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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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February 13, 2009

Reply to:
Donald T. Bartlett
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29400 Lakeland Blvd.
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ASTM D02.B0.03 L-37 Surveillance Panel
Members and Guests:

Attached for your review and comment are the unconfirmed minutes of the:

- **February 11, 2009 L-37 Surveillance Panel Meeting conducted at the PRI Headquarters, Apollo Room, Warrendale, PA.**

Please direct any corrections or comments to my attention.

Sincerely,


Donald T. Bartlett, Chairman
L-37 Surveillance Panel
Attachments

**Report of Meeting
L-37 Surveillance Panel
Warrendale, PA
PRI Apollo Room**

February 11, 2009

Sign-in/Review of Agenda & Membership: The meeting was called to order at 03:05 p.m. The sign-in sheet is included as **Attachment # 1**. Joining via teleconference were, from Dana; Miller, Guzikowski, Basset, Pappademos; From Afton, Koglin. **Attachment # 2** is the PowerPoint presentation handout provided prior to the meeting. The chairman led the panel through an agenda review (see slide 2, attach 2). There were no changes to the agenda.

The voting membership list was reviewed in detail. Mike Haire is replacing Juan Buitrago for Chevron Global Lubricants. Jim Linden (GM) and Salvatore Rea (Infineum) asked to be removed as their individual/company roles have now changed. We now have 13 voting members. (slide 3, attach 2).

Approval of Minutes:

- **November 12, 2008 SP Meeting.**

Motion # 1 ⇒ Mr. Smith/second Mr. Koehler to approve the minutes as presented. Motion for approval as written was unanimous with a vote of 8 for, 0 opposed, and 0 abstentions.

Summary of Meeting Discussions

Retrofit Ring & Pinion Hardware Update - Slides 4, through 6 of attach 2:

The total count of ring and pinion needs for the three hardware type retrofits is 2167.

Gropp questioned if it has been agreed that all rebuilding would be done at the Maumee facility. Chairman Bartlett replied that the answer was yes and was documented in earlier HTF minutes.

Dana Update: The Pinions steel melt is scheduled for February 22nd, role the heat March 1, Inspect March 9th, Delivery to Dana March 15th, Forging form March 22nd.

Pappademos: Dana would like to see an outline on how we will approve the first "pilot" build, pilot gear matrix testing, and provide approval to go ahead with final full production and retrofit. Panel discussion as follows:

Pilot Batch Matrix proposal:

- 1) Ft. Wayne, process 20 ring and 20 pinions to duplicate the P4L792/V1L417-2005 batch.
 - a. 10 non-lubrited
 - b. 10 lubrited (use custom coatings)
 - c. Assemble & ship non-lubrited retrofit to each of 4 labs first so testing can immediately commence
 - d. Assemble & ship lubrited retrofit to each of 4 labs second and test
 - e. **Lind** – freedom to assign oils to labs to best fit testing needs.

2) Reference tests to be conducted totaled 14 tests at four labs on both hardware types. The extra hardware would/could be used to cover any aborted tests or other test needs identified by the panel. Here is the proposed plan:

a. TMC 152	- 2 runs non-lubrited	- 2 runs Lubrited
b. TMC 153	- 2 runs non-lubrited	- 2 runs Lubrited
c. TMC 155	- 2 runs non-lubrited	- 2 runs Lubrited
d. TMC 134	<u>- 1</u> run non-lubrited	<u>- 1</u> run Lubrited
Total	7	7

- 3) Bartlett to work with Horvath (Maumee) to insure both lubrited and non-lubrited hardware is available for retrofit at Maumee facility. **We must not allow mixing of lubrited and non-lubrited housings and batch lot hardware** for consistency and standardization concerns.
- 4) The Panel decided that we do not want to run low temperature testing at this point in time. We will do that as part of the final matrix.
- 5) Dana to perform full measurements per normal builds to insure consistency and success.
- 6) It was presumed it would take 1 week to ship axles and that the labs would work diligently to run the tests within 2 weeks after receipt of the axles.

