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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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October 31, 2005

Reply to:
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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 August 24th, 2005 L-37 Surveillance Panel Meeting held at the PRI Headquarters in Warrendale, PA. Please direct any corrections or comments to my attention.

Sincerely,

Donald T. Bartlett

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

Report of Meeting
L-37 Surveillance Panel
PRI Headquarters, Apollo Room, Warrendale, Pa.
August 24th, 2005

Sign-in/Review of Membership: The meeting was called to order at 13:25 p.m. The sign-in sheet is ***Attachment 1.*** Under membership review, it was noted that Don Kreinbring will be replacing Ken Okamuro as the Dana representative and is included as ***Attachment # 2.***

Meeting Agenda: The meeting agenda was reviewed and is included as ***Attachment # 3.*** It was suggested that we change the order of business to insure that we address certain needs.

Approval of Meeting Minutes:

Motion 1 ⇒ Mr. Koehler, Second ⇒ Mr. Sullivan – We approve the minutes of the June 15, 2005 Surveillance Panel meeting minutes with no corrections. The motion to approve the minutes was unanimous.

Summary of Meeting Discussions

Introduction of Don Kreinbring as the new Dana ASTM Rep -

At 11:50 am, during the end of the L-42/L-42-1 surveillance panel, time was shared with the L-37 panel on this subject. Don Bartlett and Cory Koglin covered ASTM concerns, issues, and expectations for the role of Dana representatives. The summary for both panels mentioned lessons learned through prior gear batches and the goal for consistency in future gear batches. These are captured in ***Attachment # 4.***

Ken shared that this representative needs to be the conduit for flow of information to the plants and problems that are created from plants not typically running processes. The Dana representative and Task Force member needs to intervene at specific points at which the plant is preparing an important part of the manufacturing process (i.e. before gear cutting, heat treating, and final assembly). In large part, the problems encountered with past gear batches have been caused from our small hardware gear batches getting lost in production.

Mr. Koehler asked if the work assignment documentation for the Dana representative was detailed to the appropriate level. Mr. Okamuro explained that there are many details that do not belong on engineering drawings. However Mr. Okamuro has kept a separate book that is being handed off to Mr. Kreinbring. Every time they make a run of hardware, Ken has treated it as a new product which means that he ends up with about a 1-inch acceptance packet for his documentation and allows him to reference back to specific details.

Action Item ⇒ Don Kreinbring is to identify a time to visit Ft. Wayne at beginning of cutting and Lugoff N.C. such that some of the axles would be assembled for inspection.

2005 Non-Lubrited Hardware Order & Status -

The Chairman provided an update to the panel which is further summarized as ***Attachment # 5***. A total order quantity of 1370 axles was placed on May 5, 2005. The cost is $883 apiece. Dana intends to build out the gears and deliver by the end of 2005. A visitation date to Ft. Wayne and Lugoff needs to be planned. Mr. Kreinbring was asked to provide more information to Mr. Bartlett when it becomes available. A 44-test matrix has been approved once the hardware becomes available.

Mr. Okamuro discussed changes at Dana that will affect this order and future orders as well. Dana is going away from cut differential gears in favor of net forged gears. They will possibly have a higher degree of surface oxidation but should not affect the L-37 test. The steel material will be changing alloys for the differential gears. This material has been around in the Dana system and has been used in applications in Europe. Dana also plans on running some of their performance specifications. However Mr. Okamuro cautioned that Dana will want to switch over the ring/pinion in the future to these manganese chrome steels. Dana will be doing performance testing but does not believe this will have an affect on performance. Testing will start in a couple months. If the panel doesn't feel comfortable with this substitution, we could always refuse and require the material specified on the drawing. However the panel would need to pay the surcharge for purchasing the proper heat of steel.

2003 L247/T758A Lubrited Hardware Matrix -

In two previous meeting motions, the Panel had approved a Phase 6 test matrix (low temperature testing plan) where the three labs that participated in the hardware purchase were to conduct a total of 3 operationally valid tests each on TMC 152 and 153 for a total of 9 tests on each oil. ***Attachment # 6*** summarizes progress to date.

Phase 6 was aimed at determining the need and magnitude of low temperature (Canadian) correction factors with TMC 152 and TMC 153.

Mr. Lind presented the data generated to date for low temperature L247/T758A tests. Mr. Lind reported that there have been 3 invalid tests which makes the matrix fall short of the intended 18 tests. As for distress, Mr. Lind said that wear is okay across all labs and oils. For ridging, TMC 152 isn't as good as TMC 153. As for Pitting/spalling, both oils show an issue.

Mr. Lind questioned if all of the invalid tests are going to be repeated by the respective lab? Parc plans on repeating their test. Afton will repeat at least 1 of his 2 tests but is short on remaining hardware. Lubrizol agreed to ship one more axle so that Afton could repeat their test, thus giving us 18 valid tests for correction factor evaluation.

Lubrizol reported that they have completed their commitment of donated tests and had already repeated their one invalid test.

There was a discussion on whether a correction factor could be warranted if a shift was only detected with just one of the two oils. Three action items came out of this discussion:

Action item ⇒ Lubrizol is to send another axle to Afton for them to repeat their test which was invalid because it ended 1 minute early. (D ticket # 80067811, shipped 9/6/05)

Action item ⇒ TMC to review the LTMS database and publish both low temp and standard data for gear hardware batches L247/T758A and 626/686 for the panel review.

Action item ⇒ Once the three labs complete their commitment to the 18 tests, a meeting will be convened to review the data and decide, philosophically, what we should do with respect to correction factors.

July 2005 Rater Workshop Review –

The complete workshop summary data is included as ***Attachment # 7.*** Mr. Lind opened by explaining how the calibration workshop is structured. He first went through the highlights from the pinion data set. Note: Focus was only on pages 1, 2, 3, and 4 of Attachment 6. Raters 27, 28, and 29 are new raters not yet in the L37 RTMS system.

One issue was the differences in the rating of the wear distress. Looking at one gear, Mr. Lind highlighted a rating range between a 4 and a 6 and that the difference is like between night and day and is an indication of a rating problem. Mr. Koglin pointed out that the rating workshop has the specific tooth marked for each rater to rate.

