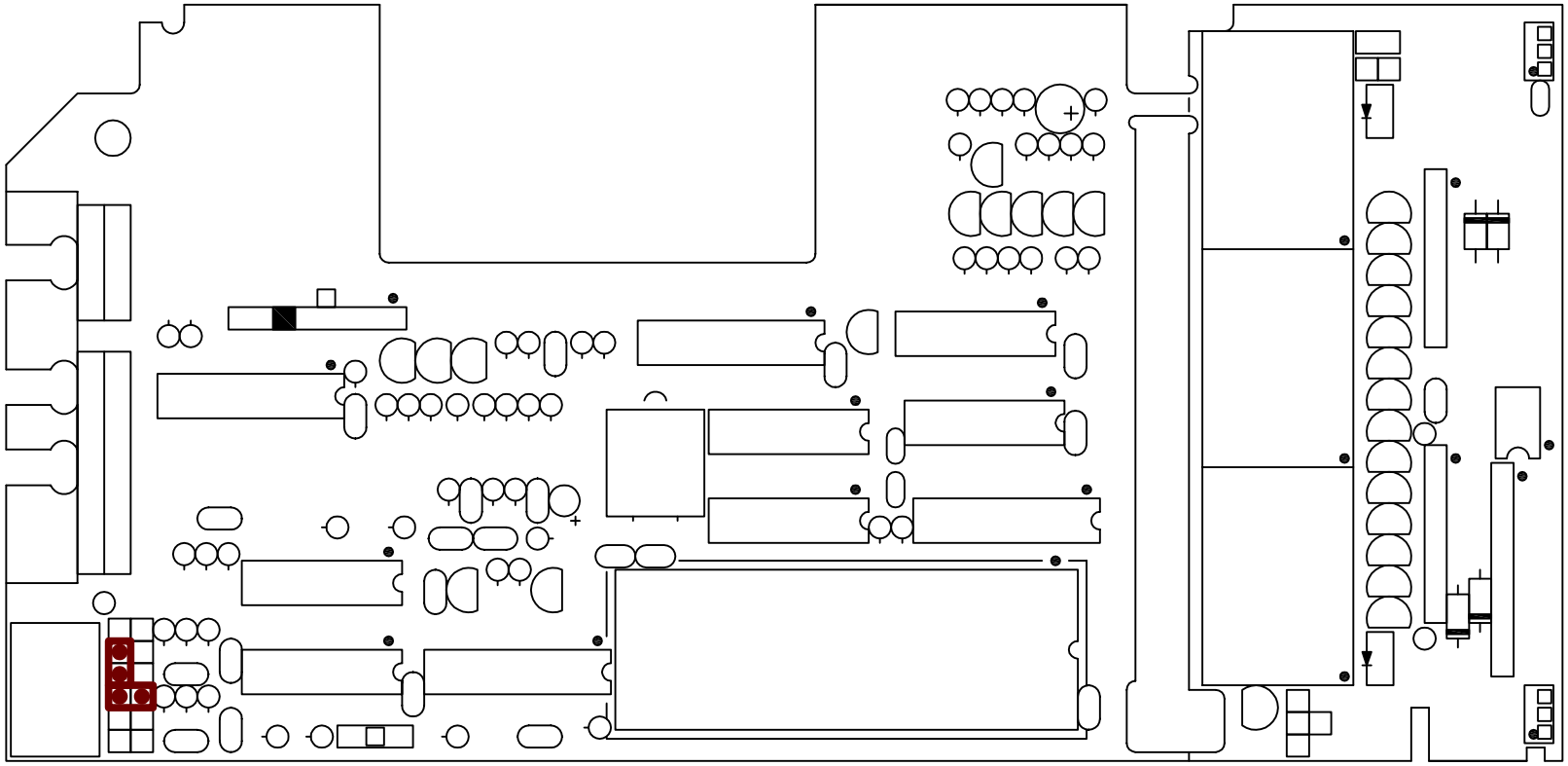
Updated: Nov 2009


NEWPORT P6000
WIRING DIAGRAM
ECM (ECCS CONTROL MODULE)
109 101
110 102
103
112 104
113 105
115 107
116 108
8 1
2
3
11 4
12 5
13 6
23
24 16
25 17
26 18
19
20
29 21
30 22
40 31
41 32
42
43 34
36 35
46 37
47 38
48 39
SIG1 +
SIG1 -
SIG2 +
SIG2 -
NEU
HOT
GND
NEWPORT P6000
INJECTOR PULSEWIDTH
NEWPORT P6000
IGNITION TIMING
1 W
22 G/Y
101 W/B
107 B/P