Action Item # 1 ⇒ **Bartlett / Panel** – Conduct a Panel teleconference on February 19th at 10:00 a.m. EST to finalize all details and timing for hardware retrofitting and matrix testing. **Call in information is 608-250-0194, code - 324160**

Chipping Definition – See slides 7 through 12, attachment 2

Bartlett – reviewed the Fett & Miller prior description discussions of the phenomena we are seeing. With respect to the Rater Calibration Monitoring System (RCMS), gear sets 44 and 45 are pinions that were removed because they were initially rated as pitting and now some raters are rating them as chipping. This will have some rater & lab severity impact in the RCMS system as well as candidate final results.

Slide 10 details the proposal by the raters from the January 2009 Calibration workshop.

Slide 11 details the HTF proposal.

There was much discussion in the panels attempt to word a motion that all could vote on. Here is the modified proposal:

Chipping, n – Ring and pinion gears - A condition caused in the manufacturing process in which a small irregular cavity is present only at the crown edge interface. The edge-chipping phenomenon occurs when sufficient fatigue cycles accumulate after tooth surface wear relieves the compressive residual stress on the tooth profile side of the profile-to-topland interface. Do not rate this as pitting.

- Note 1: If connected, these chipping cavities may be greater than one square millimeter. This should not be rated as spalling.
- Note 2: If chipping is connected to spalling, this spalling must be included in the final rating.
- Note 3: Chipping shall not extend from the crown edge greater than 4 sq. mm (trace to light) and can be confirmed using the spalling template from CRC manual 21.

The definition would need a motion, approval, issuance as an Information Letter and require a CRC manual update. The effective date of the Information Letter would be 30 days after the date of the information letter.

Action Item # 2 ⇒

- **Bartlett** – directed to document, publish final proposal (see above), and address with the Panel during the Thursday, February 19th Panel teleconference meeting.
- **Lind** – To measure the RCMS pinions 44 and 45 and propose a spalling level for the raters to use to address note 3 above.
- **Panel** - Recommend a process for reintroduction of the two pinions (44 and 45) back into the RCMS process. It is important that these two pinions be included as there are candidates exhibiting similar chipping phenomena.

January 2009 Rater Calibration Review – TMC

Note that there was not time left for review. See Attachment # 3 (Ring Gears) and Attachment # 4 (pinions) which summarizes the workshop data. Overall the data looks most promising. If there are any questions, please call the TMC.

New Business – Standardization of Percent Deviation Equation

Greene - Consistent with the findings in his review of all of the procedures, **Attachment # 5** details the proposal to standardize all procedures to use the specific formula as used in the L-60-1 and OSCT test centers.

Motion # 2 ⇒ Koehler / Smith - Adopt Deviation Percent equation from the L-60-1 (D5704) for further clarification and standardization. Effective date was 30 days from the date of the information letter. The vote was unanimous, 7-0-1

L-37 SP Chairmanship

Bartlett – thanked the surveillance panel, Dana, Labs, and TMC for all of their short and long-term support, guidance, and successes we have achieved over the many years. He indicated that his role was changing and other opportunities are approaching. There was a motion from the floor for nomination of GaleneGreene of Lubrizol to be chairman. The motion was passed unanimously.

Being no further business, Mr. Koehler/second Mr. Haire motioned to adjourn the meeting at 4:18 p.m.

