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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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Originally Issued: November 13, 2014

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Unapproved Minutes of the October 22, 2014 Sequence IV Surveillance Panel Meeting.

The meeting was called to order by Chairman Buscher at 8 AM Eastern Time.

A list of attendees is included as attachment 1. Jerry Brys, Kevin O'Malley and Teri Kowalski also participated via teleconference

A copy of the agenda is included as attachment 2

One membership changes was noted, Chris Mileti replaces Nathan Moles as the voting member for Lubrizol. Robert Stockwell has Bruce Matthews proxy and Andy Ritchie has Ryan Rieth's proxy.

Minutes from the August conference call were approved with no corrections.

Action Items from Previous Meeting
A review of the status of action items from the previous meeting was under taken. These action items and their status are listed in Attachment 3.

Hardware Update
Laboratories provide verbal update from labs. Two labs are calibrated on BC-2 cams while a third lab is calibrated on BC-1 cams. All labs indicated they have sufficient hardware for the foreseeable future. OHT indicated that grinding of BC-3 cams is about one quarter completed and should be completed by the end of the year. It was noted that BC-3 cams would only be shipped to one laboratory. The panel felt that development of equivalence limits for IVA with IVB would not be necessary as the test should be able to support older categories.

Introduction of Reference Oil 300
A total of five donated test were agreed to be run, two at SwRI, one at Lubrizol and two at Intertek. The panel reviewed the data generated on reference oil 300 to date. This oil appeared to generate high wear on limited lobes across the valve train. Tests run on reference oil 1006-2 prior to running 300 were on the same batch as the most recent reference. Lab A's results were on BC-1 while labs B and G results were on BC-2. There were questions about whether what lobes generated the highest wear might help understand the anomalous performance with reference oil 300. It was pointed out that the cams are not the hardest component in the valve train, the followers are harder. A question was asked about the vis grade and what the supplier results were on oil 300. The supplier provided a single data point of 49 um. The supplier also indicated that a 70 um result would not be unexpected. Variability can be an issue, but recent reference data on the reground cams did not show the high and low wear. Lot codes were varied. Cams were randomized and reground. Cams were reground in three groups, a small group, designated BC-1, was sent to one lab that was running out of hardware and BC-2 was a batch of 500 cams. BC-3 is the remainder of the purchase from Nissan and will go to one lab. The manufacturing codes are varied and the batch designates what group it was reground in. Review of results from the three donated indicated a large delta from average wear on several lobes on two of the cams using reference oil 300, which has not been not experienced in other reference oils. The vis grade of reference oil 300 is 5W-30. Several members commented that reference oil 300 may be a borderline oil and may experience this type of wear. Several members cautioned on drawing inferences from Batch Code. It was also pointed out that borderline oils can show large variability in performance and the limited data on this oil makes it difficult to truly understand whether this phenomena is truly unique to this oil. The panel entertained considerable discussions about data going forward and how to obtain data. The mean of the 3 data points provided thus far is 94.72 μm, versus 103 μm for 1006-2. Andy Ritchie expressed the sentiment that this oil may be poorer than what we thought. After some additional discussion, the panel agreed that there would be value in obtaining additional data on this oil, as if it is a poor oil, it may not be used in the current IVA LTMS, but may still be useful in IVB development. Three labs agreed to conduct an additional donated test on oil 300. The stand conducting the test would be granted an extension of the calibration period by one test. Labs with multiple stands agreed to run the additional test in the same stand as used for the previous donated test. What cam batch to use as well as lab severity was discussed by the panel and the results on this oil with the cams batches used were in line with the laboratories referencing history. When all the data is reported the chair will schedule a conference call. Data reviewed during the meeting regarding the performance of reference oil 300 is included as attachment 4.

Fuel Supplier Report

There was no formal report to the panel from the fuel supplier. The supplier reiterated that fuel is blended on an "as needed" basis and that roughly 1-2 batches are blended per year. The supplier was not aware of any issues going forwarded. It was further noted that this fuel is being used in IVB development and for Sequence VIII.

TMC Report

Rich Grundza of the Test Monitoring Center provided a quick update on severity and precision of the IVA test. Both severity and precision are in control and precision estimates for the period ending October, 2014 are comparable to historical levels. There are 3 calibrated labs with a total of 4 stands and all labs and stands are calibrated on the reground hardware. A copy of TMC report can be accessed via the following link:
ftp://ftp.astmtmc.cmu.edu/docs/gas/B01SemiAnnualReports/semiannualreports/B01%20SemiAnnualReport%20-%20October%202014.pdf

Scope and Objectives

The scope and objectives were reviewed and are included as attachment 5.
The status of long term hardware has been addressed. Driveline mounting is incomplete. The panel agreed this needs to be kept open and active and the panel needs to resolve these items regarding driveline. Labs have procedures for replacement of driveline components but further refinements and understanding of the influence on tests need to be pursued, this was left as on going. Introduction of GF-5 Reference oil 300 has been pushed back to December 2014 with labs agreeing to generate additional data.

IVB Development

Bill Buscher reviewed the development work to date on the development of the IVB. It will be a flush and run test. At the present time, it is anticipated that there will be a cylinder head will be used for 6 tests and blocks for 12 tests. There are no modifications to the engine, but there is potential for modification of the cylinder heads. Most of the hardware is stock production, but the heads will be shipped bare. An assembly manual is being developed to address build up of the engine, cylinder heads, etc. The intake cam is test specific, but the exhaust is stock. Lifters are production parts but will be modified CPD to index for measurement. Finally, the intake springs are higher tension exhaust stock.
OHT has been chosen as the CPD for consumables, while TEI supplies stand and stand components. Currently, wear measurements are being conducted on cams, heel to toe and wear area loss. Wear measurements are also being performed on buckets utilizing a PDI surface analyzer using pre and post test traces to determine wear values. PDI will be updating software for this purpose. Comparison measurements do both z-diff and area loss. The most promising parameter is lifter bucket wear area loss. To obtain the engines, OHT handles distribution and labs will need to engage in sales agreements with OHT to use and dispose of engines. Engines will be serialized. Engines can be stored, however engines can never end up in any vehicle. Engine can be destroyed and documentation must be provided to OHT as these engines are not emissions certified. The protocol for obtaining engines will be discussed at the next conference call. OHT indicated it takes about 4 weeks to process these engines for delivery.
As mentioned earlier, lifter wear area loss appears to be the most promising as significant variations in wear data has been noted in development work. There 2 factors influencing repeatable measurement with PDI software, filtration and edge cut off. Latest software appears to address these issues. Indexing of lifter is important, as it is not symmetrical. Work is in progress to standardize lifter fixture. OHT will laser etch the lifters to align etch to stylus. In addition, lifters will be notched to align with a pin in the measurement fixture. Standardization of the alignment is necessary to ensure proper measurement. Finally, other equipment is being

evaluated to see if there is a more efficient, more repeatable way to measure these components as there is a desire to reduce the time required to measure. Currently measurements are taking around 14 hours. It may be possible to reduce the time in half or better with other equipment. The IVB test should be available for multiple categories. A metrology workshop and build workshop are planned for late January/early February.

With regards to test operations, 4 flushes are conducted between tests, necessitating about 5 gallons for a complete test. Four 3000 ml flush are used for the test, with a 2400 ml oil charge for the test and the flushes are 30 minutes long. Concerns about oil carry over were expressed and flush effectiveness study was conducted. The flush is about 99% effective. However, it was suggested that use of slave valve train components during flush may eliminate any potential carry over. After some discussion, Bill Buscher agreed to take the suggestion of conducting flushes with slave hardware back to the development group. It was also asked if the flush can be accomplished without running engine. Again, these concerns/suggestions will be taken back to the development group for further study. A break in is conducted on the engine prior to use as well as an additional 100 hours of running to pacify silicone. Head replacement, front cover replacement, etc. will require 100 hours be run to facilitate silicone removal. In order to eliminate flushing, it was asked whether the pan can be modified to allow all oil to be drained. The pan cannot be modified because there is ribbing in the bottom of the pan and there are no drawings from Toyota to make modified pan. Also, there is no dipstick, so oil cannot be suctioned through the dipstick. The test cycle is different from the IVA. The IVB operates a 30 sec test cycle, with (2) 7 second stages and (2) 8 second transitions between 800 and 4300 rpm. RAC cooling system is separate and is maintained at 20 ºC. Test duration is still to be evaluated but 150 – 200 hours appears where test length will settle. No 0W-16 oils have been run so oil pressure may need to be tweaked. Iron levels not the same as the IVA. Iron does not appear to be coming from lobes but from the lifters. There is some variability between wear locations on the lifters, but no one area is prone to wear. Visually, the lifters look polished with circular wear patterns. A DOE (attachment 6) is under way to evaluate 3 oils, Reference oils 300 and 1006-2 and poor oil designated SD/SE, designed to mimic and SD/SE category poor oil. The DOE is evaluating test lengths of 150, 175 and 200 hours in 3 stands and 3 labs. The Vis grade of SD/SE is 0W-20. Earlier in test development a reversal in performance was observed between oils 1009 and 1006-2. It was noted that the performance of these oils was not evaluated with the current cycle, so this will need to be repeated with the current test cycle. It was suggested that oil SD/SE be run in the IVA and Bill indicated the development group will re-evaluate 1009. A matrix to define test length is planned, but the test cycle is frozen. The test cycle was designed to mimic ISB, and produce acceptable engine durability and wear rate. A number of conditions were evaluated. Wear data was reviewed by lobe from one test, and more variability was noted on exhaust versus intake. Timing of the matrix was discussed. Lifter laser etching is expected to be completed next week with possibly another week till parts are measured and available with anticipated completion of Mid December. A copy of the test cycle is included as attachment 7 and a presentation on IVB development is included as attachment 8.

ASTM Template review was cursory and will be addressed during another meeting. The template is included as attachment 9.

One action item was assigned as a result of this meeting and is included as attachment 10.

The meeting was adjourned at 11:28 AM.

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

October 22, 2014

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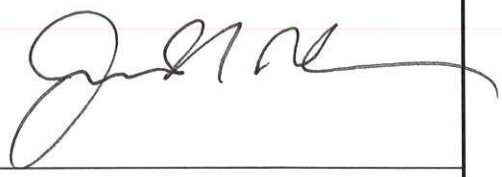
Bowden, Jason	OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 Phone No.: 440-354-7007 Fax No.: 440-354-7080 Email: jhbowden@ohtech.com	
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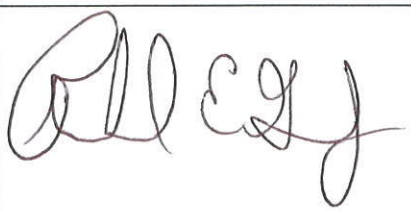
Grundza, Rich	ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 Phone No.: 412-365-1031 Fax No.: 412-365-1047 Email: reg@astmtmc.cmu.edu	
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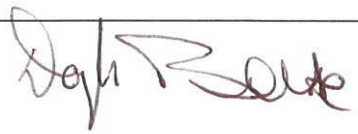
Boese, Doyle	Infineum USA L.P. 1900 E. Linden Avenue Linden, NJ 07036-0536 Phone No.: 908-474-3176 Fax No.: 908-474-3637 Email: doyle.boese@infineum.com	
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Attachment 2

Sequence IV Surveillance Panel

San Antonio, TX
Southwest Research Institute, Building 209
October 22, 2014
8:00 a.m. - 12:00 p.m.

A G E N D A

1.	Chairman comments	
2.	Attendance sign-in sheet distribution	
3.	Membership changes	
4.	Motion and action recorder	
5.	Approval of minutes for 8/19/2014	All
6.	Action item review	Chairman
7.	Status of test hardware at labs	Labs
8.	Status of camshaft regrinding	OHT
9.	Status of introduction of ASTM REO 300	All
10.	Fuel supplier report – KA24E Green fuel	Haltermann
11.	TMC reports (A*ny questions?*)	TMC
12.	Review scope & objectives	Chairman
13.	Old business	
14.	New business	
15.	Sequence IVB test development update	Dev. Team
16.	ASTM new test template review	All
17.	Motion and action item review	
18.	Next meeting	
19.	Adjourn	

Attachment 3

Sequence IV Surveillance Panel
November 20, 2013
8:00AM – 10:00AM
Southwest Research Institute
San Antonio, TX

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

1. Action Item – Surveillance panel chair and Toyota to follow up with PDI requesting a future software upgrade that will reintroduce trace overlay capabilities.
   Completed. Updated PDI software developed for Window 7 and is currently being BETA tested at Intertek and SwRI.