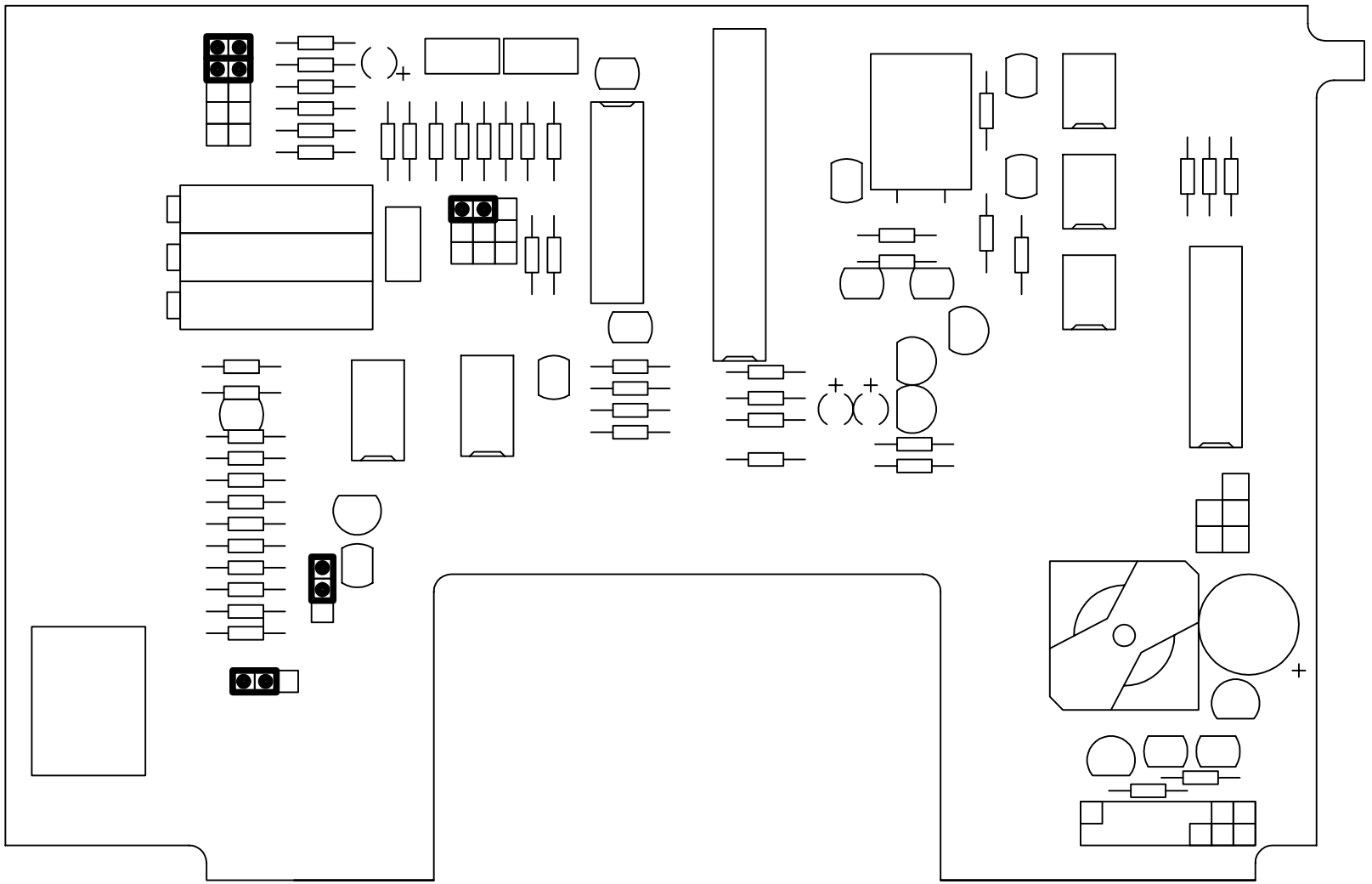
NEWPORT P6000
MAIN BOARD FOR
INJECTOR PULSEWIDTH
JUMPER LOCATIONS



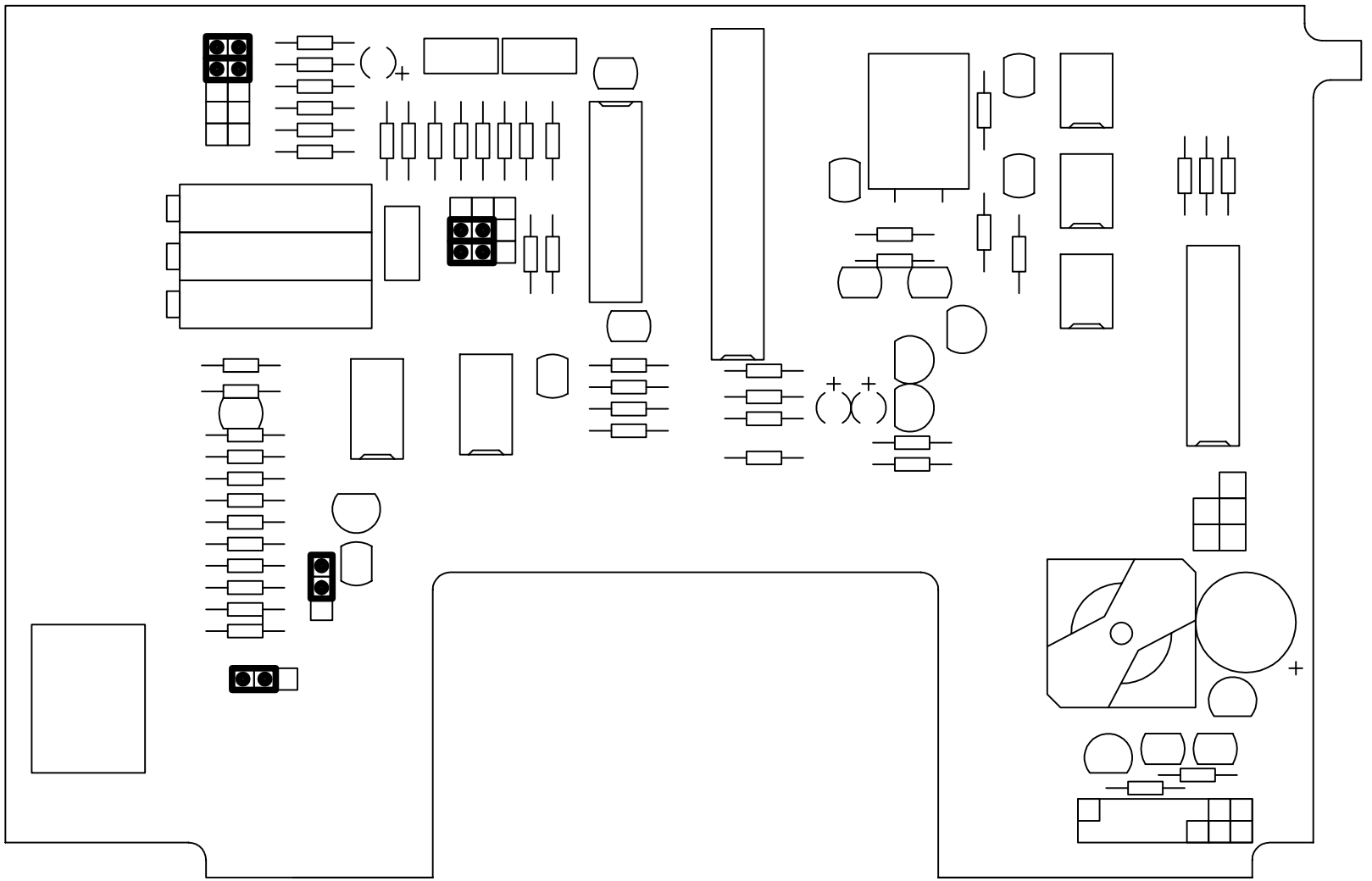
NEWPORT P6000
MAIN BOARD FOR
IGNITION TIMING