Respectfully submitted,



Donald T. Bartlett
L-37 Surveillance Panel Chairman

ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: February 11, 2009

Initials*	Name	Voting Status	Company Name & Address	Phone/Email Info
	Agusti, Rachel	Non Voting	AMSTA-TR-D/210 Tank Automotive & Armament 6501 East 11 Mile road Warren, MI 48397-5000	Phone: 586-574-4222 Fax: 586-574-4244 E-Mail: rachel.agusti@us.army.mil
	Barker, Chris	Non Voting	Southwest Research Institute PO Drawer 28510 San Antonio, Texas 78228-0510	Phone: 210-522- Fax: 210-684-7523 E-Mail: chris.barker@swri.org
<i>DTB</i>	Bartlett, Don	Voting/Chair	The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, Ohio 44092	Phone: 440-347-2388 Fax: 440-347-2878 E-Mail: donald.bartlett@lubrizol.com
<i>DB</i>	Bell, Don	Non Voting	Afton Chemical 500 Spring Street Richmond, VA 23219	Phone: 804-788-6332 Fax: 804-788-6243 E-Mail: don.bell@aftonchemical.com
	Bryson, Tom	Voting	Mack Trucks 13302 Pennsylvania Avenue Hagerstown, Maryland 21740	Phone: 301-790-6744 Fax: 301-790-5605 E-Mail: thomas.bryson@volvo.com
	Comfort, Allen	Voting	AMSTA-TR-D/210 Tank Automotive & Armament 6501 East 11 Mile road Warren, MI 48397-5000	Phone: 586-574-4225 Fax: 586-574-4244 E-Mail: allen.s.confort@us.army.mil
<i>JD</i> <i>Spee.com</i>	Dharte, John	Voting	American Axle & Manufacturing 2965 Technology Drive Rochester Hills, MI 48309-3589	Phone: 248-299-6478 Fax: 248-293-6945 E-Mail: Dhartej@aam.com
<i>lwz.</i>	Eliot, Stephen	Non Voting	ExxonMobil Lubricants & Specialities 18486 Lanier Island Sq. Leesburg, Virginia 20176	Phone: 703-669-9916 Fax: 703-669-9917 E-Mail: stephen.w.eliot@exxonmobil.com

Attachment /
Page 1 of 5
Reference L-37
2/11/09

* Initial to indicate attendance at subject meeting

ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: February 11, 2009


Initials*	Name	Voting Status	Company Name & Address	Phone/Email Info
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	Gao, Hong	Non-Voting	Conoco Phillips 100 s Pine St. Ponca City, OK 74602	Phone: 580-767-2126 Fax: 580-767-4534 E-Mail: hong.gao@conocophillips.com
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<i>MA</i>	Haire, Mike	Voting	Chevron Oronite Company 100 Chevron Way, Rm 71-7302 Richmond, California 94802	Phone: 510-242-2740 Fax: 510-242-3758 E-Mail: mhaire@chevron.com
	Higuchi, Sam	Non Voting	Afton Chemical 500 Spring Street Richmond, VA 23218	Phone: 804-788-5375 Fax: 804-788-6358 E-Mail: samuel.higuchi@aftonchemical.com
	Huron, John	Non Voting	Chevron Oronite Company LLC Suite 210 San Antonio, Texas 78228-1374	Phone: 210-731-5609 Fax: 210 731 5699 E-Mail: huro@chevrontexaco.com

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Attachment 1
Page 2 of 5
Page Reference 1-37
2/11/09

ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: February 11, 2009

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	Kanga, Percy	Non Voting	ExxonMobil Research & Engineering 600 Billingsport Road Paulsboro, New Jersey 08066	Phone: 856-224-2094 Fax: 856-224-3613 E-Mail: percy.r.kanga@exxonmobil.com
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	Lochte, Michael	Non Voting	Southwest Research Institute PO Drawer 28510 San Antonio, Texas 78228-0510	Phone: 210-522-5430 Fax: 210-684-7523 E-Mail: Mlochte@swri.org
	Marougy, Thelma	Voting	Eaton Corporation 26201 Northwestern Highway Southfield, MI 48034	Phone: 248-226-6985 Fax: 248-226-2739 E-Mail: thelmaemarougy@eaton.com
	Martin, Dan	Non Voting	The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, Ohio 44092	Phone: 440-347-4723 Fax: 440-347-2878 E-Mail: danmartin@lubrizol.com