2. Action Item – SwRI to provide OHT with sourcing information for Sequence IVA camshaft rear freeze plug.
   Completed. Necessary information was provided by SwRI and received by OHT.

3. Action Item – OHT to find out from camshaft regrind vendor if they observed any convex lobes in their pre-regrinding surface profilometer inspections of the 32 camshaft sampling.
   Completed. No convex lobes were found.

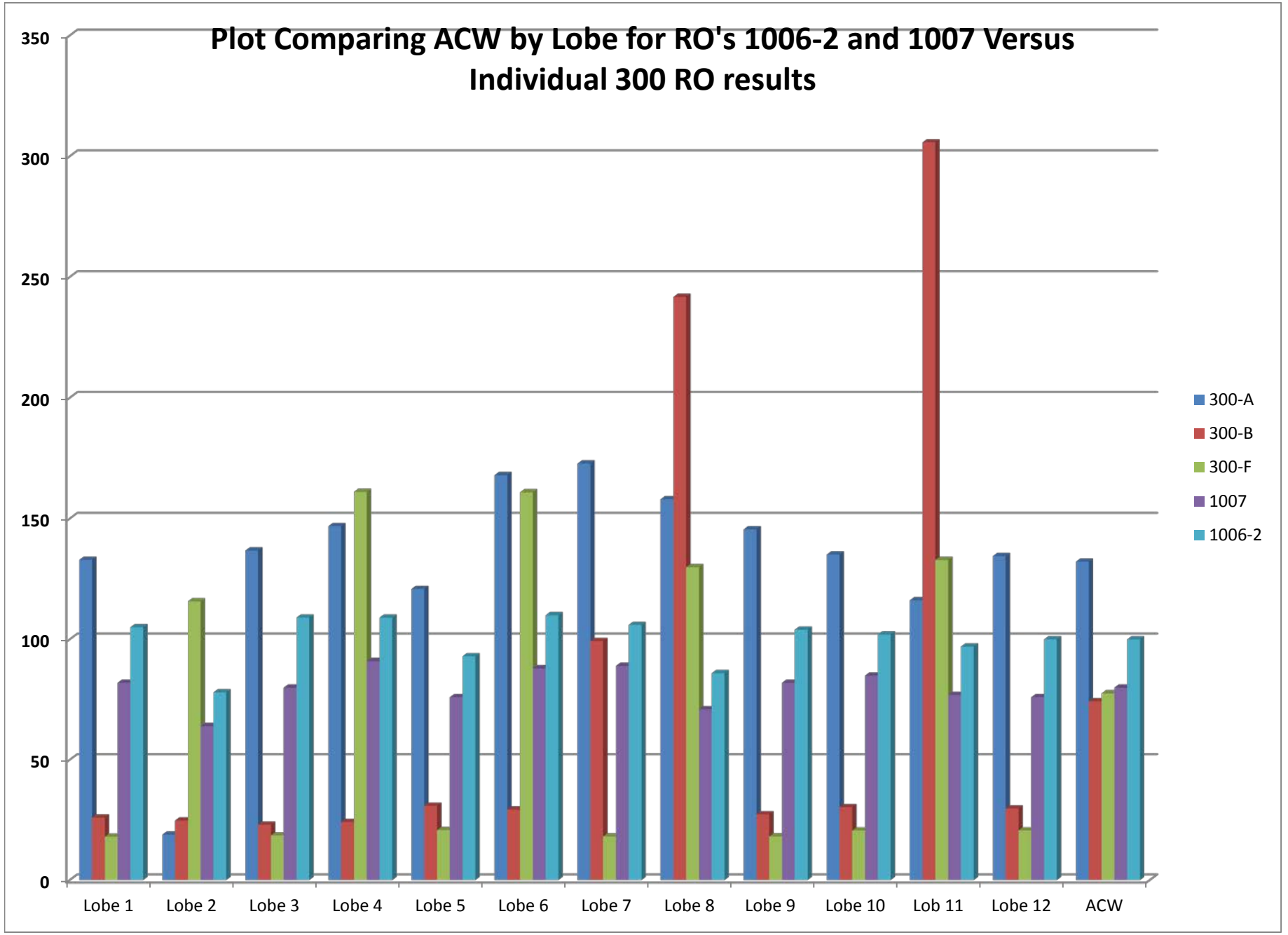
4. Action Item – Labs to follow up with Nissan on status of camshaft replacements for the 62 camshafts rejected due to shipping damage.
   Completed. Nissan replaced the 62 camshafts in a later shipment.

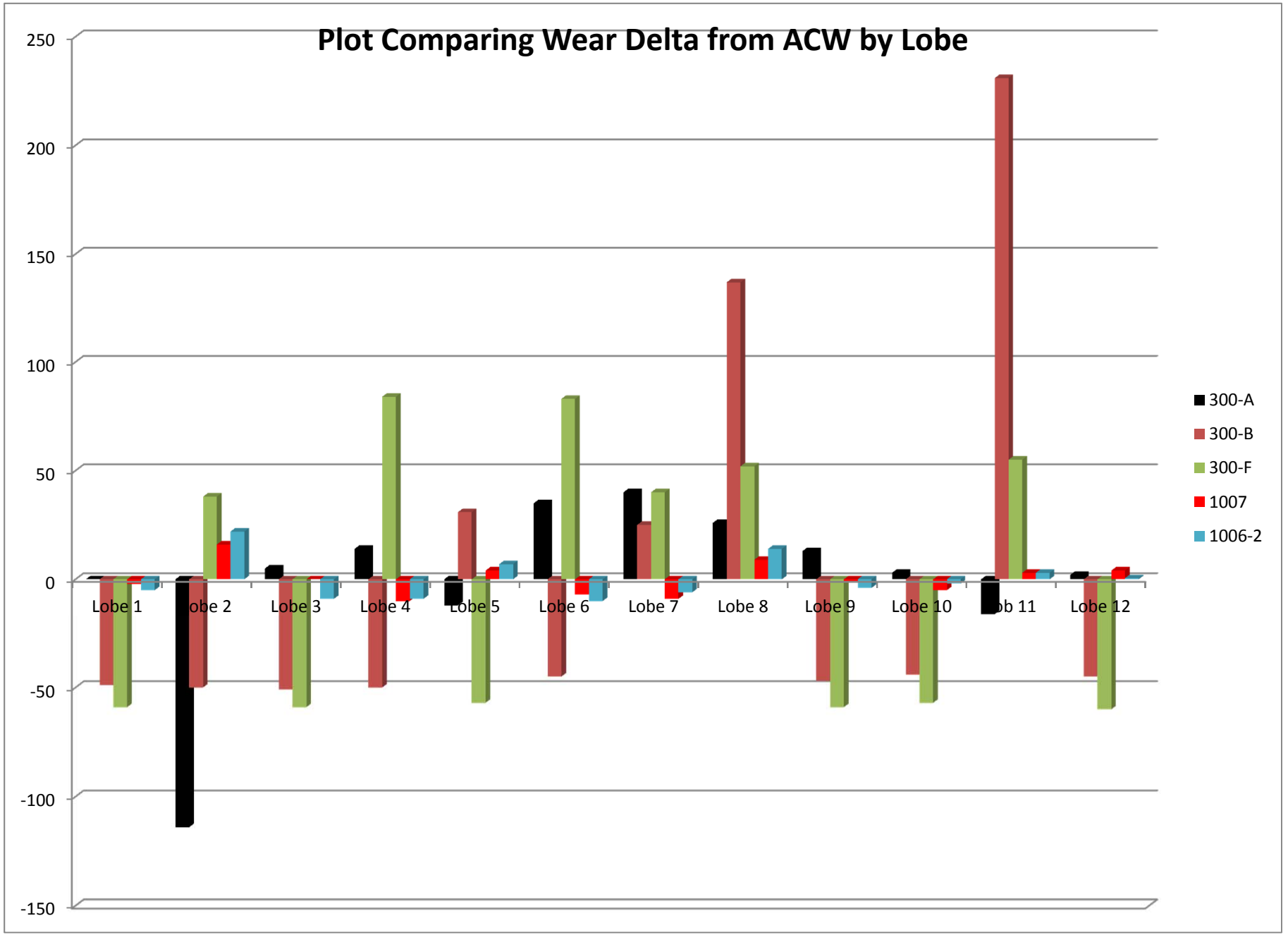
5. Action Item – Surveillance panel chair to reply to NNA indicating the 3 test labs purchasing Sequence IVA hardware directs NNA to coordinate directly with OHT for future camshaft shipments from NNA to OHT. Indicate OHT is willing to provide individual camshaft packaging, as well as shipping crates/pallets, for shipping from NNA to OHT.
   Completed. OHT coordinated and handled all additional camshaft shipments from NNA to OHT. No additional camshafts were damaged in shipment.

6. Action Item – Surveillance panel chair to request another update from Nissan on status of remaining balance from the industry order, including components other than the balance of camshafts, then report to the purchasing test labs.

Completed. All hardware from the 2013 industry order has been delivered and received by either OHT or the test labs.

7. Action Item – Form a Sequence IVA test procedure editorial review task force, with Fred Gerhart as leader, to further clean up some inconsistencies within the test procedure. Anyone interested, to contact Fred to join the task force.
   Open. To be addressed. If you have not done so already and are interested, please contact Fred asking to join this task force.

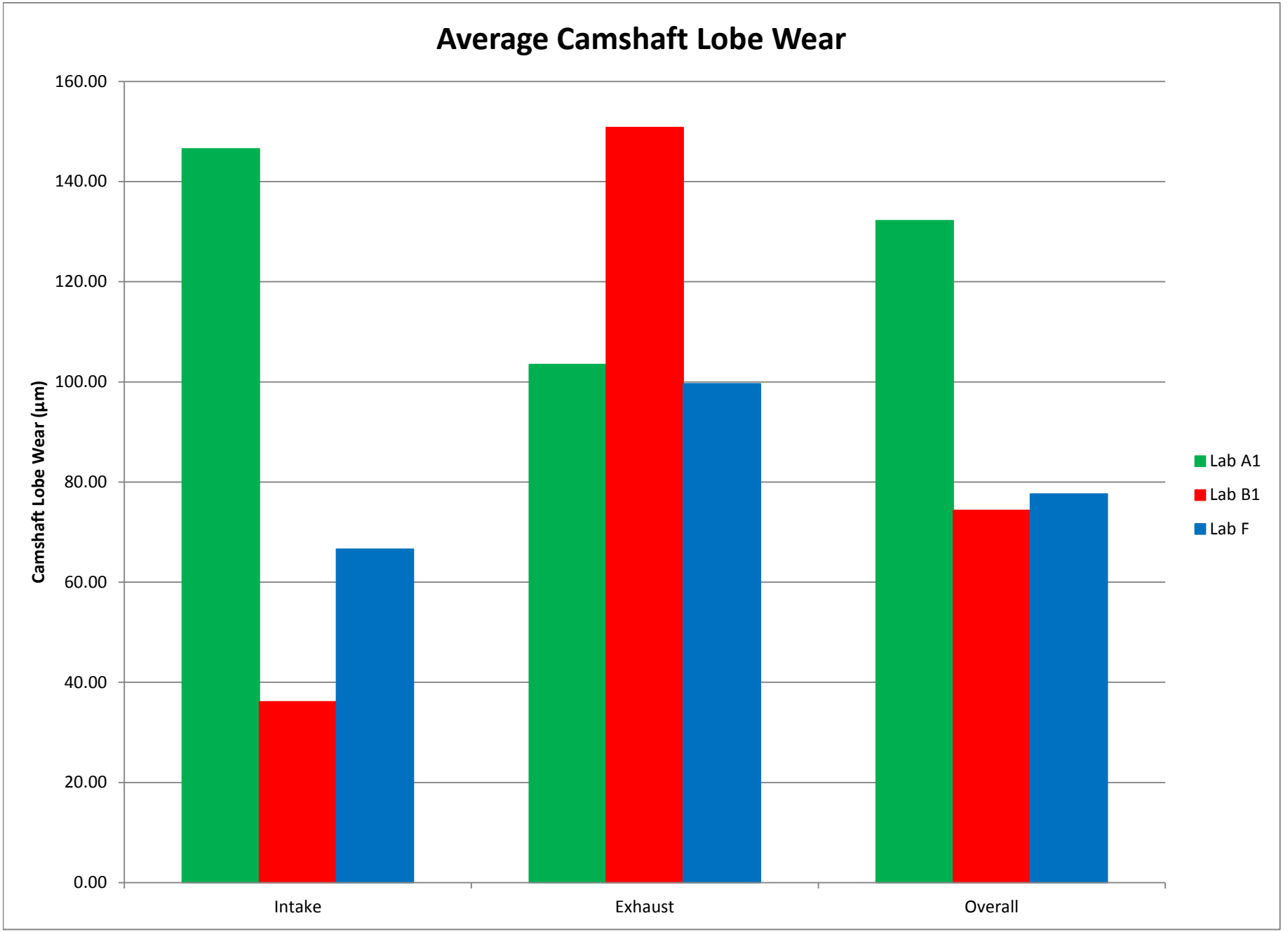

Plot Comparing ACW by Lobe for RO's 1006-2 and 1007 Versus Individual 300 RO results
350
300
250
200
150
100
50
0
Lobe 1
Lobe 2
Lobe 3
Lobe 4
Lobe 5
Lobe 6
Lobe 7
Lobe 8
Lobe 9
Lobe 10
Lob 11
Lobe 12
ACW
300-A
300-B
300-F
1007
1006-2