JUMPER LOCATIONS



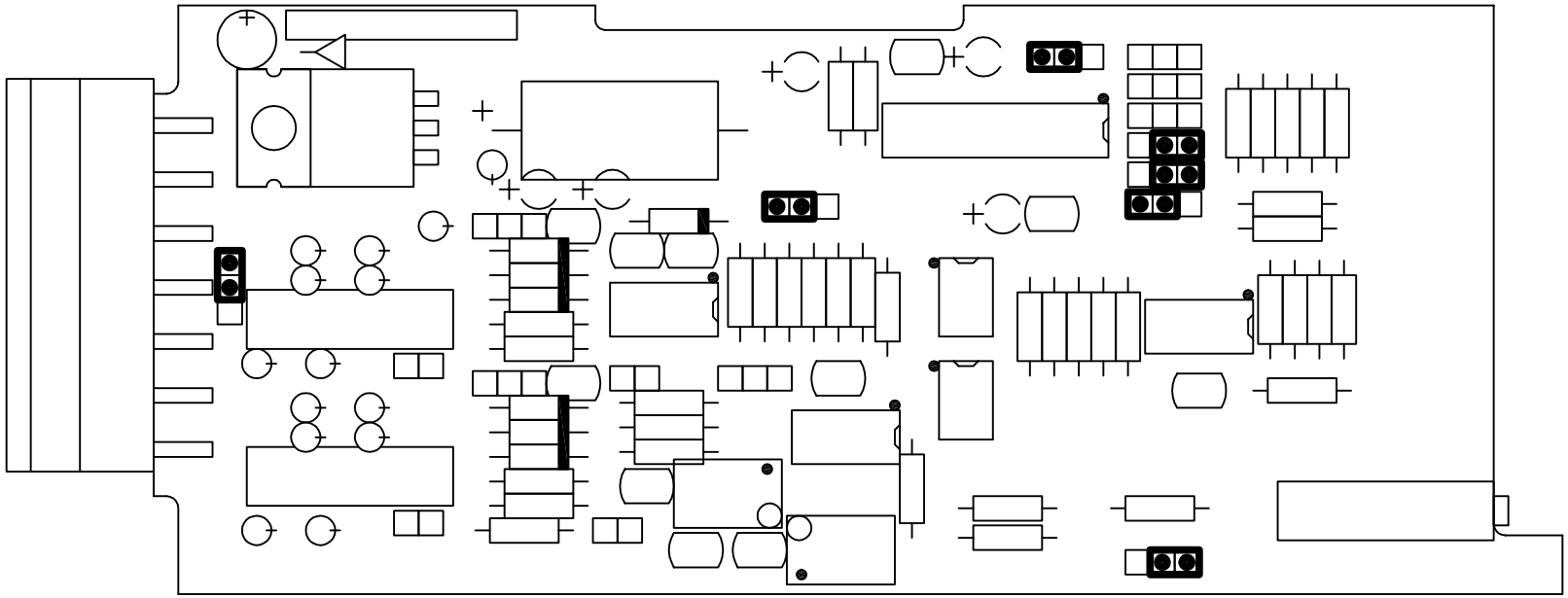
NEWPORT P6000
ANALOG OUTPUT BOARD FOR
INJECTOR PULSEWIDTH
JUMPER LOCATIONS



NEWPORT P6000
ANALOG OUTPUT BOARD FOR
IGNITION TIMING
JUMPER LOCATIONS



NEWPORT P6000
ANALOG INPUT BOARD FOR
IGNITION TIMING
JUMPER LOCATIONS



Instructions for setting up the Newport P6000 to measure ignition timing and injector pulsewidth:

1. To scroll through programmable menus, press ENTER.
2. To scroll through programmable submenus, press ADVANCE.
3. To modify programming on a particular menu or submenu option, press SET.
4. To save modifications on a particular menu or submenu option, press ENTER.

Below is a chart that shows the settings to which to program the menus and submenus:

Menu	Injector Pulsewidth	Ignition Timing
FUNC	TI INT	TI INT
SCALE	→A.SC	→A.SC
	→1.00	→1.00
OFFSET	0	0
RANGE	FFF.FFF	FFFF.FF
SLOPE	→A NEG	→A POS
	→B POS	→B POS
SP LO	0	0
SP HI	0	0
GATE T	1.00	1.00
CNFG 1	000000	000000
CNFG 2	100110	100101

NOTE: "→" indicates submenus.

In the data acquisition system, adjust output scaling to the following:

Current Output	Injector Pulsewidth	Ignition Timing
4-20 mA	0-10 msec	0-20 msec

In the data acquisition system, ignition timing must be calculated using the following equation:

Let IGTIM = ignition timing

Let RPM = engine speed

Let IGP = output signal from Newport P6000

IGTIM = -0.006 x RPM x IGP + 67

Silicone Rubber Heaters

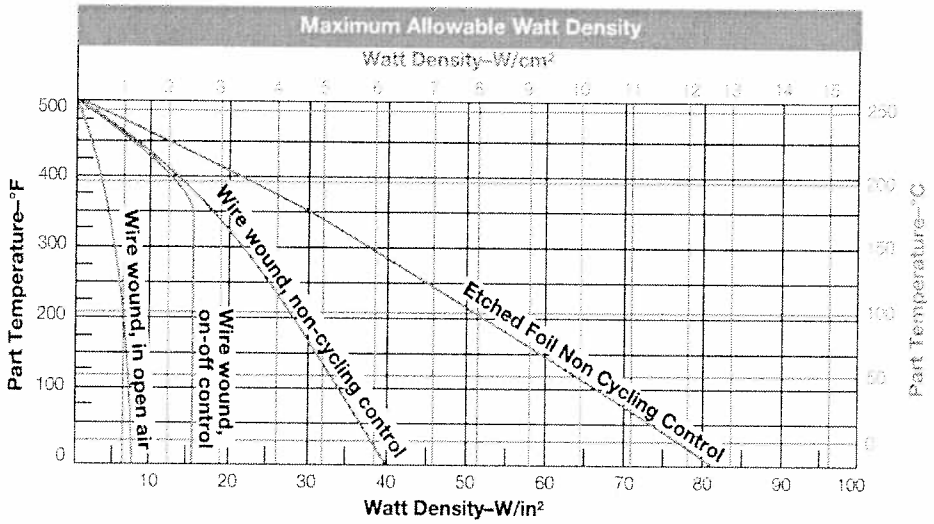
Applications and Technical Data

Determining Watt Density

The *Maximum Allowable Watt Density* graph illustrates the maximum recommended heater watt density at various metal parts or ambient air temperatures. However, it does not indicate the watt density necessary to achieve a given part temperature. See the *Surface Temperature vs. Time* graph on the next page for assistance with those calculations. When using this graph, remember:

- Part temperature is measured at the point where the heater contacts the metal part.
- Thermostats and on-off controllers are typically bimetal or capillary bulb.
- Non-cycling controllers are typically solid state, time-proportioning or SCR temperature controllers.
- Watt density values should be de-rated by one third if insulation is used.
- UL® recognition temperature limits are not detailed.
- Contact your Watlow representative before doing any of the following: selecting high watt density etched-foil elements, or operating heaters with back side insulation or non-metallic parts, which are poor thermal conductors.