Mr. Lind mentioned that at the workshop, the raters indicated they had a hard time rating wear because some pinions exhibit pitting/spalling distress as well. However, this wasn't a factor in all of the gears. The chairman indicated that he is aware that the rating task force is working on a future recommendation/presentation to make to this panel with respect to their concern on this topic. The panel will wait for that recommendation.

Mr. Sullivan stated that the panel should fashion a letter to the raters indicating that we have observed that there are still gains to be made in minimizing repeatability. In this letter, the panel would clarify the goal such as no observation in differences in magnitude greater than 1 number and that we are asking their opinion on what is needed to achieve this desired outcome (additional training, more/better rating aids, etc.). Mr. Sullivan frankly stated that the rater variability is still at unacceptable levels.

When Mr. Sullivan asked Mr. Lind whether one rater appears to be different than the group, Mr. Lind answered yes. Rater 6 tends to be mild and Rater 1 tends to be severe. This is not only true in this workshop but is also reflected in the Rater LTMS system.

Mr. Smith asked if we could tighten up the numbers by rating to half numbers. Mr. Gropp brought up that Lubrizol had analyzed workshop data where the raters tried this exercise and the conclusion was that ½ numbers didn't seem to help much. Mr. Bartlett recalled that the experiment was about 5 years back and the conclusion was possibly confounded somewhat by the fact that one rater refused to rate to ½ numbers and another rater rated to tenths. Possible a better-defined experiment would be the best outcome for this experiment?

Mr. Lind mentioned that raters' variability with the ring data was even greater. Mr. Gropp shared his thoughts on how to minimize rater repeatability through a systematic change such as averaging all 7 teeth. Mr. Koglin asked if that magnitude of a difference would only be seen in one distress such as pitting/spalling? Mr. Gropp indicated that this was probably the case with pitting/spalling but has also shown up in Ridging.

Action item ⇒ **The panel chairman and Mr. Lind were tasked to write a letter to the raters on this expectation.**

PRI Request for significant digit precision reporting –

The chairman updated the panel on this topic, see ***Attachment # 8***
Mrs. Vermilya, Lubrizol statistician, presented a statistical review of the July 2005 workshop and is included as ***Attachment # 9.***

Mrs. Vermilya pointed out that all of the raters did not carry the same number designation across into each of her charts. Hence, rater 1 could be a different person for each pinion.

There was discussion that Mr. Lind could select pinions that we have multiple ratings on and send pinions around to the raters and have the raters rate all 7 teeth.

Motion 2 ⇒ **Brian Koehler, Second ⇒ Don Lind): The TMC is instructed to pull 6 pinions from the Rater LTMS system and assign a number to each of the 7 gear teeth so that the raters can place a discrete number for each pinion tooth for all distress parameters. The rating task needs to be complete this task by November 24th.** The motion passed unanimously with 8 votes in favor, none opposed, and no abstentions.

Action Item: The TMC was tasked to go back and statistically identify the best rater in the Rater LTMS system.

Due to other business meeting needs, Mr. Sullivan motioned, second by Mr. Koglin, to adjourn the meeting at 3:40 p.m.

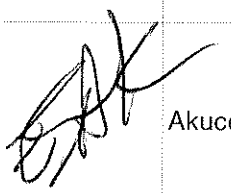
Respectfully submitted,

Donald T Bartlett

Donald T. Bartlett
L-37 Surveillance Panel Chairman

ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: August 24, 2005

Initials*	Name	Voting Status	Company Name & Address	Phone/Email Info
	Akucewich, Ed	Non-Voting	The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, Ohio 44092	Phone: 440-347-2415 Fax: 440-347-9011 E-Mail: esak@lubrizol.com
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* Initial to indicate attendance at subject meeting

Attachment 1
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ASTM L-37 Surveillance Panel Membership/Mailing List

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	Follis, Mike	Non Voting	Dana Corporation P.O. Box 955 Toledo, Ohio 43697	Phone: 419-887-3424 Fax: 419-887-5962 E-Mail: mike.follis@dana.com
JLG	Gropp, Jerry	Non Voting	The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, Ohio 44092	Phone: 440-347-1223 Fax: 440-347-1555 E-Mail: jlg@lubrizol.com
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ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: August 24, 2005

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	Kozlowski, Ralph	Non Voting	PARC Technical Services, Inc. 100 William Pitt Way Pittsburg, PA 15238	Phone: 412-826-5044 Fax: 412-826-5443 E-Mail:
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DEK	Kreinbring, Don	Non Voting	Dana Corporation PO Box ~~4013,~~ 4097 Kalamazoo, MI 49003	Phone: ~~616~~ 269-567-1140 Fax: E-Mail: don.kreinbring@dana.com

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Attachment 1
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ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: August 24, 2005

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ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: August 24, 2005

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WTS	Sullivan, Bill	Voting	ExxonMobil Chemical Company P. O. Box 3140 Edison, New Jersey 08818	Phone: 732-321-3354 Fax: 732-321-6064 E-Mail: william.t.sullivan@exxonmobil.com
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	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

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ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: August 24, 2005

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DK	DICK KUHLMAN	NON	AFTON CHEMICAL 2000 TOWN CENTER, 1750 SOUTHFIELD, MI 48075	Ph: 248-350-0647 F: -0025 E: DICK.KUHLMAN@AFTONCHEMICAL.COM
	BILL KEARNEY	NON	"	" Bill.Jkearney@aftonchemical.com
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				Phone: Fax: E-Mail:
				Phone: Fax: E-Mail:
				Phone: Fax: E-Mail:
				Phone: Fax: E-Mail:

* Initial to indicate attendance at subject meeting

L-37 Surveillance Panel Voting Members

Donald Bartlett	The Lubrizol Corporation (Chairman)
Tom Bryson	Volvo Powertrain Corporation
Juan Buitrago	Chevron Oronite Company
John Dharte	American Axle & Manufacturing
Brian Koehler	Southwest Research Institute
Cory Koglin	Afton Chemical Company
Don Lind	ASTM Test Monitoring Center
Jim Linden	GMR Research and Development
Don Kreinbring	Dana Corporation
Thelma Marougy	Eaton Corporation
Bruce McGlone	ArvinMeritor Materials Engineering
Dale Smith	PARC Technical Services
William Sullivan	ExxonMobil Chemical Company
Paula Vettel	D.A. Stuart Company
Khaled A. Zreik	AMSTA-TR-D/210 US Army Tacom-Tardec

L-37 Surveillance Panel
PRI/ Headquarters, Apollo Room - Warrendale, PA
August 24, 2005

AGENDA

Call to Order & Membership Review

Approval of June 15, 2005 Panel Minutes

2003 L247/T758A Lubrited Low Temperature Matrix Review – TMC

July GO Rating Workshop Review – TMC

Industry Hardware Order

- Introduction of new Dana ASTM Representative
- Expectations
- 2005 L-37 Hardware Order Production Update

PRI Request for Significant Digit Precision Reporting

New Business

Adjournment

Attachment	3
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Changes at Dana Corporation

A Time for Changing of the Guard:

- Ken Okamuro, good luck in your retirement and THANK YOU!