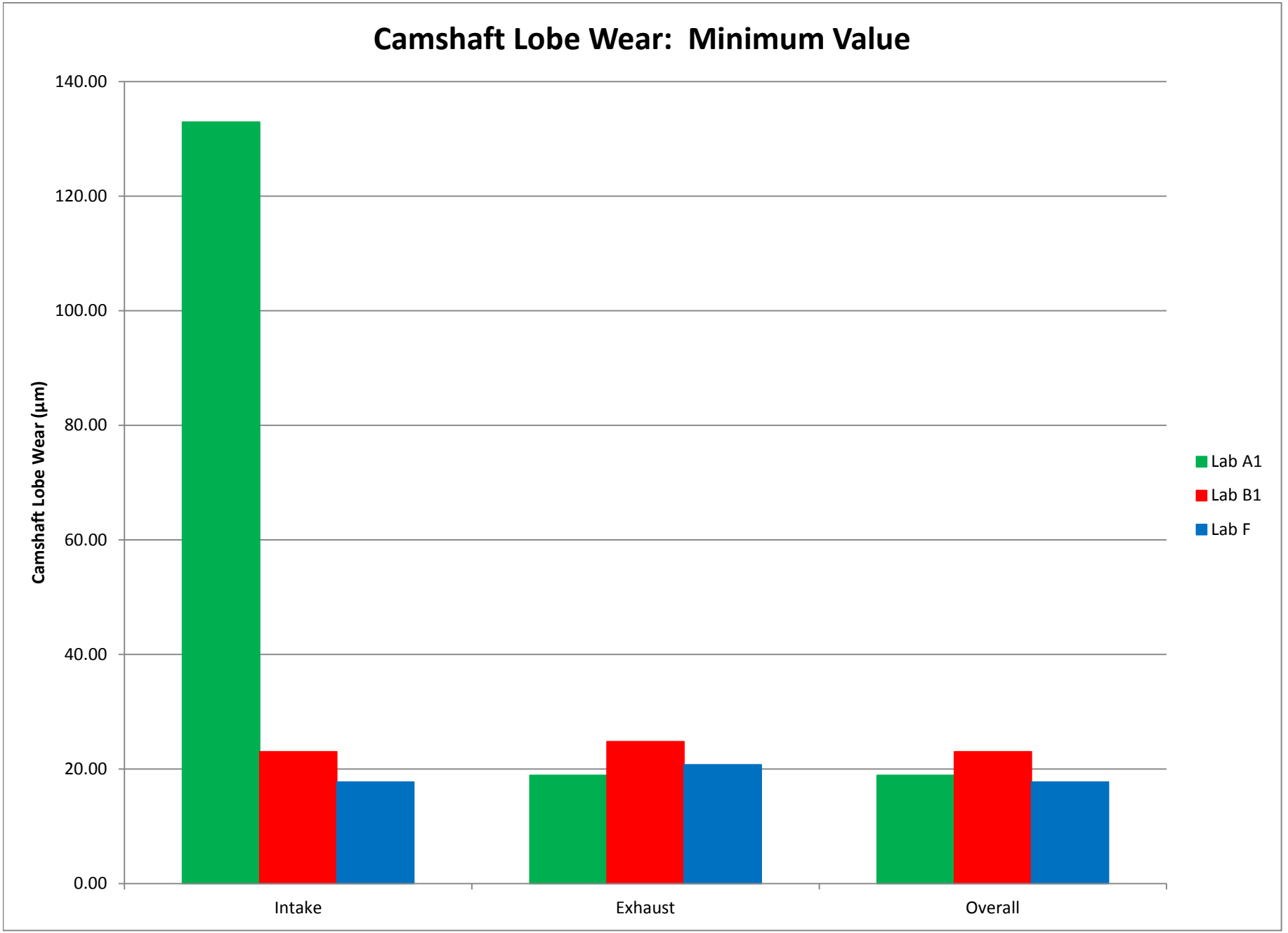

Plot Comparing Wear Delta from ACW by Lobe
250
200
150
100
50
0
-50
-100
-150
Lobe 1
Lobe 2
Lobe 3
Lobe 4
Lobe 5
Lobe 6
Lobe 7
Lobe 8
Lobe 9
Lobe 10
Lobe 11
Lobe 12
300-A
300-B
300-F
1007
1006-2