Example: A wire-wound heater with non-cycling control at a part temperature of 250°F (120°C) can be rated at 24 W/in² (3.7 W/cm²) maximum. An etched foil heater under the same conditions can be rated at 45 W/in² (7 W/cm²) maximum.



Standard Silicone Rubber Specifications

Max. width x max. length

- Wire-wound: 36 x 120 in. (914 mm x 3048 mm)
- Etched foil: 20 x 30 in. (508 mm x 762 mm)

Thickness (standard)

- Wire-wound: 0.055 in. (1.4 mm)
- Etched foil: 0.022 in. (0.6 mm)

Weight (standard)

- Wire-wound: 8 oz/ft² (0.24 g/cm²)
- Etched foil: 3 oz/ft² (0.09 g/cm²)

Max. operating temperature: 500°F (260°C)

Max. temperature for UL® recognition: 428°F (220°C)

Min. ambient temperature: -80°F (-62°C)

Max. voltage: 600V~(ac)

Max. wattage: see watt density graph

Lead size: sized to load

Lead length: 12 +1½ -½ in. (305 mm +38 mm -13 mm)

Wattage tolerance

- Wire: ±5%
- Foil: +5% -10%

Dimensional tolerances

- 0 to 6 in. (0 to 152 mm): ±1/16 in. (1.59 mm)
- 6 to 18 in. (152 to 457 mm): ±⅛ in. (3.18 mm)
- 18 to 36 in. (457 mm to 914 mm): ±3/16 in. (4.76 mm)
- Over 36 in. (914 mm): ±1%

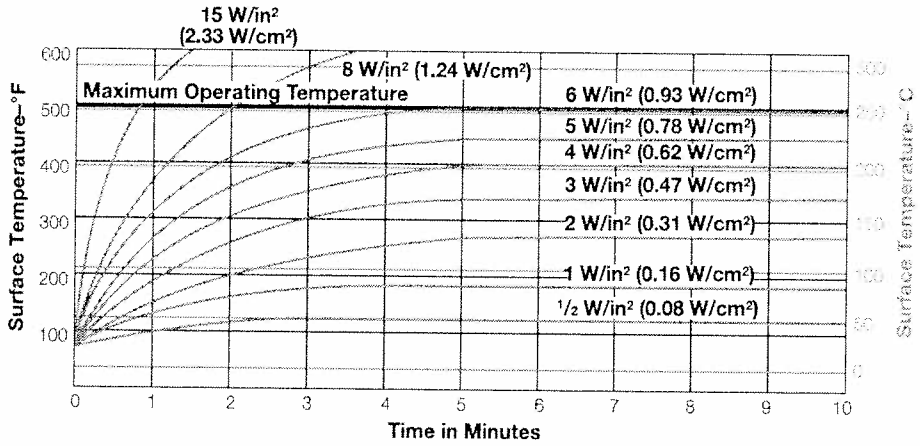
Silicone Rubber Heaters

Applications and Technical Data (Continued)

Surface Temperature vs. Time

This graph illustrates the surface temperature a silicone rubber heater will reach when the heater is uninsulated and is suspended vertically in 70°F (20°C) still air.

This data is based on 0.055 in. (1.4 mm) thick standard construction and is offered as a reference tool.



UR®, cUR®, VDE and CE Recognition for Silicone Rubber Heaters

Watlow frequently works with customers requiring agency approvals such as UR®, cUR®, VDE and CE. Many stock silicone rubber heaters are available with one or more of these certifications.

UL® Component Recognition (UR) of factory-bonded heaters is available up to 392°F (200°C) and for customer installed heaters up to 428°F (220°C) (UL® File No. E52951).