- Don Kreinbring, welcome aboard!

- Representative expectations –
  - Engineering expertise and recommendations and a 'go to' representative to address questions and provide support.
  - Attend panel meetings and teleconference calls.
  - Has to co-ordinate/be a conduit of flow of information to the Dana plants in insure production flows. We desire a hardware production and assembly that reduces variation.
  - Has to communicate the production issues with hardware orders with the ASTM surveillance panels that hardware is being produced for.
  - Has to understand cause and effect relationships with the specific ASTM tests and the respective purchased hardware.
  - Communicate all issues and concerns with the L-33-1 (Dana model 30), L-37 (Dana model 60), and L-42/L-42-1(Dana model 44) ASTM surveillance panel chairmen.

2005 Non-Lubrited Hardware Order and Status

- 2005 L-37 Hardware Order Production Update
  - Update/general comments by Ken and Don.
  - Dana is changing from cut differential gears to net forged gears.
  - Future steel change options under consideration

    Dana is switching over from cut differential gears to net forged. The cut gears will no longer be made. I have written a work order to change the differential side gears and pinion mates in the differentials to the net forged gear. The side gear has the same spline as the cut gear and will not affect your test shafts. This change applies to the following axle assemblies:

    060AA100-2

    060AA100-4

    This change will not affect your test.
  - Overlapping causes scoring issues.
  - Case depth increase to address tooth breakage
  - Higher cost carriers were a good decision, stay with them.

2005 Non-Lubrited Hardware Order and Status (con't)

- Grinding out handling damage. Examples that are not acceptable.

  The top land damage is the result of a rework attempt to grind out handling damage. This invalidated test is likely the result of improper manufacturing technique by the responsible Dana factory. Hopefully this is a fairly isolated incident.

2005 Non-Lubrited Hardware Order and Status (con't)

- Acute angle chamfer vs. finite analysis

The spall at the heel looks like there is an excessive acute angle chamfer on the tooth (this chamfer is a normal operation). The significance of this is that the chamfer subtracts from the contact area that must carry the load, especially under high loads where the contact spreads to the heel. It is difficult to tell from the picture how wide the chamfer is since I have no scale comparison, but it looks relatively wide.

This loss of tooth stress carrying area means that the area just in front of the chamfer must carry more load since the pattern effectively runs off the heel of the tooth where the chamfer begins. All things being equal, it is likely to spall at that spot.

2005 Non-Lubrited Hardware Order and Status –

Summary from the April 21, 2005 Teleconference Panel Meeting:

The axles are going to cost $ 883.00 each and have taken into account steel prices as of the April12th date. Binding PO's were issued May 5th, 2005.

The drawing specification for steel primarily calls out 8620/8625 steel. If/when an insufficient quantity of the primary steel is not available; other 'similar' steel choices can be used but the panel is to be notified for discussion.

Axle's quantity ordered:

PARC:	220
Afton	450
Lubrizol	400
SRI	300

Total Gears Ordered: 1370

TF Teleconference with Ft. Wayne before gear sets are produced – fall of 2005?

The Laboratory Hardware TF will visit Lugoff, SC facility before assembly begins 4th qtr 2005.

Instructions for assembly line build out of the contact pattern were for the assembly line to target L2F0. If the line was not able to achieve L2F0, they were to move to L2F+1. The goal is for no L2F-1 contact patterns and supported by the panel.

We anticipate that the hardware should be received by the end of the year 2005.

2005 Non-Lubrited Hardware Order and Status – (Con't)

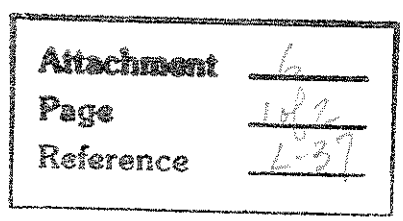
Each of the 4 labs will equally participate in a 44-test matrix to evaluate the 2005 non-lubrited hardware batch.

- 4-test on TMC 127 (standard)
  - TMC will assign each lab one test on TMC 127 and stop to review results (to insure that this oil has performed as expected). Targeted completion date is TBD.
- 8-tests on TMC 151-3 (standard)
  - TMC will assign each lab one test on TMC 151-3 and stop to review results (to insure that this oil has performed as expected). Targeted completion date is TBD.
- 8-tests on TMC 152 (standard)
- 8-tests on TMC 153 (standard)
- 8-tests on TMC 152 (Canadian)
- 8-tests on TMC 153 (Canadian)

2003 L247/T758A Lubrited Hardware

- Phase 5 testing completed 2nd qtr 2005:
    - April 21, 2005 - Panel approved hardware targets and Standard candidate testing approvals.

- Phase 6 testing – Low Temperature Only, Are Correction Factors Needed?
    - April 21, 2005 – Panel approved - - 1 test each at each at 3 labs on TMC 152 and 153 to be completed for June 15 meeting review.
    - June 15, 2005 – Panel approved Phase 6 Extended - - 2 more tests each at 3 labs on TMC 152 and 153 to be completed by August 12 and reviewed at August 24 meeting.
        - Total of 9 tests on each oil to evaluate correction factor options.
    - TMC Review of Phase 6 results to date
    - Action Item – Review of July GO RWSTF pinion and ring re-rates on this hardware batch.
    - Where do we go from here?