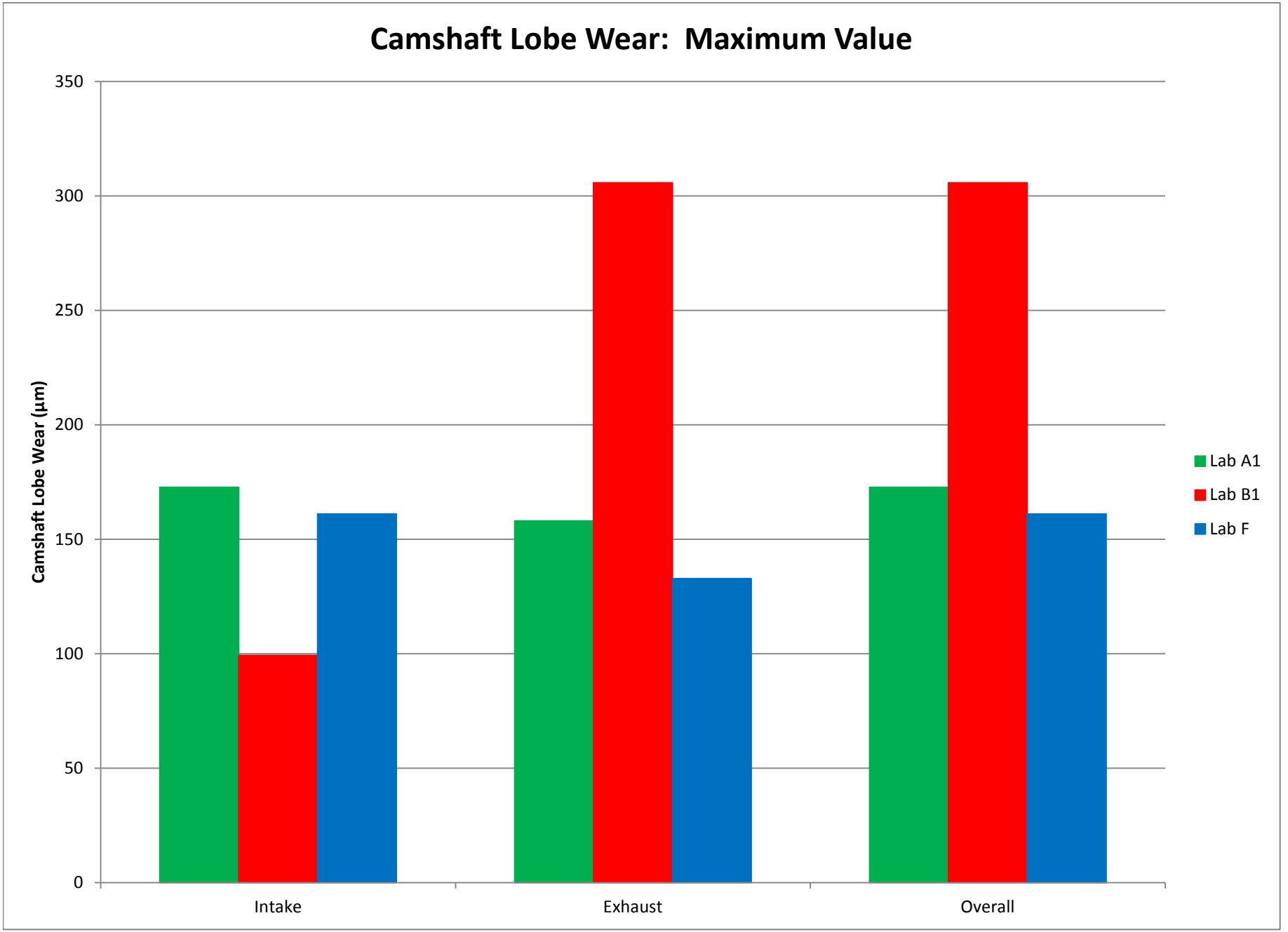
Sequence IVA

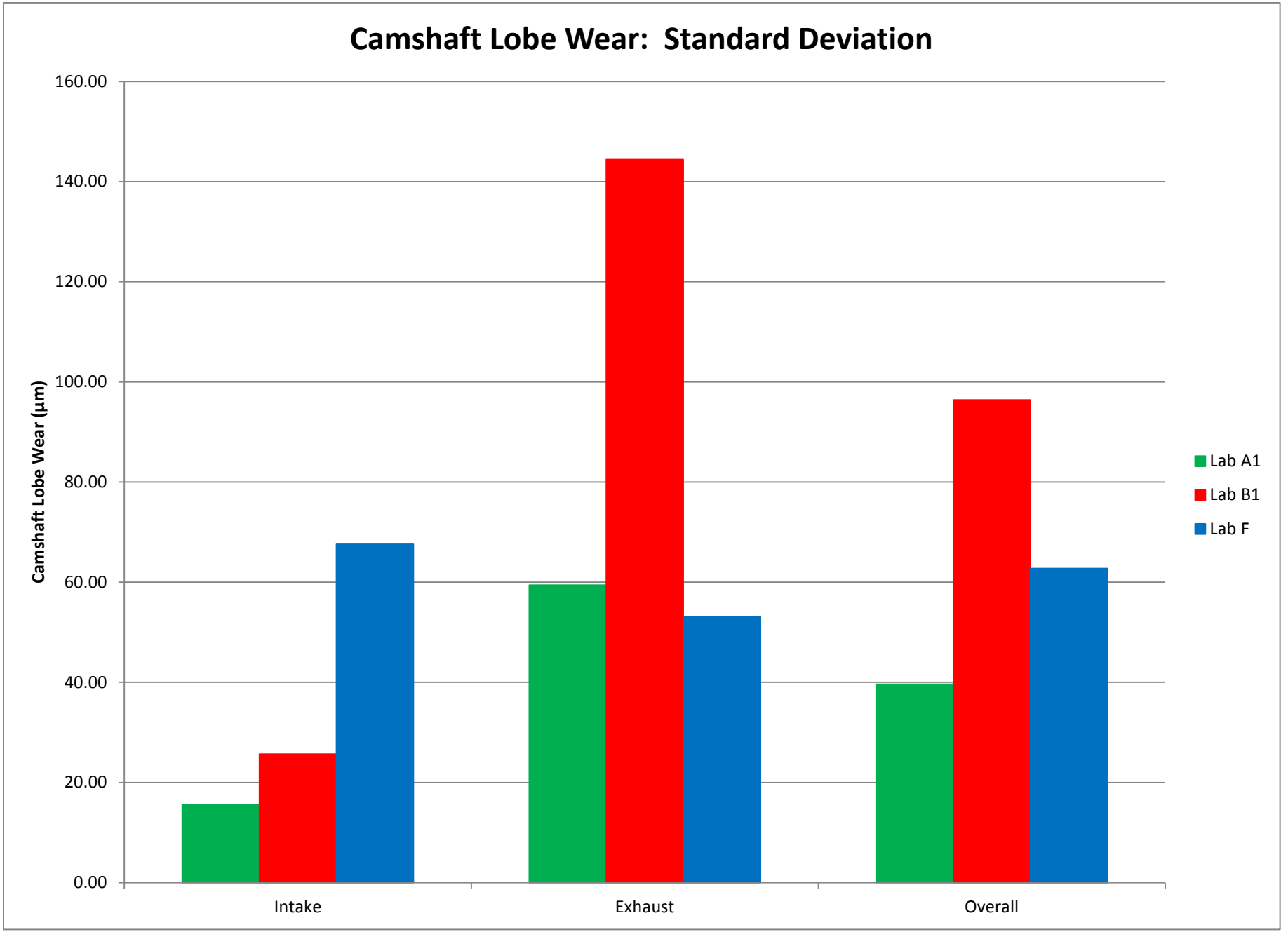
ASTM REO 300 Donated Testing

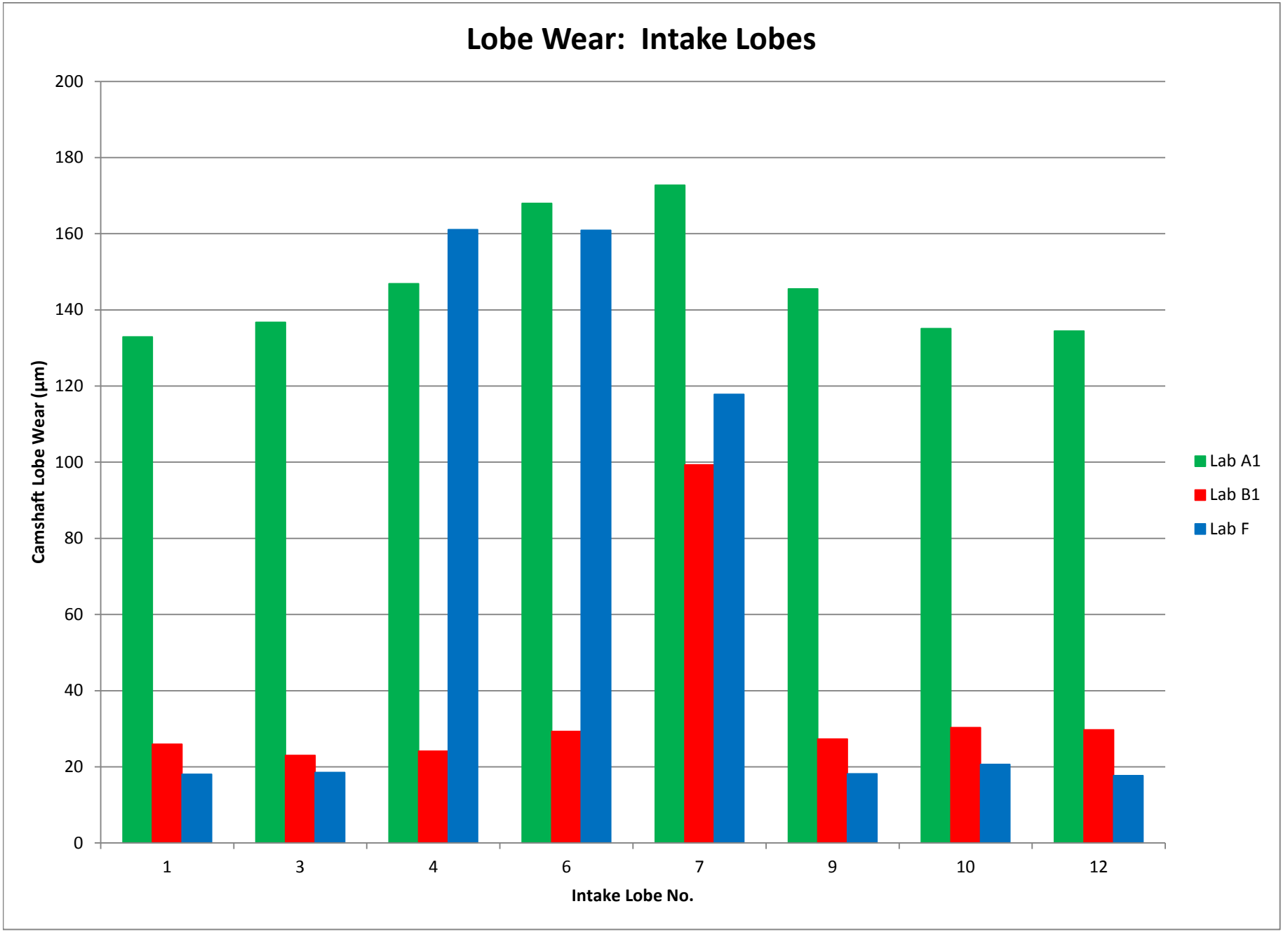
LTMS Lab		A1	B1	F
Camshaft Batch		BC-1	BC-2	BC-2
Intake	1	132.91	25.97	18.04
	3	136.75	23.02	18.52
	4	146.87	24.13	161.08
	6	167.97	29.30	160.89
	7	172.77	99.32	117.84
	9	145.53	27.33	18.14
	10	135.10	30.28	20.63
	12	134.47	29.74	17.72
	Avg.	146.55	36.14	66.61
	Min.	132.91	23.02	17.72
	Max.	172.77	99.32	161.08
	Std. Dev.	15.614	25.666	67.573
Exhaust	2	18.88	24.77	115.72
	5	120.86	30.89	20.74
	8	158.01	241.75	129.14
	11	116.16	305.76	132.87
	Avg.	103.48	150.79	99.62
	Min.	18.88	24.77	20.74
	Max.	158.01	305.76	132.87
	Std. Dev.	59.424	144.391	53.098
Overall	Avg.	132.19	74.36	77.61
	Min.	18.88	23.02	17.72
	Max.	172.77	305.76	161.08
	Std. Dev.	39.596	96.396	62.760

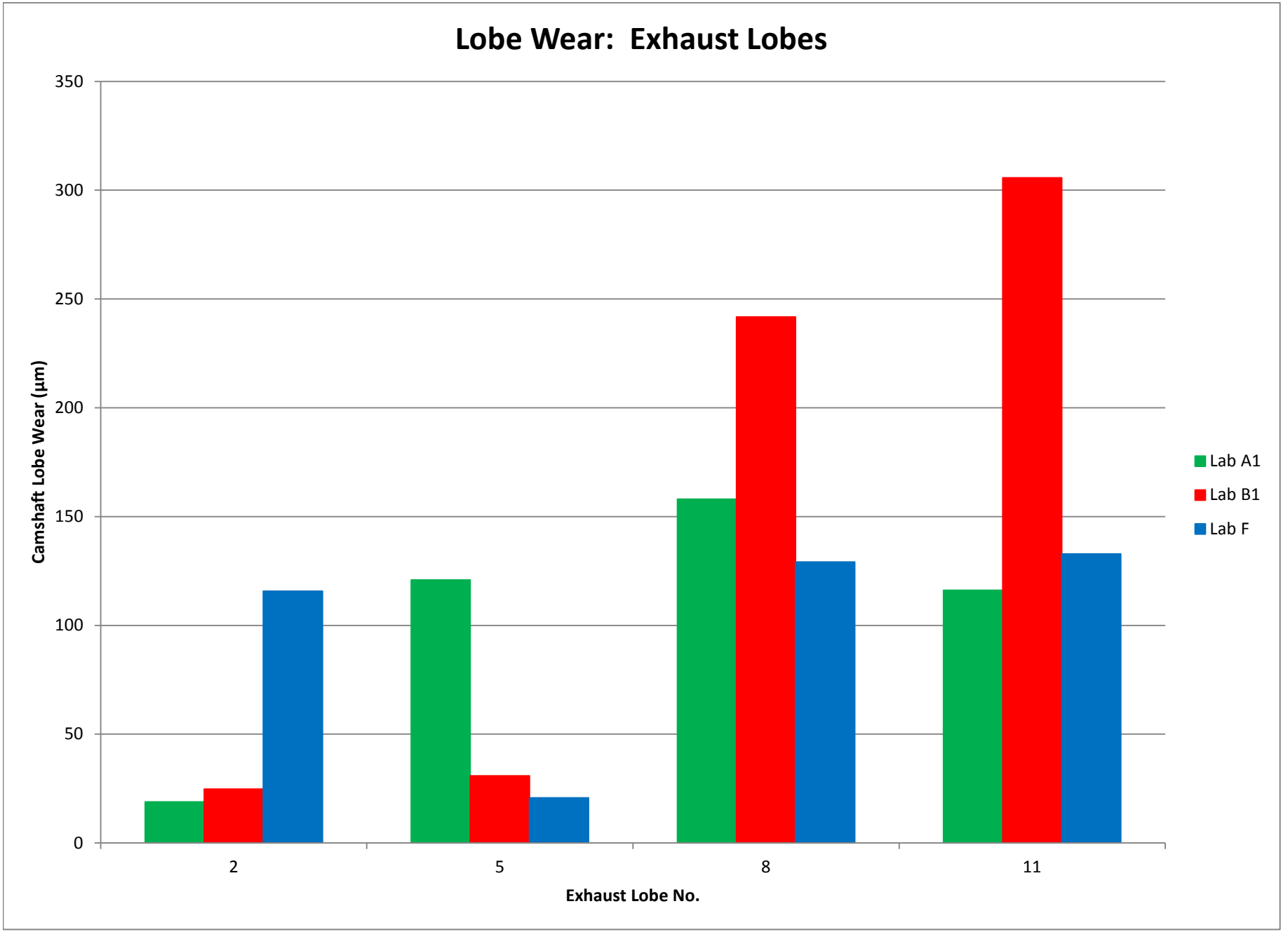

Average Camshaft Lobe Wear
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Camshaft Lobe Wear (µm)
Intake
Exhaust
Overall
Lab A1
Lab B1
Lab F


Camshaft Lobe Wear: Minimum Value
Camshaft Lobe Wear (µm)
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Intake
Exhaust
Overall
Lab A1
Lab B1
Lab F


Camshaft Lobe Wear: Maximum Value
Camshaft Lobe Wear (µm)
350
300
250
200
150
100
50
0
Intake
Exhaust
Overall
Lab A1
Lab B1
Lab F


Camshaft Lobe Wear: Standard Deviation
Camshaft Lobe Wear (µm)
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Intake
Exhaust
Overall
Lab A1
Lab B1
Lab F


Lobe Wear: Intake Lobes
Camshaft Lobe Wear (µm)
200
180
160
140
120
100
80
60
40
20
0
1
3
4
6
7
9
10
12
Intake Lobe No.
Lab A1
Lab B1
Lab F


Lobe Wear: Exhaust Lobes
350
300
250
200
150
100
50
0
Camshaft Lobe Wear (µm)
2
5
8
11
Exhaust Lobe No.
Lab A1
Lab B1
Lab F

Sequence IVA Valve Train Wear Test

Camshaft Lobe Wear

LTMS Lab: A1	Test Key: 103251	Date Completed: 8/25/14
Industry Oil Code: 300		

7-Point Measurement Method, µm

Position	Cylinder	Lobe Number	14° BTC Wear, µm	10° BTC Wear, µm	4° BTC Wear, µm	0° (Nose) Wear, µm	4° ATC Wear, µm	10° ATC Wear, µm	14° ATC Wear, µm	Lobe Wear, µm
Intake	1	1	15.59	17.66	20.30	23.69	27.11	25.57	2.99	132.91
		3	15.76	18.22	20.33	22.24	26.95	26.15	7.10	136.75
	2	4	8.40	15.92	20.59	23.97	27.67	30.69	19.63	146.87
		6	14.39	18.51	21.32	24.92	28.22	31.48	29.13	167.97
	3	7	16.17	20.71	22.54	26.15	29.53	33.50	24.17	172.77
		9	13.14	16.89	18.77	23.08	25.60	26.46	21.59	145.53
	4	10	15.24	17.45	21.00	22.89	23.95	26.86	7.71	135.10
		12	11.12	16.59	21.22	25.86	27.49	26.04	6.15	134.47
	Max. of Intake		16.17	20.71	22.54	26.15	29.53	33.50	29.13	172.77
	Avg. of Intake		**13.73**	**17.74**	**20.76**	**24.10**	**27.07**	**28.34**	**14.81**	**146.55**
Exhaust	1	2	2.12	2.89	3.37	3.43	3.04	2.21	1.82	18.88
	2	5	2.40	10.30	23.43	27.18	23.44	18.45	15.66	120.86
	3	8	27.19	31.47	25.64	21.83	18.55	18.09	15.24	158.01
	4	11	9.23	10.88	18.17	25.41	22.61	16.43	13.43	116.16
	Max. of Exhaust		27.19	31.47	25.64	27.18	23.44	18.45	15.66	158.01
	Avg. of Exhaust		**10.24**	**13.89**	**17.65**	**19.46**	**16.91**	**13.80**	**11.54**	**103.48**
Over-all Maximum			27.19	31.47	25.64	27.18	29.53	33.50	29.13	172.77
Over-all Average			**12.56**	**16.46**	**19.72**	**22.55**	**23.68**	**23.49**	**13.72**	**132.19**