For Canadian recognition Watlow offers **cUR® Recognized** silicone rubber heaters under UL® File #E52951. Several constructions are available with ratings to 600V~(ac) and 428°F (220°C) maximum surface temperature. Contact your Watlow representative for further information.

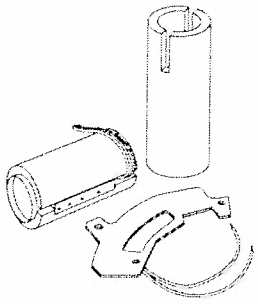
VDE Approval is available on several constructions of both wire-wound (File No. 62533) and etched foil (File No. 62535) silicone rubber heaters. The maximum ratings are 440V~(ac) and 428°F (220°C) surface temperature. Under VDE guidelines, minimum installed bend radius is ⅛ in. (3.2 mm) for etched foil and ¼ in. (6 mm) for wire wound. VDE also states that the user is responsible for the safe application, installation and wiring of the heaters. Maximum working temperature must be maintained by an appropriate temperature controller.

The **CE mark** is available on UR® and/or VDE recognized heaters.

Options

Watlow offers a variety of options such as attachment techniques, thermostats, special leads, holes and cutouts and three-dimensional shapes. These are all described in the introduction to flexible heaters section. In addition, the following option is available only on silicone rubber heaters.

Thermal Insulation



To increase the heating efficiency of your application, silicone rubber heaters can be thermally insulated with silicone sponge rubber, bonded to one side in the following thicknesses: 1/16, ⅛, ¼, ⅜ or ½ in. (1.6, 3.2, 6, 9.5 or 13 mm). Heaters with thermal insulation are still quite flexible.

An aluminized surface can be added to the back of the heater to reduce radiated heat losses. This aluminized surface, called "Low Loss Treatment," adds very little to the unit thickness and maintains a very clean appearance.

Silicone Rubber Heaters

Wire-Wound Elements (Continued)

Width in.	Width (mm)	Length in.	Length (mm)	Watts	120V~(ac) Code Number	120/240V~(ac) Code Number
4	(102)	4	(102)	80	**040040C1**	
		5	(127)	100	**040050C1**	
		5	(127)	25/100		**040050C2**
		10	(254)	200	**040100C1**	
		10	(254)	50/200		**040100C2**
		15	(381)	300	**040150C1**	
		15	(381)	75/300		**040150C2**
		20	(508)	400	**040200C1**	
		20	(508)	100/400		**040200C2**
		25	(635)	500	**040250C1**	
		30	(762)	600	**040300C1**	
		35	(889)	700	**040350C1**	
		40	(1016)	800	**040400C1**	
5	(127)	5	(127)	125	**050050C1**	
		5	(127)	31.25/125		**050050C2**
		10	(254)	250	**050100C1**	
		10	(254)	62.5/250		**050100C2**
		15	(381)	375	**050150C1**	
		15	(381)	9.375/375		**050150C2**
		20	(508)	500	**050200C1**	
		20	(508)	125/500		**050200C2**
		25	(635)	625	**050250C1**	
		30	(762)	750	**050300C1**	
		35	(889)	875	**050350C1**	
		40	(1016)	1000	**050400C1**	
6	(152)	5	(127)	150	**060050C1**	
		5	(127)	37.5/150		**060050C2**
		10	(254)	300	**060100C1**	
		10	(254)	75/300		**060100C2**
		15	(381)	450	**060150C1**	
		15	(381)	112.5/450		**060150C2**
		20	(508)	600	**060200C1**	
		20	(508)	150/600		**060200C2**
		25	(635)	750	**060250C1**	
		30	(762)	900	**060300C1**	
		35	(889)	1050	**060350C1**	
		40	(1016)	1200	**060400C1**	

Notes:
- Standard thickness 0.055 in. (1.4 mm)
- Stock heaters have standard lead length 12 in. (305 mm) UL® 1180 Teflon®
- UL® component recognition
- Silicone rubber wire-wound elements rated at 5 W/in²