* Initial to indicate attendance at subject meeting

Attachment 1
Page 3 of 5
Page Reference L-37
2/11/09

ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: February 11, 2009

Initials*	Name	Voting Status	Company Name & Address	Phone/Email Info
	Zakarian, Jack	Non Voting	Chevron Products 100 Chevron Way Richmond, CA 94802	Phone: 510-242-3595 Fax: 510-242-3758 E-Mail: jaza@chevron.com
<i>Tele</i>	<i>Guy Kenushi</i>			Phone: Fax: E-Mail:
<i>Tele</i>	<i>Bussert</i>			Phone: Fax: E-Mail:
<i>Tele</i>	<i>Appelbaum</i>			Phone: Fax: E-Mail:
				Phone: Fax: E-Mail:
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				Phone: Fax: E-Mail:
				Phone: Fax: E-Mail:

Attachment /
Page 5 of 5
Reference 4-37
2/11/09

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L-37 Surveillance Panel

PRI Headquarters,
Warrendale, Pa.

February 11, 2009

Donald Bartlett



L-37 SP Agenda

- I. Call to order
- II. Review Membership and Agenda
- III. Approve Minutes, November 12, 2008 Meeting
- IV. Retrofit Ring & Pinion Hardware Update
- V. Chipping Definition
- VI. January 2009 Rater Calibration Review – TMC
- VII. New Business
- VIII. L-37 Surveillance Panel Chairmanship
- IX. Adjournment

Attachment	<u>2</u>
Page	<u>10/B</u>
Reference	<u>L-37</u> <u>2/11/09</u>

L-37 Surveillance Panel Voting Members

Donald Bartlett	The Lubrizol Corporation (Chairman)
Tom Bryson	Volvo Power Train Corporation
Allen Comfort	AMSTA-TR-D/210 US Army Tacom-Tardec
John Dharte	American Axle & Manufacturing
Mike Haire	Chevron Oronite Company
Brian Koehler	Southwest Research Institute
Cory Koglin	Afton Chemical Company
Kenny Miller	Dana Corporation
Don Lind	ASTM Test Monitoring Center
Thelma Marougy	Eaton Corporation
Bruce McGlone	ArvinMeritor Materials Engineering
Dale Smith	Intertek-PARC Technical Services
Paula Vettel	D.A. Stuart Company

Total 13 Voting Members

2009 Ring & Pinion Retrofit Information

<u>Axle</u> <u>Type</u>	<u>Total</u> <u>Count</u>	<u>Ring</u> <u>Code</u>	<u>Pinion</u> <u>Code</u>	<u>Labs</u>
Lub – 2006	956	xxxxxx	yyyyyy	4
Lub – 2008	226	xxxxxx	yyyyyy	2
Plain – 2008	985	xxxxxx	yyyyyy	3
Total	2167			

Attachment	<u>2</u>
Page	<u>2 of 8</u>
Reference	<u>6-37</u> <u>2/11/09</u>

Dana Update

- Rings** – Presrite - they are scheduled to take delivery of the Timken material on February 23, 2009 and see forgings week of March 9th. They will forward a material certification to Basset once available.
- Pinions** – Colfor- reports that Mac Monroe is going to be rolling the correct size bar the week of February 23, 2009. They will be able to melt a heat that week. Heat code V1L500 was also a Mac Monroe heat.

Dana & Panel Decision

- Steel** - 'drop dead' date for looking vs. making new steel? *New order Feb 22.*
 - Production** - ?
 - Assembly** - ?
 - Matrix Test** - ?
 - Availability** - ?
- To Be determined after pilot Batch MATRIX.*

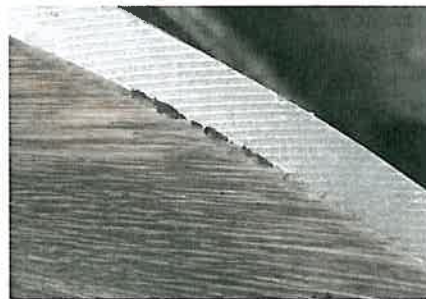
Attachment	<u>2</u>
Page	<u>348</u>
Reference	<u>A-37</u> <u>2/11/09</u>