Sequence IVA Valve Train Wear Test

Camshaft Lobe Wear

LTMS Lab: B1	Test Key: 103249	Date Completed: 9/28/14
Industry Oil Code: 300		

7-Point Measurement Method, µm

Position	Cylinder	Lobe Number	14° BTC Wear, µm	10° BTC Wear, µm	4° BTC Wear, µm	0° (Nose) Wear, µm	4° ATC Wear, µm	10° ATC Wear, µm	14° ATC Wear, µm	Lobe Wear, µm
Intake	1	1	2.95	3.02	4.44	4.73	5.09	2.95	2.79	25.97
		3	2.26	2.79	4.40	4.45	4.29	2.48	2.35	23.02
	2	4	1.83	2.73	2.80	3.51	3.34	5.47	4.45	24.13
		6	2.25	3.43	5.28	5.86	8.29	2.43	1.76	29.30
	3	7	3.42	5.11	16.12	25.38	32.21	14.86	2.22	99.32
		9	3.39	4.19	4.46	4.99	5.00	3.14	2.16	27.33
	4	10	2.96	3.45	5.31	6.33	6.27	3.11	2.85	30.28
		12	3.28	3.75	5.23	6.16	5.67	2.36	3.29	29.74
	Max. of Intake		3.42	5.11	16.12	25.38	32.21	14.86	4.45	99.32
	Avg. of Intake		**2.79**	**3.56**	**6.01**	**7.68**	**8.77**	**4.60**	**2.73**	**36.14**
Exhaust	1	2	3.46	3.45	3.32	3.75	3.88	3.64	3.27	24.77
	2	5	3.09	3.51	4.05	4.64	5.56	5.49	4.55	30.89
	3	8	6.52	48.36	50.22	45.75	36.89	29.07	24.94	241.75
	4	11	47.04	51.55	53.97	50.42	41.38	33.57	27.83	305.76
	Max. of Exhaust		47.04	51.55	53.97	50.42	41.38	33.57	27.83	305.76
	Avg. of Exhaust		**15.03**	**26.72**	**27.89**	**26.14**	**21.93**	**17.94**	**15.15**	**150.79**
Over-all Maximum			47.04	51.55	53.97	50.42	41.38	33.57	27.83	305.76
Over-all Average			**6.87**	**11.28**	**13.30**	**13.83**	**13.16**	**9.05**	**6.87**	**74.36**

Sequence IVA Valve Train Wear Test

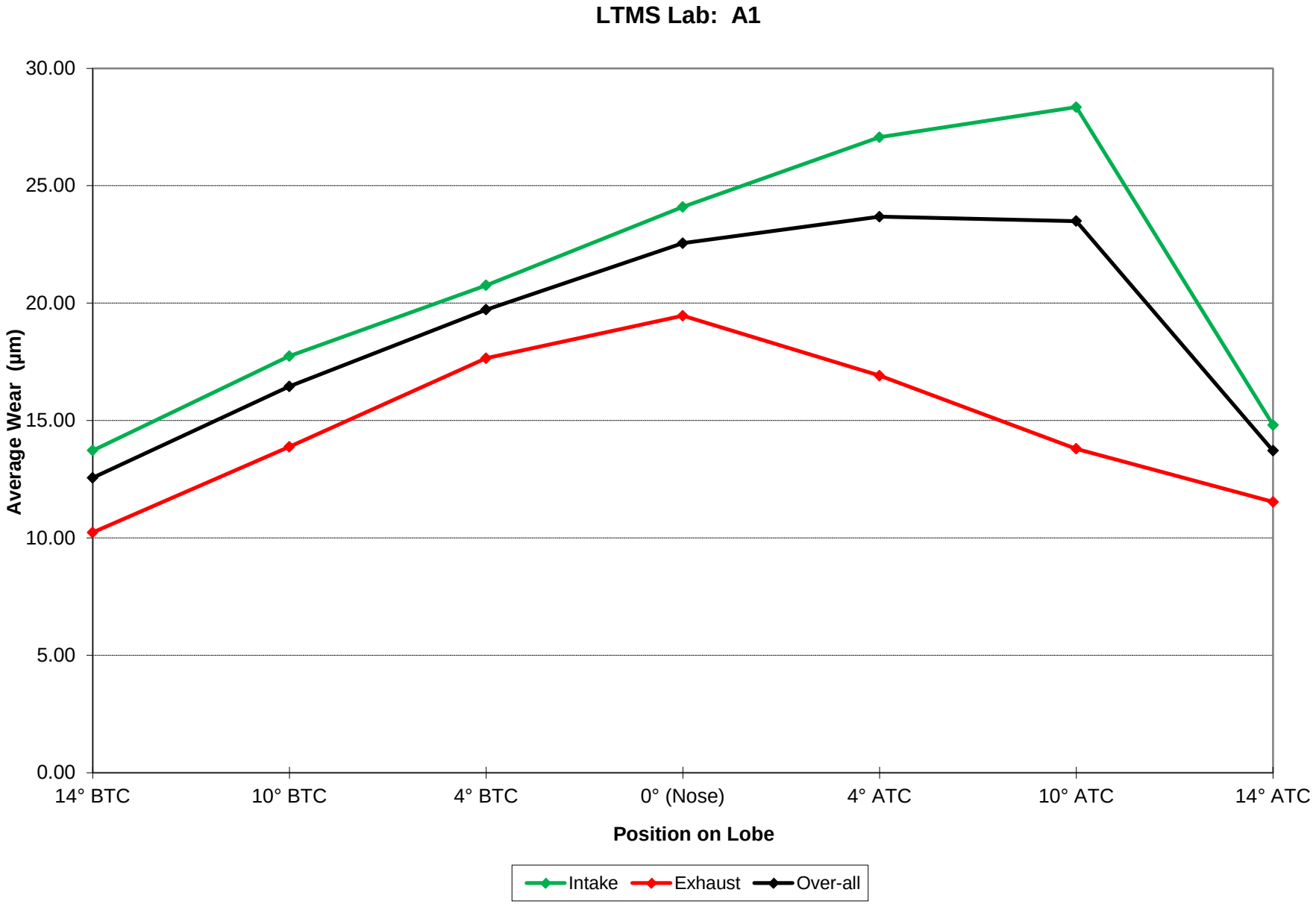
Camshaft Lobe Wear

LTMS Lab: F	Test Key: 103247	Date Completed: 9/30/14
Industry Oil Code: 300		

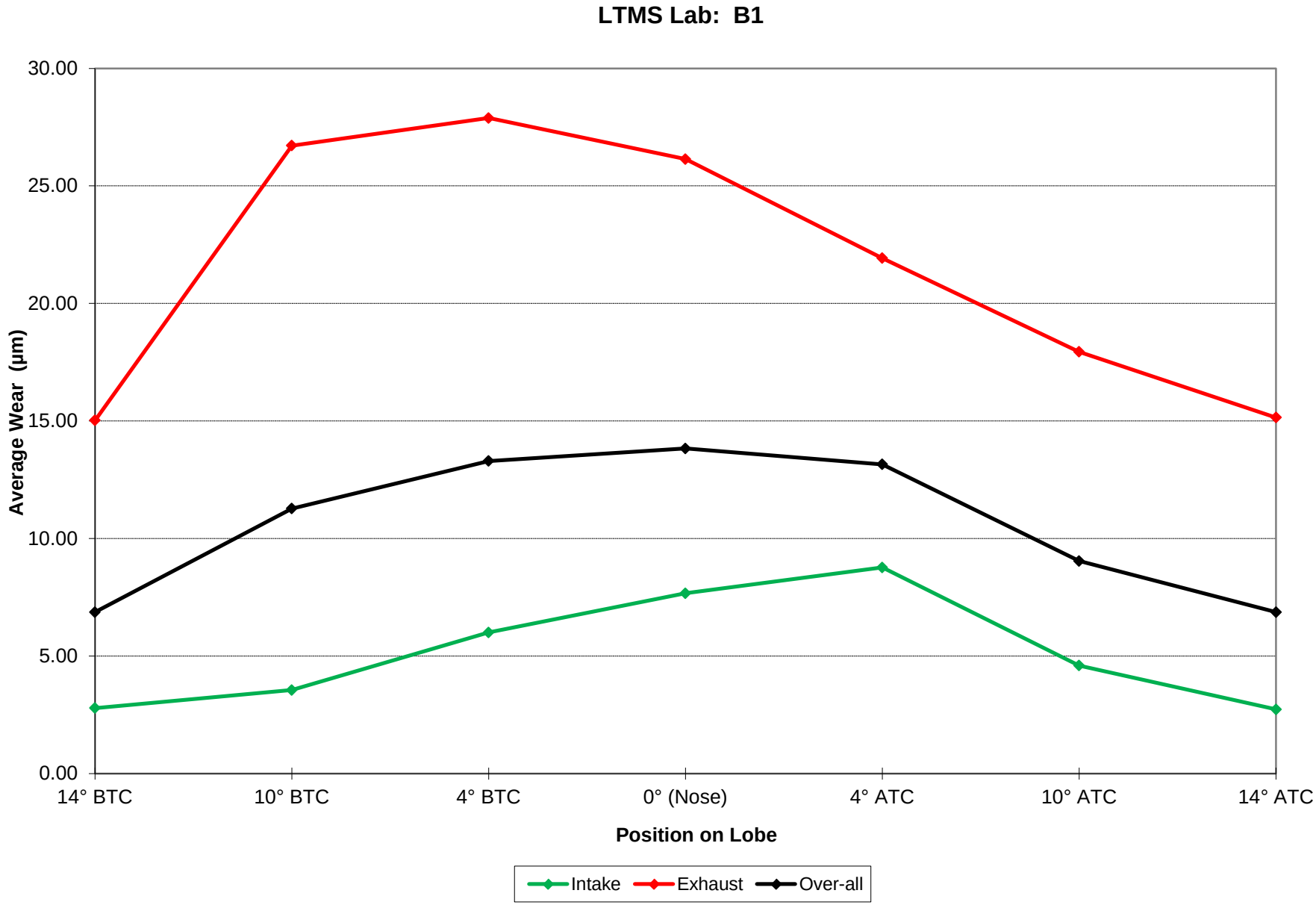
7-Point Measurement Method, µm

Position	Cylinder	Lobe Number	14° BTC Wear, µm	10° BTC Wear, µm	4° BTC Wear, µm	0° (Nose) Wear, µm	4° ATC Wear, µm	10° ATC Wear, µm	14° ATC Wear, µm	Lobe Wear, µm
Intake	1	1	1.42	2.12	2.96	2.72	2.93	2.82	3.07	18.04
		3	2.21	2.02	2.45	3.89	3.44	2.06	2.45	18.52
	2	4	15.34	22.80	30.97	28.38	24.94	20.45	18.20	161.08
		6	15.77	27.52	29.19	26.67	23.02	21.01	17.71	160.89
	3	7	7.94	18.11	24.94	23.77	21.95	13.72	7.41	117.84
		9	1.81	2.59	2.96	3.02	2.15	2.91	2.70	18.14
	4	10	2.01	3.43	3.97	3.31	3.61	2.59	1.71	20.63
		12	2.56	3.44	2.56	2.82	2.29	1.99	2.06	17.72
	Max. of Intake		15.77	27.52	30.97	28.38	24.94	21.01	18.20	161.08
	Avg. of Intake		**6.13**	**10.25**	**12.50**	**11.82**	**10.54**	**8.44**	**6.91**	**66.61**
Exhaust	1	2	15.11	19.28	22.43	24.64	22.77	9.02	2.47	115.72
	2	5	2.93	3.08	3.78	4.13	2.72	1.89	2.21	20.74
	3	8	18.38	18.07	18.93	21.89	24.96	16.51	10.40	129.14
	4	11	17.24	19.18	21.52	24.97	29.30	17.80	2.86	132.87
	Max. of Exhaust		18.38	19.28	22.43	24.97	29.30	17.80	10.40	132.87
	Avg. of Exhaust		**13.42**	**14.90**	**16.67**	**18.91**	**19.94**	**11.31**	**4.49**	**99.62**
Over-all Maximum			18.38	27.52	30.97	28.38	29.30	21.01	18.20	161.08
Over-all Average			**8.56**	**11.80**	**13.89**	**14.18**	**13.67**	**9.40**	**6.10**	**77.61**