LUBRITED HARDWARE
GEAR BATCH L247/T758A
LOW TEMPERATURE, PHASE 6

CMIR	Lab	STD	Run	Oil	Pinbat	Ringbat	DTCOMP	Pwear	Pridg	Pripp	Pspit	Rwear	Rridg	Rripp	Rspit	frcrat	lpcrat
53532	D	3A	381	152	L247	T758A	20050725	6	7	9	9.8	8	10	10	10	0	2
53541	B	191	2107	152	L247	T758A	20050317	5	6	8	8	7	7	9	9.4	0	2
53543	B	191	2156	152	L247	T758A	20050703	6	6	9	8	7	8	9	9.8	0	2
55381	B	191	2162	152	L247	T758A	20050711	6	6	9	8	8	8	10	9.5	0	2
53461	E	2	112	152	L247	T758A	20050426	6	7	9	8	7	8	9	9.8	0	2
53548	E	2	136	152	L247	T758A	20050715	6	8	8	7	7	9	9	9.4	0	2
	6																
53537	D	3A	375	153	L247	T758A	20050716	6	8	9	9.8	8	10	10	9.9	1	3
53539	D	3A	393	153	L247	T758A	20050810	6	8	8	9.9	9	10	10	10	0	2
53544	B	191	2109	153	L247	T758A	20050319	6	8	7	8	8	9	10	9.9	1	2
53546	B	191	2158	153	L247	T758A	20050706	6	8	8	9	8	10	10	10	1	2
53547	B	191	2159	153	L247	T758A	20050707	6	9	8	7	8	10	10	10	0	2
53465	E	2	113	153	L247	T758A	20050427	6	9	8	9.6	7	9	9	9.9	0	2
53466	E	2	137	153	L247	T758A	20050719	6	9	8	9.7	7	9	9	9.9	0	2
53552	E	2	145	153	L247	T758A	20050729	6	9	8	9.9	7	9	9	9.9	0	2
	8																

INVALID TESTS

53530	D	3A	355	152	L247	T758A	20050604	6	8	9	9.8	9	9	10	9.9	0	3
53542	B	191	2155	152	L247	T758A	20050630	6	6	9	9.4	8	8	10	10	0	2
53462	E	2	133	152	L247	T758A	20050630	6	7	8	7	7	8	9	9.3	0	2

wear - good
Ripp - good
Ridg - ?
Spit - ?
oil interactions?

Attachment 6
Page 2 of 2
Reference L-37

ASTM Gear Calibration Workshop

San Antonio, TX July 12, 13, & 14, 2005

L-37 PINION GEARS

		RATER																	
SET #	DISTRESS	1	2	4	6	7	10	11	22	25	27	28	29		MAX	MIN	AVG	Std Dev	Pinion #
1C	Ridging	7.0	7.0	7.0	9.0		8.0	8.0	7.0		8.0	9.0	8.0		9.0	7.0	7.80	0.789	8
1C	Rippling	8.0	7.0	7.0	8.0		7.0	9.0	8.0		9.0	9.0	8.0		9.0	7.0	8.00	0.816	
1C	Wear	6.0	7.0	7.0	7.0		7.0	7.0	7.0		6.0	8.0	7.0		8.0	6.0	6.90	0.568	
1C	Spitting	9.9	9.9	9.9	9.9		9.9	9.9	9.9		9.9	9.9	9.9		9.9	9.9	9.90	0.000	
1C	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000	
2C	Ridging	10.0	9.0	9.0	9.0		10.0	9.0	9.0		9.0	9.0	10.0		10.0	9.0	9.30	0.483	41
2C	Rippling	9.0	9.0	10.0	9.0		10.0	10.0	9.0		9.0	10.0	10.0		10.0	9.0	9.50	0.527	
2C	Wear	7.0	7.0	8.0	7.0		7.0	7.0	8.0		7.0	8.0	8.0		8.0	7.0	7.40	0.516	
2C	Spitting	9.9	9.9	10.0	9.9		9.9	9.9	9.9		9.9	10.0	9.9		10.0	9.9	9.92	0.042	
2C	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000	
3C	Ridging	7.0	7.0	7.0	8.0		8.0	7.0	7.0		7.0	8.0	8.0		8.0	7.0	7.40	0.516	24
3C	Rippling	9.0	8.0	8.0	8.0		9.0	9.0	8.0		9.0	9.0	9.0		9.0	8.0	8.60	0.516	
3C	Wear	5.0	4.0	6.0	4.0		6.0	6.0	6.0		7.0	4.0	7.0		7.0	4.0	5.50	1.179	
3C	Spitting	2.0	2.0	2.0	2.0		2.0	2.0	3.0		1.0	2.0	1.0		3.0	1.0	1.90	0.568	
3C	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000	
4C	Ridging	5.0	4.0	6.0	5.0		6.0	5.0	5.0		6.0	5.0	5.0		6.0	4.0	5.20	0.632	52
4C	Rippling	8.0	8.0	9.0	9.0		9.0	9.0	8.0		9.0	9.0	9.0		9.0	8.0	8.70	0.483	
4C	Wear	6.0	6.0	6.0	6.0		6.0	6.0	7.0		7.0	9.0	6.0		9.0	6.0	6.50	0.972	
4C	Spitting	9.9	9.9	9.9	9.9		9.9	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		10.0	10.0	10.0		10.0	10.0	10.00	0.000	
5	Ridging	9.0	9.0	9.0	8.0		9	9.0	8.0		9.0	8.0	9.0		9.0	8.0	8.70	0.483	2
5	Rippling	9.0	8.0	8.0	8.0		7	8.0	7.0		9.0	8.0	8.0		9.0	7.0	8.00	0.667	
5	Wear	6.0	6.0	6.0	6.0		6	6.0	6.0		7.0	6.0	6.0		7.0	6.0	6.10	0.316	
5	Spitting	9.4	9.7	9.7	9.3		9.8	9.7	9.5		9.0	9.9	9.8		9.9	9.0	9.58	0.278	
5	Scoring	10.0	10.0	10.0	10.0		10	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000	
6	Ridging	6.0	7.0	6.0	7.0		6	6.0	6.0		8.0	7.0	7.0		8.0	6.0	6.60	0.699	6
6	Rippling	7.0	7.0	7.0	8.0		7	8.0	7.0		8.0	7.0	6.0		8.0	6.0	7.20	0.632	
6	Wear	6.0	6.0	6.0	6.0		6	6.0	6.0		7.0	6.0	6.0		7.0	6.0	6.10	0.316	
6	Spitting	9.9	9.9	9.9	9.9		9.9	9.9	10.0		9.9	10.0	10.0		10.0	9.9	9.93	0.048	
6	Scoring	10.0	10.0	10.0	10.0		10	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000	
7	Ridging	10.0	9.0	10.0	9.0		10	10.0	9.0		10.0	9.0	10.0		10.0	9.0	9.60	0.516	31
7	Rippling	9.0	9.0	10.0	10.0		9	10.0	9.0		10.0	9.0	9.0		10.0	9.0	9.40	0.516	
7	Wear	8.0	7.0	8.0	7.0		7	7.0	7.0		8.0	8.0	7.0		8.0	7.0	7.40	0.516	
7	Spitting	10.0	9.9	10.0	10.0		9.9	9.9	9.9		9.9	10.0	10.0		10.0	9.9	9.95	0.053	
7	Scoring	10.0	10.0	10.0	10.0		10	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000	
8	Ridging	5.0	7.0	7.0	8.0		6	7.0	6.0		7.0	6.0	7.0		8.0	5.0	6.60	0.843	14
8	Rippling	9.0	9.0	9.0	8.0		9	8.0	9.0		9.0	9.0	9.0		9.0	8.0	8.80	0.422	
8	Wear	6.0	6.0	6.0	6.0		6	6.0	6.0		6.0	6.0	6.0		6.0	6.0	6.00	0.000	
8	Spitting	9.9	9.9	9.9	9.9		9.9	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	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000	