Chipping Phenomena

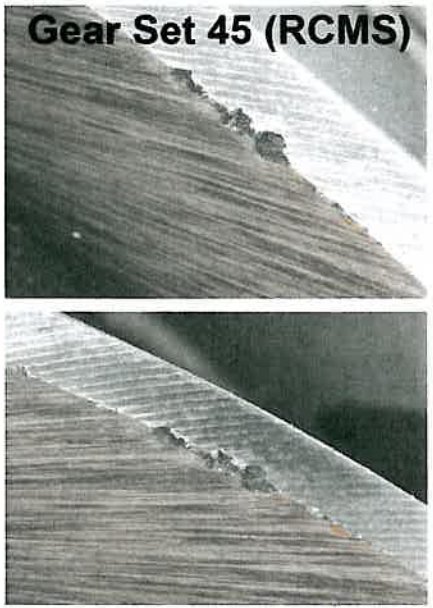
Fett/Miller comments:

- » The anomaly at the top of the L37 gear teeth is chipping and is a result of the wear on the tooth face and the compressive residual stress from the shot peening operation
- » The shot peening operation puts a considerable amount of compressive residual stress in the corner of the tooth tip which tends to make it want to crack or pop off
- » When there is wear on the tooth face the stress is relieved on one side only which tends to cause these cracks
- » These are not normal pitting which is associated with localized high contact stresses or poor lubricant performance

Gear Set 44 (RCMS)



Attachment	<u>2</u>
Page	<u>4 MB</u>
Reference	<u>L-37</u> <u>2/11/09</u>



Raters Proposal from January 2009 Calibration WS

Chipping, n--on-ring and pinion gears

- » A condition caused in the manufacturing process in which a small irregular cavity is present only at the crown edge. If connected, these cavities may be greater than one square millimeter. If chipping is connected to spalling, this spalling must be included in the final rating

Attachment	<u>2</u>
Page	<u>54/8</u>
Reference	<u>L-37</u> <u>2/11/09</u>

L-37 SP Agenda

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Since the November SP Meeting

- 9 Lab TF Teleconference Calls
- 0 HTF Facility Visits
- 0 SP Teleconference Calls
- Dana
- TMC
- Labs

Thank You !

Attachment	<u>2</u>
Page	<u>70/0</u>
Reference	<u>L-37</u> <u>2/11/09</u>

L-37 SP Agenda

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Attachment	<u>2</u>
Page	<u>2 of 3</u>
Reference	<u>L-37</u> <u>2/11/09</u>