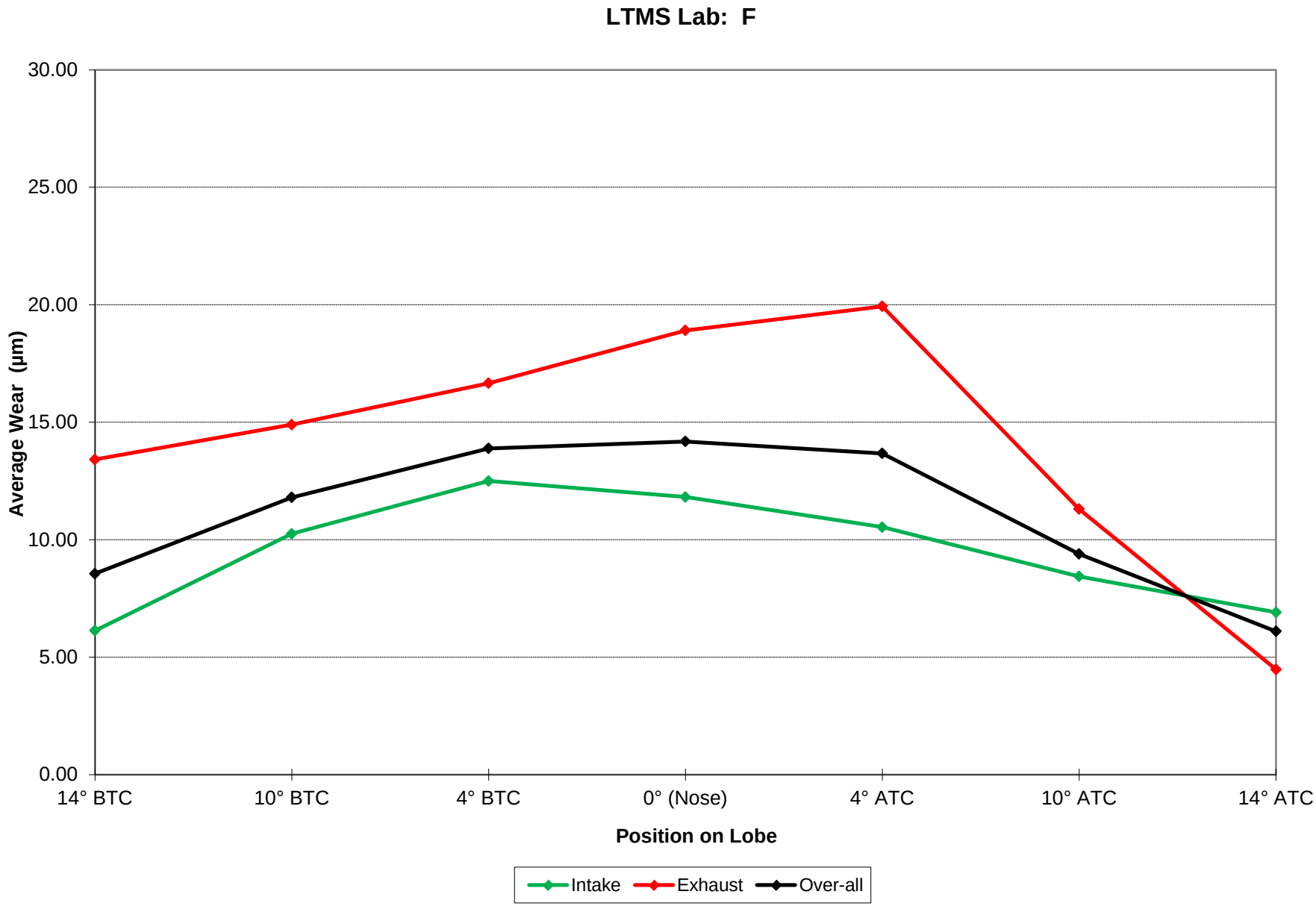
Sequence IVA: Camshaft Lobe Wear Profiles



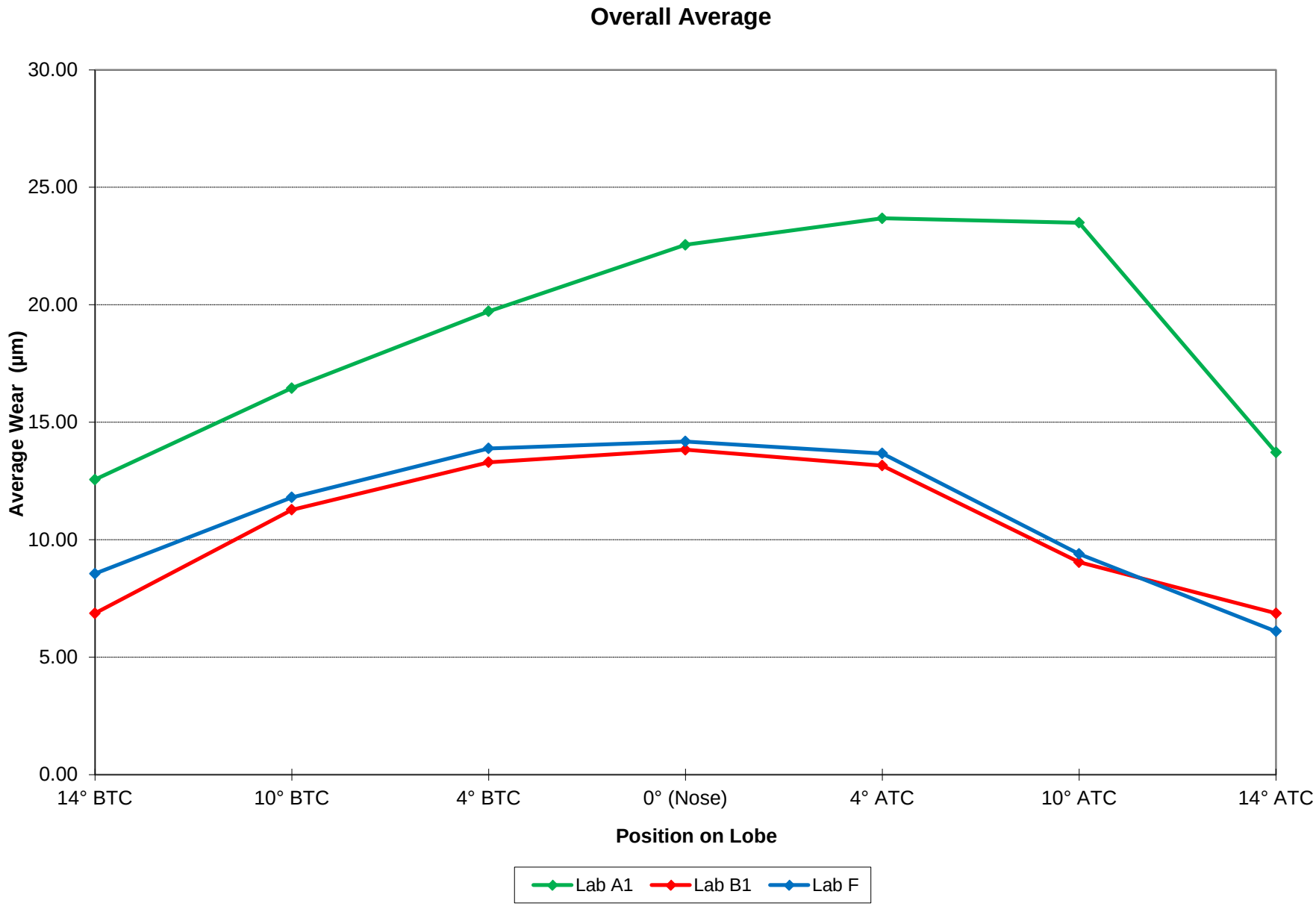
Sequence IVA: Camshaft Lobe Wear Profiles



Sequence IVA: Camshaft Lobe Wear Profiles



Sequence IVA: Camshaft Lobe Wear Profiles



Attachment 5

ASTM Sequence IV Surveillance Panel

Scope and Objectives

Scope

The Sequence IV 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. Pursue engine mounting and driveline identification, optimization and maintenance procedure and interval.	*On-going*
2. Introduce GF-5 technology reference oil 300.	*Dec 2014*

William A. Buscher III, Chairman
Sequence IV Surveillance Panel

Updated: Oct. 2014

SOUTHWEST RESEARCH INSTITUTE®

SwRI IVB Proposed Experimental Designs

10/16/14

Proposed Factors

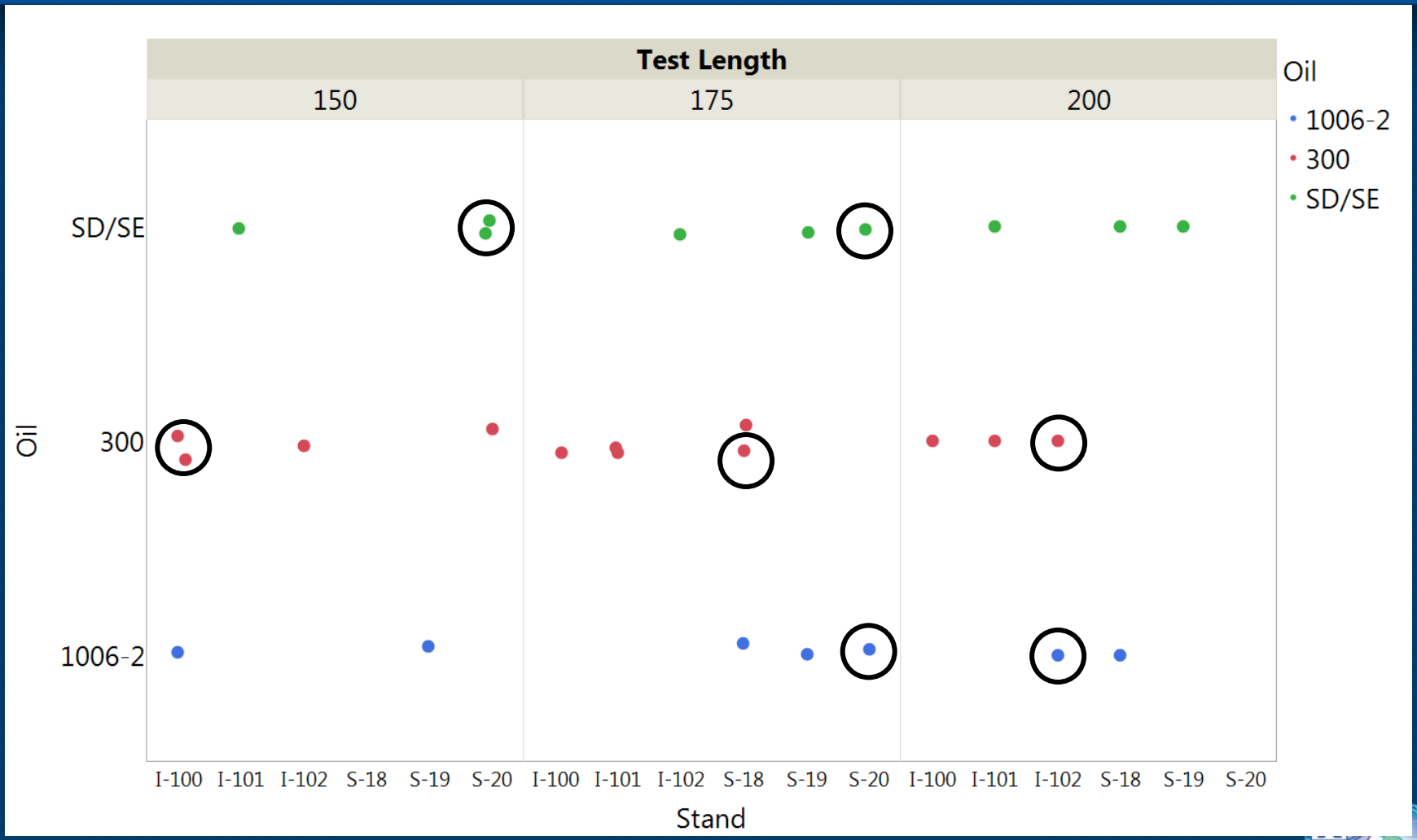
1. Oils
   - 1006-2
   - 300
   - SD/SE
2. Test Length
   - 150 hrs
   - 175 hrs
   - 200 hrs
3. Labs/Stands
   - SwRI (3 stands labeled S-18, S-19, S-20)
   - Intertek (3 stands labeled I-100, I-101, I-102)
4. Fuel
   - KA24E Green (all tests run to date are with this fuel)