Attachment 1
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Reference L-37

* Calibration Set

ASTM Gear Calibration Workshop

San Antonio, TX July 12, 13, & 14, 2005

L-37 PINION GEARS

SET #	DISTRESS	RATER 1	2	4	6	7	10	11	22	25	27	28	29	MAX	MIN	AVG	Std Dev	Pinion #
9	Ridging	5.0	6.0	6.0	5.0		6	6.0	6.0		6.0	5.0	6.0	6.0	5.0	5.70	0.483	40
9	Rippling	9.0	9.0	9.0	9.0		9	10.0	9.0		9.0	9.0	7.0	10.0	7.0	8.90	0.738	
9	Wear	6.0	6.0	6.0	6.0		6	6.0	7.0		7.0	7.0	7.0	7.0	6.0	6.40	0.516	
9	Spitting	9.8	9.9	9.9	9.9		9.9	9.9	9.9		9.9	9.9	9.8	9.9	9.8	9.88	0.042	
9	Scoring	10.0	10.0	10.0	10.0		10	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.00	0.000	
10	Ridging	9.0	8.0	9.0	9.0		9	8.0	7.0		9.0	8.0	10.0	10.0	7.0	8.60	0.843	21
10	Rippling	9.0	9.0	9.0	9.0		9	9.0	9.0		9.0	9.0	9.0	9.0	9.0	9.00	0.000	
10	Wear	6.0	6.0	6.0	5.0		5	6.0	5.0		6.0	6.0	6.0	6.0	5.0	5.70	0.483	
10	Spitting	8.0	8.0	8.0	8.0		8	8.0	8.0		8.0	8.0	8.0	8.0	8.0	8.00	0.000	
10	Scoring	10.0	10.0	10.0	10.0		10	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.00	0.000	
11	Ridging	10.0	9.0	10.0	10.0		10	10.0	10.0		10.0	9.0	10.0	10.0	9.0	9.80	0.422	51
11	Rippling	9.0	8.0	9.0	8.0		9	8.0	9.0		10.0	9.0	8.0	10.0	8.0	8.70	0.675	
11	Wear	8.0	7.0	6.0	8.0		7	7.0	7.0		8.0	7.0	7.0	8.0	6.0	7.20	0.632	
11	Spitting	9.9	9.9	9.9	9.9		9.9	9.9	9.9		9.9	10.0	9.9	10.0	9.9	9.91	0.032	
11	Scoring	10.0	10.0	10.0	10.0		10	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	8.0		9	8.0	8.0		9.0	9.0	9.0	9.0	8.0	8.70	0.483	3
12	Rippling	8.0	7.0	7.0	7.0		6	7.0	7.0		7.0	7.0	8.0	8.0	6.0	7.10	0.568	
12	Wear	6.0	6.0	6.0	6.0		6	6.0	6.0		7.0	6.0	7.0	7.0	6.0	6.20	0.422	
12	Spitting	9.9	9.9	9.9	9.9		9.9	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	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.00	0.000	
RERATE																		
R1/12	Ridging	9.0	9.0	8.0	8.0		8.0	8.0	8.0		8.0	8.0	9.0	9.0	8.0	8.30	0.483	
R1/12	Rippling	7.0	7.0	7.0	8.0		6.0	7.0	7.0		8.0	7.0	7.0	8.0	6.0	7.10	0.568	
R1/12	Wear	6.0	6.0	6.0	6.0		6.0	6.0	6.0		7.0	6.0	6.0	7.0	6.0	6.10	0.316	
R1/12	Spitting	9.9	9.9	9.8	9.9		9.9	9.9	9.9		9.9	10.0	9.9	10.0	9.8	9.90	0.047	
R1/12	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.00	0.000	
R2/5	Ridging	9.0	9	9.0	9.0		9.0	9.0	8.0		9.0	8.0	8.0	9.0	8.0	8.70	0.483	
R2/5	Rippling	9.0	8	8.0	8.0		7.0	8.0	6.0		9.0	9.0	7.0	9.0	6.0	7.90	0.994	
R2/5	Wear	6.0	6	6.0	6.0		6.0	6.0	5.0		7.0	6.0	6.0	7.0	5.0	6.00	0.471	
R2/5	Spitting	9.5	9.8	9.7	9.0		9.8	9.7	9.6		9.4	9.9	9.8	9.9	9.0	9.62	0.266	
R2/5	Scoring	10.0	10	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.00	0.000	
R3/9	Ridging	5.0	5.0	6.0	6.0		6.0	5.0	7.0		5.0	5.0	6.0	7.0	5.0	5.60	0.699	
R3/9	Rippling	9.0	9.0	9.0	9.0		9.0	9.0	9.0		9.0	9.0	9.0	9.0	9.0	9.00	0.000	
R3/9	Wear	6.0	6.0	6.0	6.0		6.0	6.0	7.0		7.0	7.0	7.0	7.0	6.0	6.40	0.516	
R3/9	Spitting	9.9	9.9	9.8	9.9		9.9	9.9	9.9		9.9	9.9	9.9	9.9	9.8	9.89	0.032	
R3/9	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.00	0.000	
R4/8	Ridging	6.0	7.0	7.0	7.0		7.0	7.0	7.0		8.0	7.0	7.0	8.0	6.0	7.00	0.471	
R4/8	Rippling	8.0	9.0	8.0	9.0		8.0	8.0	8.0		9.0	9.0	8.0	9.0	8.0	8.40	0.516	
R4/8	Wear	6.0	6.0	6.0	6.0		6.0	6.0	6.0		7.0	6.0	6.0	7.0	6.0	6.10	0.316	
R4/8	Spitting	9.9	9.9	9.9	9.9		9.9	9.9	9.9		9.9	9.9	9.9	9.9	9.9	9.90	0.000	
R4/8	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.00	0.000	