ASTM Gear Calibration Workshop
San Antonio, TX January 20, 21, 22 & 23, 2009

L-37 RING GEARS

SET #	DISTRESS	4	6	7	10	11	22	25	27	28	29	30	31	32	33	MAX	MIN	AVG	Std Dev
1C	Ridging				6.0	5.0	6.0		5.0						5.0	6.0	5.0	5.40	0.548
	Rippling				8.0	9.0	10.0		9.0						8.0	10.0	8.0	8.80	0.837
	Wear				4.0	6.0	6.0		6.0						5.0	6.0	4.0	5.40	0.894
	Spitting				9.9	9.9	9.9		9.9						9.7	9.9	9.7	9.86	0.089
	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
2C	Ridging				10.0	9.0	10.0		10.0						10.0	10.0	9.0	9.80	0.447
	Rippling				10.0	10.0	9.0		9.0						10.0	10.0	9.0	9.60	0.548
	Wear				8.0	8.0	7.0		7.0						8.0	8.0	7.0	7.60	0.548
	Spitting				9.9	10.0	9.9		9.9						9.9	10.0	9.9	9.92	0.045
	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
3C	Ridging				9.0	9.0	9.0		9.0						10.0	10.0	9.0	9.20	0.447
	Rippling				10.0	10.0	10.0		9.0						10.0	10.0	9.0	9.80	0.447
	Wear				8.0	8.0	8.0		7.0						9.0	9.0	7.0	8.00	0.707
	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
4C	Ridging				10.0	10.0	10.0		9.0						10.0	10.0	9.0	9.80	0.447
	Rippling				10.0	10.0	9.0		9.0						10.0	10.0	9.0	9.60	0.548
	Wear				8.0	8.0	8.0		7.0						8.0	8.0	7.0	7.80	0.447
	Spitting				9.9	10.0	9.9		9.9						9.9	10.0	9.9	9.92	0.045
	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
5	Ridging				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
	Rippling				10.0	10.0	9.0		10.0						10.0	10.0	9.0	9.80	0.447
	Wear				9.0	9.0	8.0		8.0						8.0	9.0	8.0	8.40	0.548
	Spitting				9.9	10.0	9.9		9.8						9.9	10.0	9.8	9.90	0.071
	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
6	Ridging				8.0	9.0	9.0		9.0						9.0	9.0	8.0	8.80	0.447
	Rippling				10.0	10.0	9.0		10.0						9.0	10.0	9.0	9.60	0.548
	Wear				6.0	6.0	7.0		7.0						8.0	8.0	6.0	6.80	0.837
	Spitting				9.9	9.9	9.9		9.9						9.8	9.9	9.8	9.88	0.045
	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
7	Ridging				9.0	10.0	10.0		10.0						10.0	10.0	9.0	9.80	0.447
	Rippling				10.0	10.0	9.0		9.0						9.0	10.0	9.0	9.40	0.548
	Wear				8.0	8.0	8.0		8.0						8.0	8.0	8.0	8.00	0.000
	Spitting				10.0	9.9	9.9		9.9						9.8	10.0	9.8	9.90	0.071
	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
8	Ridging				9.0	10.0	9.0		10.0						10.0	10.0	9.0	9.60	0.548
	Rippling				10.0	10.0	9.0		10.0						10.0	10.0	9.0	9.80	0.447
	Wear				8.0	8.0	7.0		8.0						8.0	8.0	7.0	7.80	0.447
	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
9	Ridging				9.0	10.0	9.0		10.0						9.0	10.0	9.0	9.40	0.548
	Rippling				10.0	10.0	9.0		9.0						10.0	10.0	9.0	9.60	0.548
	Wear				8.0	7.0	7.0		7.0						8.0	8.0	7.0	7.40	0.548
	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000

Attachment 3
Page 1062
Reference L-37
2/11/09

ASTM Gear Calibration Workshop
San Antonio, TX January 20, 21, 22 & 23, 2009

L-37 RING GEARS

SET #	DISTRESS	4	6	7	10	11	22	25	27	28	29	30	31	32	33	MAX	MIN	AVG	Std Dev
10	Ridging				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
10	Rippling				10.0	10.0	9.0		9.0						10.0	10.0	9.0	9.60	0.548
10	Wear				8.0	8.0	7.0		7.0						8.0	8.0	7.0	7.60	0.548
10	Spitting				9.9	10.0	9.9		9.9						9.9	10.0	9.9	9.92	0.045
10	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
R1/6	Ridging				9.0	9.0	9.0		9.0						9.0	9.0	9.0	9.00	0.000
R1/6	Rippling				10.0	10.0	9.0		10.0						10.0	10.0	9.0	9.80	0.447
R1/6	Wear				6.0	6.0	7.0		7.0						8.0	8.0	6.0	6.80	0.837
R1/6	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
R1/6	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
R2/8	Ridging				9.0	10.0	9.0		10.0						10.0	10.0	9.0	9.60	0.548
R2/8	Rippling				10.0	10.0	10.0		10.0						9.0	10.0	9.0	9.80	0.447
R2/8	Wear				8.0	8.0	7.0		8.0						8.0	8.0	7.0	7.80	0.447
R2/8	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
R2/8	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
R3/9	Ridging				9.0	10.0	9.0		10.0						10.0	10.0	9.0	9.60	0.548
R3/9	Rippling				9.0	10.0	9.0		9.0						10.0	10.0	9.0	9.40	0.548
R3/9	Wear				8.0	7.0	7.0		7.0						8.0	8.0	7.0	7.40	0.548
R3/9	Spitting				9.9	9.9	9.9		9.8						9.9	9.9	9.8	9.88	0.045
R3/9	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000

Raters 27 and 33 are not rating L-37 reference or non-reference oil tests at their respective labs.