Proposed Design

- Working from previous Design #5
  - –Linear + one interaction (assumes only one fuel)
    Stand, Oil, Test Length and Oil*Test Length
- Design #5b – additional Test Length level (200 hrs)
  Stand, Oil, Test Length and Oil*Test Length

N = 24 unique combinations
+ 2 repeats already run
+ 2 repeats at each lab for Oil 300 @175 hrs
Total = 28 tests

Design #5b:28 Tests
9 Completed



Linear + one interaction (assumes one fuel):
Stand, Oil, Test Length and Oil*Test Length

Design #5b Proposed Test Matrix (run order not included)

Run	Stand	Oil	Test Length	Already Run?
1	I-100	300	150	Yes
2	I-100	300	150	Yes
3	I-100	1006-2	150	
4	I-100	300	175	
5	I-100	300	200	
6	I-101	SD/SE	150	
7	I-101	300	175	
8	I-101	300	175	
9	I-101	300	200	
10	I-101	SD/SE	200	
11	I-102	300	150	
12	I-102	SD/SE	175	
13	I-102	300	200	Yes
14	I-102	1006-2	200	Yes
15	S-18	300	175	Yes
16	S-18	300	175	
17	S-18	1006-2	175	
18	S-18	1006-2	200	
19	S-18	SD/SE	200	
20	S-19	1006-2	150	
21	S-19	1006-2	175	
22	S-19	SD/SE	175	
23	S-19	SD/SE	200	
24	S-20	300	150	
25	S-20	SD/SE	150	Yes
26	S-20	SD/SE	150	Yes
27	S-20	1006-2	175	Yes
28	S-20	SD/SE	175	Yes
Note	Repeats			

Sequence IVB Test Specification

Stage	1	1.1	2	2.1
Time, seconds	7	8	7	8
Controlled Parameters				
Dyno_Speed	800 ± 25	700 to 4400	4300 ± 25	700 to 4400
Eng Load	25 ± 2	22 to 28	25 ± 2	22 to 28
Oil Gallery T	53 ± 3	50 to 58	55 ± 3	50 to 58
Eng Coolant In T	49 ± 3	49 ± 3	49 ± 3	49 ± 3
Coolant Delta T	2 ± 1	1 to 6	5 ± 1	1 to 6
Inlet (Intake) Air T	32 ± 3	32 ± 3	32 ± 3	32 ± 3
Fuel T	32 ± 3	32 ± 3	32 ± 3	32 ± 3
Exh Gas Pr	103.5 ± 1	98 to 118	104.5 ± 1	98 to 118
Inlet (Intake) Air Pr	0.07 ± 0.02	-0.05 to 0.20	0.07 ± 0.02	-0.05 to 0.20
Rocker Cover Coolant Out T	20 ± 2	20 ± 2	20 ± 2	20 ± 2
Load Cell T	45 ± 3	45 ± 3	45 ± 3	45 ± 3
Humidity	11.5 ± 0.5	11.5 ± 0.5	11.5 ± 0.5	11.5 ± 0.5
Uncontrolled Parameters (Typical Ranges)				
Eng Coolant Pr	70 ± 10	70 ± 10	70 ± 10	70 ± 10
Fuel Pr	325 ± 75	325 ± 75	325 ± 75	325 ± 75
Oil Gallery Pr	125 ± 25	100 to 350	325 ± 25	100 to 350
Rocker Cover Gas Flow	10 ± 3	1 to 20	10 ± 3	1 to 20
Fuel Flow	0.75 ± 0.25	0.5 to 7.0	4.50 ± 0.25	0.5 to 7.0
Air Fuel Ratio	14.5 ± 0.5	12 to 17	14.5 ± 0.5	12 to 17

TOYOTA

Sequence IVB Development Update

AOAP
October 15, 2014

Teri Kowalski

Highlights of Update

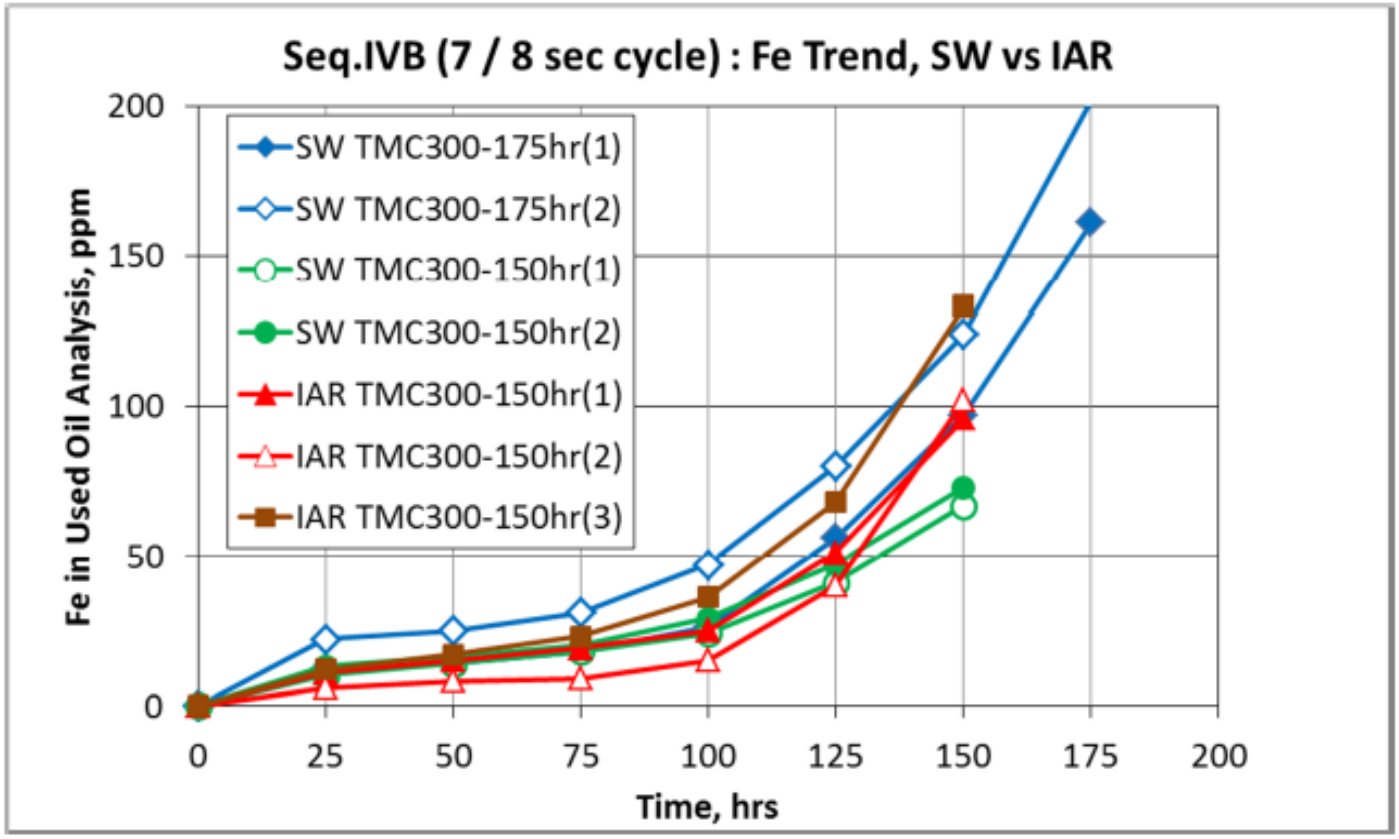
TOYOTA

- Reproducibility Study
  - IAR completed TMC300 tests on 3 test stands.
  - These are comparable to past SW results as Fe trends.
  - Wear measurements will be reported after the final fix of PDI surface measurement equipment.

- Fix of PDI Surface Measurement Equipment
  - Different version of software gave different wear results
  - PDI is working on the software fix
  - Once it is fixed, we restart the prove-out matrix

Reproducibility among Test Stands

TOYOTA



Highlights of Update

TOYOTA

- Matrix Design
  - Variables :
    - Test Stand (3 stands from SW, 3 stands from IAR)
    - Test Oil (TMC1006-2, TMC300, SD/SE Oil (Poor Oil))
    - Test Length (150hr vs 175hr)
    - Interaction between Oil and Test Length
  - Number of Test Runs
    - Total 21 tests
      - 7 data points can be included from existing results.
      - 14 tests need to be run to complete over 6 test stands

Intertek

Valued Quality. Delivered.

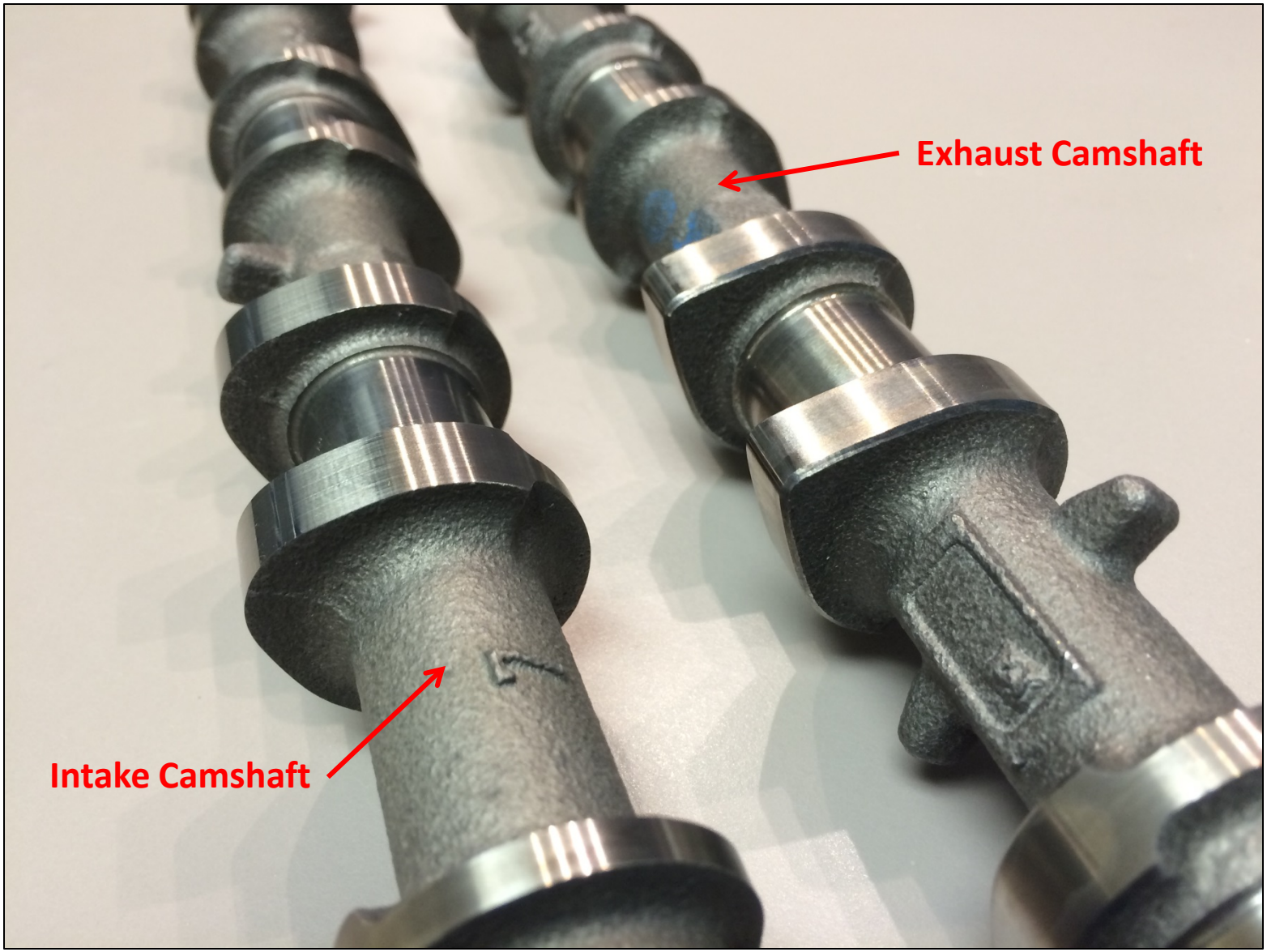
Sequence IVB

Camshaft Lobe and Lifter Photos

Camshaft Lobes
Intake and Exhaust

Intertek

Valued Quality. Delivered.