Attachment 7
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Reference L-37

* Calibration Set

ASTM Gear Calibration Workshop

San Antonio, TX July 12, 13, & 14, 2005

L-37 RING GEARS

SET #	DISTRESS	RATER 1	2	4	6	7	10	11	22	25	27	28	29		MAX	MIN	AVG	Std Dev
1C	Ridging	10.0	9.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0		10.0	9.0	9.90	0.316
1C	Rippling	10.0	9.0	10.0	10.0		10.0	10.0	10.0		9.0	8.0	9.0		10.0	8.0	9.50	0.707
1C	Wear	8.0	7.0	7.0	9.0		7.0	8.0	8.0		7.0	9.0	6.0		9.0	6.0	7.60	0.966
1C	Spitting	9.9	9.9	10.0	10.0		10.0	9.9	9.9		9.9	9.9	10.0		10.0	9.9	9.94	0.052
1C	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000
2C	Ridging	6.0	6.0	7.0	7.0		6.0	7.0	6.0		6.0	6.0	7.0		7.0	6.0	6.40	0.516
2C	Rippling	10.0	9.0	9.0	9.0		9.0	10.0	10.0		8.0	8.0	9.0		10.0	8.0	9.10	0.738
2C	Wear	6.0	7.0	6.0	8.0		6.0	6.0	7.0		7.0	7.0	9.0		9.0	6.0	6.90	0.994
2C	Spitting	9.9	9.9	9.9	10.0		9.9	9.9	9.9		9.9	9.9	9.9		10.0	9.9	9.91	0.032
2C	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000
3C	Ridging	6.0	7.0	7.0	8.0		7.0	7.0	6.0		7.0	6.0	8.0		8.0	6.0	6.90	0.738
3C	Rippling	10.0	9.0	9.0	10.0		10.0	10.0	10.0		9.0	9.0	9.0		10.0	9.0	9.50	0.527
3C	Wear	7.0	7.0	6.0	8.0		6.0	6.0	7.0		7.0	7.0	9.0		9.0	6.0	7.00	0.943
3C	Spitting	9.9	9.9	9.9	9.9		9.9	9.9	9.9		9.0	9.9	9.9		9.9	9.0	9.81	0.285
3C	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000
4C	Ridging	10.0	9.0	10.0	10.0		10.0	9.0	9.0		10.0	9.0	9.0		10.0	9.0	9.50	0.527
4C	Rippling	9.0	9.0	10.0	10.0		10.0	10.0	9.0		9.0	10.0	10.0		10.0	9.0	9.60	0.516
4C	Wear	7.0	7.0	7.0	9.0		7.0	7.0	8.0		7.0	8.0	8.0		9.0	7.0	7.50	0.707
4C	Spitting	9.9	9.9	10.0	10.0		9.9	9.9	10.0		9.9	9.9	9.9		10.0	9.9	9.93	0.048
4C	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.00	0.000
5	Ridging	10.0	9.0	9.0	9.0		10.0	9.0	9.0		9.0	9.0			10.0	9.0	9.22	0.441
5	Rippling	9.0	9.0	10.0	10.0		10.0	10.0	10.0		9.0	9.0			10.0	9.0	9.56	0.527
5	Wear	7.0	7.0	6.0	7.0		5.0	6.0	6.0		6.0	7.0			7.0	5.0	6.33	0.707
5	Spitting	9.9	9.9	9.9	9.9		10.0	9.9	10.0		9.9	10.0			10.0	9.9	9.93	0.050
5	Scoring	10.0	10.0	7.0	3.0		3.0	7.0	3.0		10.0	10.0			10.0	3.0	7.00	3.240
6	Ridging	8.0	9.0	7.0	8.0		8.0	7.0	9.0		8.0	8.0			9.0	7.0	8.00	0.707
6	Rippling	9.0	9.0	9.0	9.0		10.0	10.0	10.0		9.0	9.0			10.0	9.0	9.33	0.500
6	Wear	6.0	5.0	4.0	5.0		4.0	5.0	5.0		7.0	8.0			8.0	4.0	5.44	1.333
6	Spitting	9.9	9.9	9.9	9.9		9.9	9.9	9.9		9.9	10.0			10.0	9.9	9.91	0.033
6	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0			10.0	10.0	10.00	0.000
7	Ridging	5.0	6.0	6.0	6.0		5.0	6.0	7.0		6.0	6.0			7.0	5.0	5.89	0.601
7	Rippling	9.0	9.0	9.0	9.0		10.0	10.0	9.0		9.0	9.0			10.0	9.0	9.22	0.441
7	Wear	6.0	6.0	6.0	6.0		6.0	6.0	6.0		7.0	7.0			7.0	6.0	6.22	0.441
7	Spitting	9.5	9.9	9.8	9.9		9.8	9.8	9.9		9.9	9.9			9.9	9.5	9.82	0.130
7	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0			10.0	10.0	10.00	0.000
8	Ridging	4.0	5.0	3.0	3.0		3.0	4.0	4.0		4.0	3.0			5.0	3.0	3.67	0.707
8	Rippling	9.0	9.0	8.0	5.0		8.0	10.0	10.0		9.0	8.0			10.0	5.0	8.44	1.509
8	Wear	5.0	5.0	4.0	5.0		3.0	4.0	6.0		4.0	5.0			6.0	3.0	4.56	0.882
8	Spitting	9.3	9.7	9.6	9.5		9.6	9.5	9.5		9.0	9.7			9.7	9.0	9.49	0.220
8	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0			10.0	10.0	10.00	0.000

much more difficult with ring vs pinion wear - visible damage, pits, ratings getting confused, may be able ... due to particles in oil?