Attachment	<u>3</u>
Page	<u>20/2</u>
Reference	<u>L-37</u>
	<u>2/1/09</u>

ASTM Gear Calibration Workshop
San Antonio, TX January 20, 21, 22 & 23, 2009

L-37 PINION GEARS

SET #	DISTRESS	4	6	7	10	11	22	25	*27	28	29	30	31	32	*33	MAX	MIN	AVG	Std Dev
1C	Ridging				9.0	9.0	9.0		8.0						9.0	9.0	8.0	8.80	0.447
1C	Rippling				8.0	9.0	9.0		8.0						9.0	9.0	8.0	8.60	0.548
1C	Wear				7.0	6.0	6.0		6.0						5.0	7.0	5.0	6.00	0.707
1C	Spitting				9.9	9.9	9.9		9.9						9.8	9.9	9.8	9.88	0.045
1C	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
2C	Ridging				7.0	5.0	6.0		6.0						6.0	7.0	5.0	6.00	0.707
2C	Rippling				9.0	8.0	9.0		8.0						8.0	9.0	8.0	8.40	0.548
2C	Wear				6.0	5.0	6.0		6.0						4.0	6.0	4.0	5.40	0.894
2C	Spitting				8.0	8.0	8.0		8.0						8.0	8.0	8.0	8.00	0.000
2C	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
3C	Ridging				9.0	9.0	9.0		9.0						10.0	10.0	9.0	9.20	0.447
3C	Rippling				5.0	4.0	5.0		6.0						6.0	6.0	4.0	5.20	0.837
3C	Wear				6.0	6.0	6.0		7.0						5.0	7.0	5.0	6.00	0.707
3C	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
3C	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
4C	Ridging				10.0	10.0	9.0		9.0						9.0	10.0	9.0	9.40	0.548
4C	Rippling				9.0	9.0	9.0		9.0						8.0	9.0	8.0	8.80	0.447
4C	Wear				7.0	7.0	7.0		7.0						6.0	7.0	6.0	6.80	0.447
4C	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
4C	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
5	Ridging				7.0	7.0	8.0		9.0						8.0	9.0	7.0	7.80	0.837
5	Rippling				4.0	5.0	5.0		5.0						6.0	6.0	4.0	5.00	0.707
5	Wear				6.0	6.0	7.0		7.0						8.0	8.0	6.0	6.80	0.837
5	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
5	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
6	Ridging				9.0	9.0	9.0		9.0						9.0	9.0	9.0	9.00	0.000
6	Rippling				10.0	10.0	10.0		9.0						9.0	10.0	9.0	9.60	0.548
6	Wear				7.0	6.0	7.0		6.0						8.0	8.0	6.0	6.80	0.837
6	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
6	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
7	Ridging				6.0	5.0	6.0		5.0						5.0	6.0	5.0	5.40	0.548
7	Rippling				9.0	9.0	9.0		9.0						9.0	9.0	9.0	9.00	0.000
7	Wear				6.0	6.0	6.0		6.0						5.0	6.0	5.0	5.80	0.447
7	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
7	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
8	Ridging				5.0	6.0	6.0		6.0						5.0	6.0	5.0	5.60	0.548
8	Rippling				9.0	9.0	9.0		9.0						9.0	9.0	9.0	9.00	0.000
8	Wear				6.0	6.0	6.0		6.0						5.0	6.0	5.0	5.80	0.447
8	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
8	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
9	Ridging				8.0	10.0	8.0		9.0						9.0	10.0	8.0	8.80	0.837
9	Rippling				9.0	10.0	9.0		9.0						10.0	10.0	9.0	9.40	0.548
9	Wear				6.0	6.0	6.0		7.0						6.0	7.0	6.0	6.20	0.447
9	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
9	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000