Camshaft Lobes
Intake and Exhaust

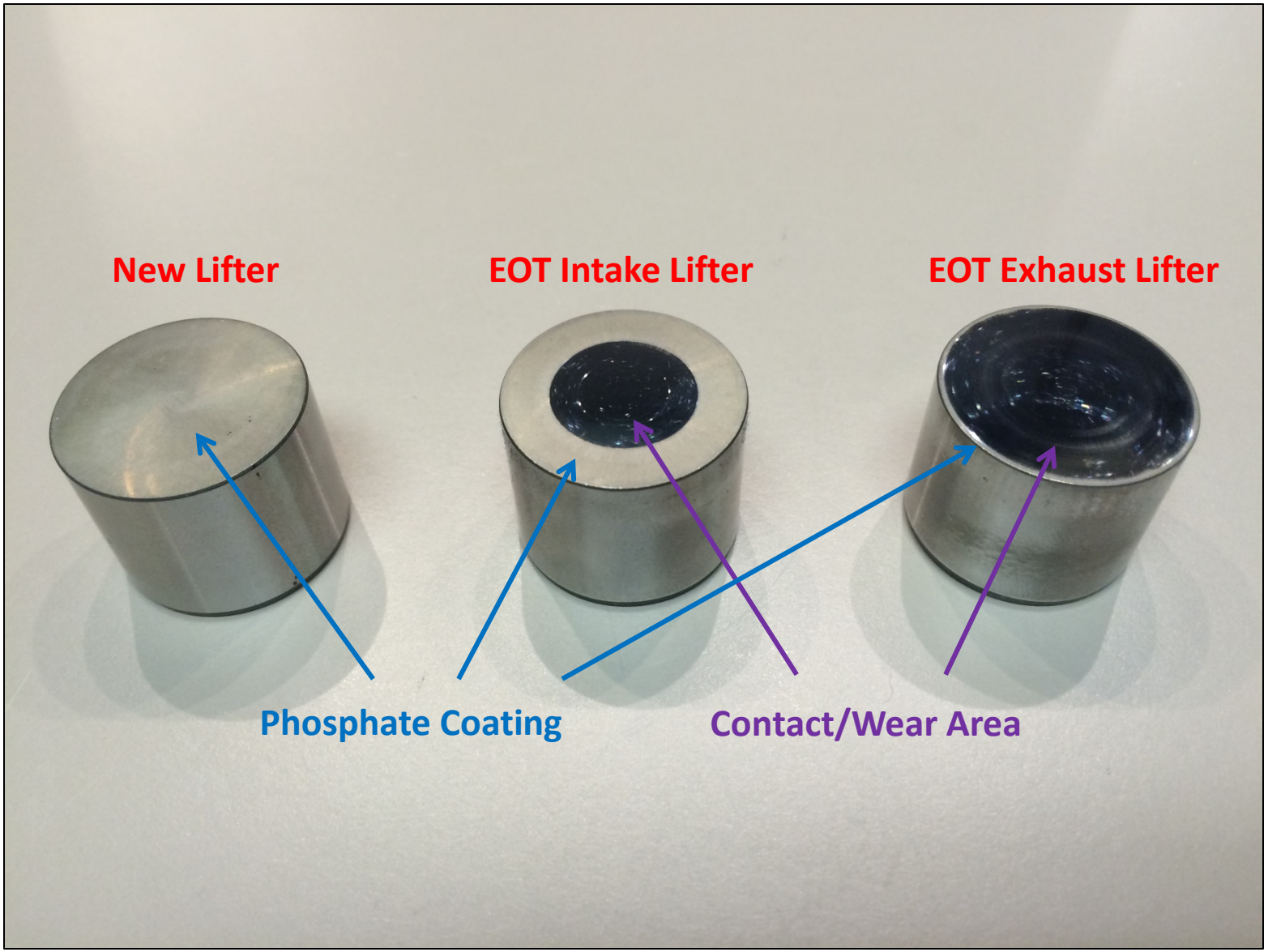
Intertek

Valued Quality. Delivered.

New and EOT Lifters
Angled Side View

Intertek

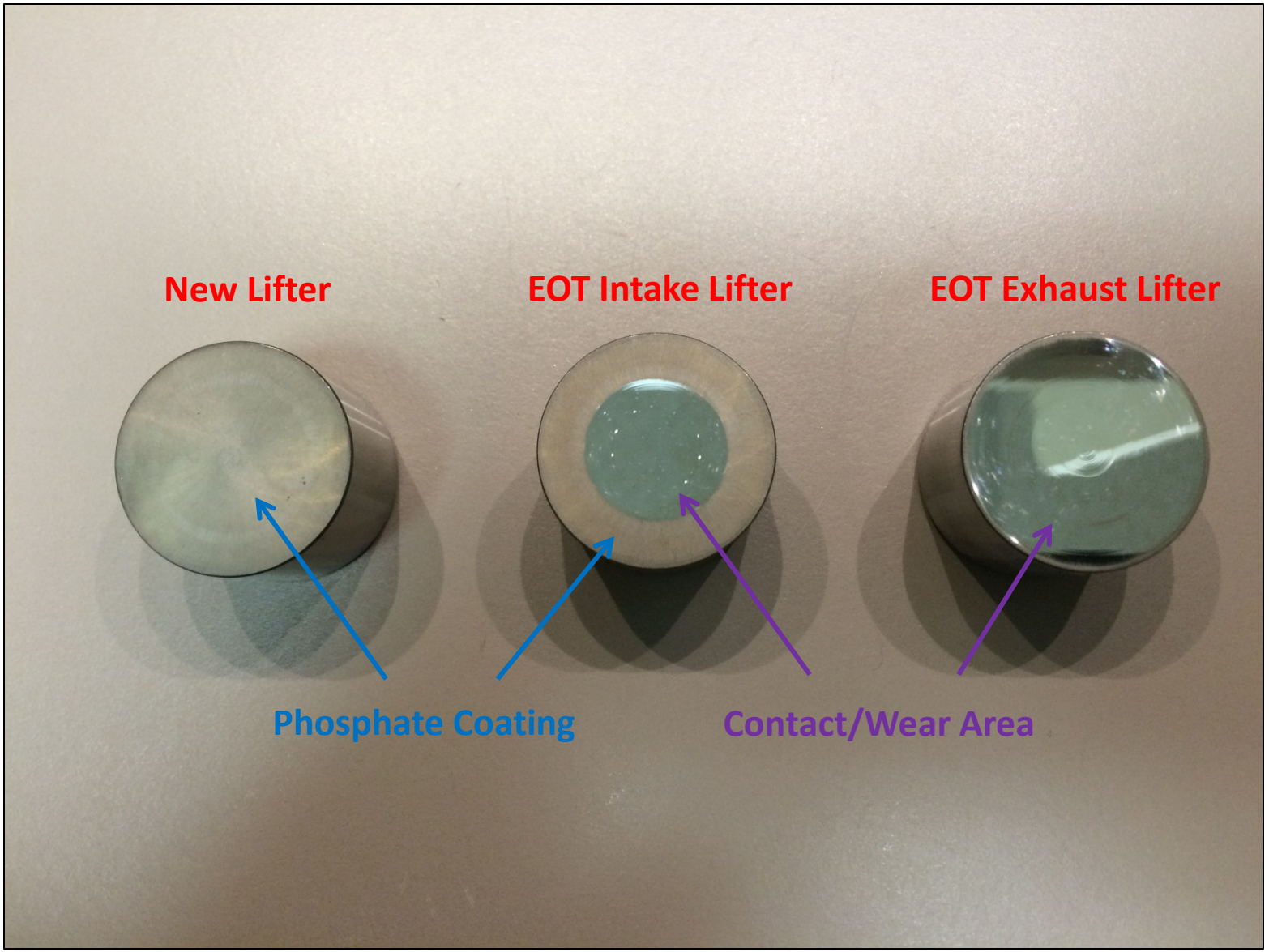
Valued Quality. Delivered.



New and EOT Lifters
Top View

Intertek

Valued Quality. Delivered.



Attachment 9

ASTM New Test Type Introduction Template

Items rated as "A" status and marked with * require supporting documentation to be attached

1.0 Action Plan

1.1 Reference Oils

1.1.1 Do the majority of reference oils represent current technology? X

1.1.2 Are the majority of reference oils of passing or borderline pass/fail performance? X

1.1.3 Is reference oil supply and distribution handled through ASTM/TMC? X

1.1.4 Is a quality control plan defined and in place? X

1.1.5 Is a turnover plan defined/in place to ensure uninterrupted supply of reference oil and an orderly transition to reblends? X

1.1.6 Is a process for introducing replacement reference oils defined and in place? X

1.1.7 Are oils blended in a homogeneous quantity to last 5 years? X

1.1.8 How many reference oil are there and what are the identifying oil codes?
Fill out.

Comments:
Add comments if needed.

2.0 Test Parts

2.1 Are all critical parts identified? X

2.1.1 List the parts consider as critical. Fill out.

2.2 Is a system defined/in place to maintain uniform hardware? X*

2.3 Is there a system for engineering support and test parts supply? X

2.3.1 How many tests can be run with the supply of parts currently in stock?
Fill out.

2.4 Are critical parts distributed through a Central Parts Distributor (CPD)? X

2.5 Are critical parts serialized, and their use documented in test report? X

2.6 Are all parts used on a first in/first out basis? X

2.7 Are all rejected critical parts accounted for and returned to the CPD? X

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action; E - TBD

2.8 Does the CPD make status reports to the test surveillance body at least semi-annually? X

2.9 Is there a quality control and turnover plan in place for critical test parts, including identification and measurement of key part attributes, a system for parts quality accountability, a turnover plan in place for simultaneous industry-wide use of new parts or supply sources? X*

2.10 Is the CPD active in industry surveillance panel/group, and in industry sponsored test matrices? X

Comments:
Add comments if needed.

3.0 Test Fuel

3.1 Is the fuel specified and the supplier(s) identified? X

3.1.1 Who is the fuel supplier? Fill out.

3.2 Is a process in place to monitor fuel stability over time? X*

3.3 Are approval guidelines in place for fuel certification? X*

3.4 If the test fuel is treated as a critical part of the test procedure: Is an approval plan and severity monitoring plan for each fuel batch in place? X*

3.5 Is a quality control plan defined and in place to assure long term quality of the fuel? X*

3.6 Is a turnover plan defined, in place and demonstrated to ensure uninterrupted supply of fuel? X*

Comments:
Add comments if needed.

4.0 Test Procedure

4.1 Is a technical report published documenting, per ASTM Flow Plan:

4.1.1 Test precision for reference oils? X*
4.1.2 Field correlation? X*
4.1.3 Test development history? X*

4.2 Are test preparation and operation clearly documented in an ASTM standard format? X*

4.3 Are test stand configuration requirements documented and standardized? X*

4.4 Are milestones for precision improvements established? X*

4.5 Are routine engine builder workshops planned/conducted? X

4.5.1 How often and by whom? Fill out.

Comments:
Add comments if needed.

5.0 Rating and Reporting of Results

5.1 Are the reported ratings from single raters (i.e. not averages from various raters)? X

5.2 Is a suitable severity adjustment system in place? X*

5.3 Is each pass/fail parameter unique and have a significant purpose for judging engine oil performance? X

5.3.1 List the pass/fail parameters. Fill out.

5.4 Do all rate and report parameters judge operational validity, help in test interpretation or judge engine oil performance? X

5.5 Are routine rater workshops conducted/planned? X

5.5.1 How often and by whom? Fill out.

Comments:
Add comments if needed.

6.0 Calibration, Monitoring and Surveillance

6.1 Is a process in place for independent monitoring of severity and precision with an action plan for maintaining calibration of all laboratories? X*

6.2 Are stand, lab, and industry reference oil control charts of all pass/fail criteria parameters used to judge calibration status? X*

6.3 Does the specified calibration test interval allow no more than 15 non-reference oil tests between successful calibration tests? X

6.4 Is an ASTM Surveillance Panel in place? X

6.4.1 Who is chairman? Fill out.

Comments:
Add comments if needed.

7.0 Test prove out data

7.1 Has a test development Task Force/TMC visit been made to each of the labs that will participate in the industry precision matrix? X

7.2 Have prove out tests been run with the finalized test procedure and test parts? X*

7.2.1 How many labs and stands? Fill out.

Comments:
Add comments if needed.

Attachment 10

Sequence IV Surveillance Panel
October 22, 2014
8:00AM – 12:00PM
Southwest Research Institute
San Antonio, TX

Motions and Action Items
As Recorded at the Meeting by Al Lopez

1. Action Item – Run 3 more donated tests on oil 300. TMC to grant reference extensions for the test stands used on a one for one basis. Tests to be conducted on currently calibrated stands and currently calibrated cam batches. A conference call will be scheduled to discuss the results.