Attachment 7
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Reference L-37

* Calibration Set

ASTM Gear Calibration Workshop

San Antonio, TX July 12, 13, & 14, 2005

L-37 RING GEARS

		RATER																
SET #	DISTRESS	1	2	4	6	7	10	11	22	25	27	28	29	MAX	MIN	AVG	Std Dev
9	Ridging	4.0	5.0	4.0	5.0		4.0	4.0	5.0		5.0	5.0		5.0	4.0	4.56	0.527
9	Rippling	9.0	9.0	8.0	8.0		8.0	10.0	9.0		9.0	6.0		10.0	6.0	8.44	1.130
9	Wear	6.0	6.0	6.0	7.0		3.0	5.0	6.0		6.0	6.0		7.0	3.0	5.67	1.118
9	Spitting	9.7	9.9	9.8	9.9		9.8	9.8	9.9		9.0	9.9		9.9	9.0	9.74	0.288
9	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0		10.0	10.0	10.00	0.000
10	Ridging	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0		10.0	10.0	10.00	0.000
10	Rippling	9.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0		10.0	9.0	9.89	0.333
10	Wear	8.0	7.0	8.0	8.0		7.0	9.0	8.0		7.0	9.0		9.0	7.0	7.89	0.782
10	Spitting	9.9	9.9	9.9	9.9		10.0	10.0	9.9		9.9	10.0		10.0	9.9	9.93	0.050
10	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0		10.0	10.0	10.00	0.000
11	Ridging	5.0	5.0	4.0	5.0		5.0	5.0	5.0		5.0	5.0		5.0	4.0	4.89	0.333
11	Rippling	10.0	9.0	9.0	9.0		10.0	10.0	10.0		9.0	9.0		10.0	9.0	9.44	0.527
11	Wear	6.0	6.0	6.0	7.0		6.0	5.0	6.0		7.0	7.0		7.0	5.0	6.22	0.667
11	Spitting	9.4	9.9	9.7	9.9		9.8	9.9	9.8		9.9	9.9		9.9	9.4	9.80	0.166
11	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0		10.0	10.0	10.00	0.000
12	Ridging	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0		10.0	10.0	10.00	0.000
12	Rippling	9.0	9.0	9.0	10.0		9.0	10.0	10.0		10.0	9.0		10.0	9.0	9.44	0.527
12	Wear	7.0	7.0	7.0	7.0		7.0	7.0	8.0		7.0	9.0		9.0	7.0	7.33	0.707
12	Spitting	9.9	9.9	10.0	9.9		10.0	10.0	10.0		9.9	9.9		10.0	9.9	9.94	0.053
12	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0		10.0	10.0	10.00	0.000
RERATE																	
R1/5	Ridging	10.0	9.0	9.0	9.0		10.0	9.0	9.0		9.0	9.0	10.0	10.0	9.0	9.30	0.483
R1/5	Rippling	9.0	9.0	10.0	9.0		10.0	10.0	10.0		9.0	10.0	9.0	10.0	9.0	9.50	0.527
R1/5	Wear	6.0	7.0	7.0	6.0		5.0	7.0	7.0		6.0	7.0	6.0	7.0	5.0	6.40	0.699
R1/5	Spitting	9.9	9.9	9.9	9.9		10.0	9.9	10.0		9.9	10.0	10.0	10.0	9.9	9.94	0.052
R1/5	Scoring	7.0	10.0	7.0	3.0		5.0	7.0	3.0		7.0	10.0	8.0	10.0	3.0	6.70	2.452
R2/7	Ridging	5.0	6.0	6.0	7.0		5.0	6.0	6.0		6.0	5.0	8.0	8.0	5.0	6.00	0.943
R2/7	Rippling	9.0	9.0	9.0	9.0		10.0	10.0	10.0		9.0	9.0	9.0	10.0	9.0	9.30	0.483
R2/7	Wear	6.0	6.0	6.0	6.0		6.0	6.0	7.0		6.0	6.0	7.0	7.0	6.0	6.20	0.422
R2/7	Spitting	9.5	9.9	9.7	9.9		9.9	9.8	9.8		9.9	9.8	9.9	9.9	9.5	9.81	0.129
R2/7	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.00	0.000
R3/9	Ridging	5.0	5.0	4.0	6.0		5.0	4.0	5.0		4.0	5.0	7.0	7.0	4.0	5.00	0.943
R3/9	Rippling	9.0	9.0	9.0	8.0		9.0	10.0	10.0		9.0	9.0	9.0	10.0	8.0	9.10	0.568
R3/9	Wear	6.0	6.0	6.0	6.0		4.0	6.0	6.0		6.0	6.0	7.0	7.0	4.0	5.90	0.738
R3/9	Spitting	9.7	9.9	9.8	9.9		9.9	9.8	9.9		9.9	9.9	9.9	9.9	9.7	9.86	0.070
R3/9	Scoring	10.0	10.0	10.0	10.0		10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.00	0.000