Attachment 4
Page 10/2
Reference L-37
2/11/09

ASTM Gear Calibration Workshop
San Antonio, TX January 20, 21, 22 & 23, 2009

L-37 PINION GEARS

SET #	DISTRESS	4	6	7	10	11	22	25	*27	28	29	30	31	32	*33	MAX	MIN	AVG	Std Dev
10	Ridging				9.0	8.0	8.0		8.0						9.0	9.0	8.0	8.40	0.548
10	Rippling				9.0	9.0	9.0		9.0						9.0	9.0	9.0	9.00	0.000
10	Wear				7.0	8.0	7.0		6.0						8.0	8.0	6.0	7.20	0.837
10	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
10	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
11	Ridging				8.0	8.0	9.0		9.0						8.0	9.0	8.0	8.40	0.548
11	Rippling				6.0	6.0	6.0		6.0						6.0	6.0	6.0	6.00	0.000
11	Wear				6.0	6.0	5.0		7.0						6.0	7.0	5.0	6.00	0.707
11	Spitting				8.0	8.0	9.0		9.3						9.0	9.3	8.0	8.66	0.615
11	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
12	Ridging				9.0	9.0	9.0		10.0						9.0	10.0	9.0	9.20	0.447
12	Rippling				8.0	10.0	9.0		10.0						10.0	10.0	8.0	9.40	0.894
12	Wear				7.0	8.0	7.0		8.0						8.0	8.0	7.0	7.60	0.548
12	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
12	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
RERATE																			
R1/6	Ridging				9.0	9.0	9.0		9.0						9.0	9.0	9.0	9.00	0.000
R1/6	Rippling				10.0	10.0	10.0		9.0						9.0	10.0	9.0	9.60	0.548
R1/6	Wear				7.0	6.0	7.0		6.0						6.0	7.0	6.0	6.40	0.548
R1/6	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
R1/6	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
R2/7	Ridging				6.0	5.0	5.0		6.0						8.0	8.0	5.0	6.00	1.225
R2/7	Rippling				9.0	9.0	9.0		9.0						9.0	9.0	9.0	9.00	0.000
R2/7	Wear				6.0	6.0	6.0		6.0						6.0	6.0	6.0	6.00	0.000
R2/7	Spitting				9.0	9.9	9.9		9.9						9.9	9.9	9.0	9.72	0.402
R2/7	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
R3/11	Ridging				8.0	8.0	9.0		9.0						9.0	9.0	8.0	8.60	0.548
R3/11	Rippling				6.0	6.0	9.0		6.0						8.0	9.0	6.0	7.00	1.414
R3/11	Wear				6.0	6.0	5.0		7.0						7.0	7.0	5.0	6.20	0.837
R3/11	Spitting				8.0	8.0	9.0		9.0						9.0	9.0	8.0	8.60	0.548
R3/11	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000
R4/12	Ridging				9.0	9.0	9.0		10.0						9	10.0	9.0	9.20	0.447
R4/12	Rippling				9.0	10.0	9.0		9.0						9	10.0	9.0	9.20	0.447
R4/12	Wear				8.0	8.0	7.0		8.0						8	8.0	7.0	7.80	0.447
R4/12	Spitting				9.9	9.9	9.9		9.9						9.9	9.9	9.9	9.90	0.000
R4/12	Scoring				10.0	10.0	10.0		10.0						10.0	10.0	10.0	10.00	0.000

Raters 27 and 33 are not rating L-37 reference or non-reference oil tests at their respective labs.

Attachment 4
Page 2 of 2
Reference L-37
2/11/09

Percent deviation equation in each procedure:

L-60-1 Procedure: *LOSCT*

$$\% = \sum_{i=1}^n \left(\frac{Mi}{0.5R} \cdot \frac{Ti}{D} \right) \cdot 100$$

L-37, L-33-1, L-42: *Q Cyclic*

$$\% = \sum \frac{\text{amount out of specification}}{\frac{1}{2} \text{ spec range}} \cdot \frac{\text{hours out of specification}}{\text{test length (hours)}} \cdot 100$$

Attachment	<u>5</u>
Page	<u>1 of 1</u>
Reference	<u>L-37</u>
	<u>2/11/09</u>