Attachment 7
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Reference L-37

* Calibration Set

ASTM Gear Calibration Workshop

San Antonio, TX July 12, 13, & 14, 2005

L-42 GEARS

		RATER																
SET #		1	2	3	4	6	7	10	11	22	24	25	27		MAX	MIN	AVG	Std Dev
1C	Pinion	30	28		28	30		22	25	27			29		30	22	27.4	2.722
1C	Ring	21	16		19	22		15	15	25			25		25	15	19.8	4.166
2C	Pinion	32	39		39	39		35	35	36			30		39	30	35.6	3.378
2C	Ring	26	26		30	34		26	25	30			25		34	25	27.8	3.240
3C	Pinion	15	18		16	18		14	14	15			15		18	14	15.6	1.598
3C	Ring	13	9		12	15		12	9	9			10		15	9	11.1	2.232
4C	Pinion	17	21		21	24		17	20	18			19		24	17	19.6	2.387
4C	Ring	14	13		13	16		10	10	12			11		16	10	12.4	2.066
5	Pinion	17	17		17	18		18	16	18			19		19	16	17.5	0.926
5	Ring	15	11		10	14		14	11	12			10		15	10	12.1	1.959
6	Pinion	17	20		18	18		17	18	18			20		20	17	18.3	1.165
6	Ring	10	11		10	10		13	12	11			7		13	7	10.5	1.773
7	Pinion	12	13		12	12		9	10	12			9		13	9	11.1	1.553
7	Ring	10	6		6	8		7	6	8			11		11	6	7.8	1.909
8	Pinion	22	27		24	26		27	30	24			25		30	22	25.6	2.446
8	Ring	16	17		15	17		14	20	17			12		20	12	16.0	2.390
9	Pinion	36	43		43	43		39	39	39			45		45	36	40.9	3.044
9	Ring	30	26		31	31		29	29	34			28		34	26	29.8	2.375
10	Pinion	10	10		8	11		8	8	8			11		11	8	9.3	1.389
10	Ring	6	5		4	7		7	4	5			4		7	4	5.3	1.282
RERATE																		
R1/5	Pinion	22	13		16	16		13	15	16			20		22	13	16.4	3.159
R1/5	Ring	15	10		10	11		12	10	10			11		15	10	11.1	1.727
R2/6	Pinion	17	16		17	20		20	18	18			25		25	16	18.9	2.850
R2/6	Ring	9	9		9	12		14	12	11			8		14	8	10.5	2.070
R3/8	Pinion	22	20		28	30		33	25	25			30		33	20	26.6	4.406
R3/8	Ring	15	16		18	18		23	18	20			12		23	12	17.5	3.295

Attachment 2
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Reference L-37

* Calibration Set

ASTM Gear Calibration Workshop

San Antonio, TX July 12, 13, & 14, 2005

L-33 GEARS

		RATER															
SET No.	AREA	1	2	4	6	7	10	11	22	24	25	26		MAX	MIN	AVG	Std Dev
1C	1	9	10	10	10		9	9	10					10.0	9.0	9.57	0.535
1C	2	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
1C	3	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
1C	4	10	10	10	10		10	10	10					10.0	10.0	10.00	0.000
1C	5	9	9	8	10		9	8	10					10.0	8.0	9.00	0.816
1C	6	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
1C	7	8	8	8	9		9	8	10					10.0	8.0	8.57	0.787
1C	8	8	9	8	8		8	8	10					10.0	8.0	8.43	0.787
1C	9	9	10	9	10		9	9	10					10.0	9.0	9.43	0.535
1C	10	8	8	8	8		8	8	10					10.0	8.0	8.29	0.756
	Total Rust	8.58	8.82	8.58	8.86	0.00	8.63	8.50	9.27		0.00			9.27	0.00	6.80	3.864
	Yi	0.1	1.1	0.1	1.3	-37.2	0.3	-0.3	3.1	-37.2	-37.2	-37.2					
2	1	9	9	9	8		9	8	9					9.0	8.0	8.71	0.488
2	2	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
2	3	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
2	4	8	8	8	10		10	8	9					10.0	8.0	8.71	0.951
2	5	10	9	10	9		10	10	9					10.0	9.0	9.57	0.535
2	6	10	9	10	10		10	9	9					10.0	9.0	9.57	0.535
2	7	10	10	10	10		10	10	9					10.0	9.0	9.86	0.378
2	8	10	10	10	10		10	10	8					10.0	8.0	9.71	0.756
2	9	9	9	9	9		9	9	9					9.0	9.0	9.00	0.000
2	10	8	8	8	8		8	8	9					9.0	8.0	8.14	0.378
	Total Rust	8.74	8.58	8.74	8.91	0.00	9.08	8.58	8.63		0.00			9.08	0.00	6.81	3.863
	Yi	0.8	0.1	0.8	1.5	-37.2	2.3	0.1	0.3	-37.2	-37.2	-37.2					
3	1	8	8	8	8	8	8	8	8					8.0	8.0	8.00	0.000
3	2	8	8	8	8	8	8	8	8					8.0	8.0	8.00	0.000
3	3	8	8	8	8	8	8	8	8					8.0	8.0	8.00	0.000
3	4	8	8	8	9	8	9	9	8					9.0	8.0	8.38	0.518
3	5	8	9	8	9	9	8	8	8					9.0	8.0	8.38	0.518
3	6	8	8	8	8	8	8	8	8					8.0	8.0	8.00	0.000
3	7	9	9	8	9	8	8	9	8					9.0	8.0	8.50	0.535
3	8	9	10	9	9	9	9	9	8					10.0	8.0	9.00	0.535
3	9	8	8	8	8	8	8	8	8					8.0	8.0	8.00	0.000
3	10	8	8	8	8	8	8	8	8					8.0	8.0	8.00	0.000
	Total Rust	8.13	8.30	8.08	8.38	8.16	8.25	8.30	8.00		0.00			8.38	0.00	7.29	2.736
	Yi	-1.9	-1.1	-2.1	-0.8	-1.7	-1.3	-1.1	-2.4	-37.2	-37.2	-37.2					
4	1	9	9	9	9		9	9	9					9.0	9.0	9.00	0.000
4	2	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
4	3	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
4	4	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
4	5	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
4	6	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
4	7	8	8	8	10		9	8	8					10.0	8.0	8.43	0.787
4	8	9	9	8	10		8	8	8					10.0	8.0	8.57	0.787
4	9	9	9	9	10		9	9	9					10.0	9.0	9.14	0.378
4	10	9	9	8	9		8	8	8					9.0	8.0	8.43	0.535
	Total Rust	8.34	8.34	8.16	8.59	0.00	8.21	8.16	8.16		0.00			8.59	0.00	6.44	3.653
	Yi	-1.0	-1.0	-1.7	0.1	-37.2	-1.5	-1.7	-1.7	-37.2	-37.2	-37.2					

Attachment 2
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Reference L-33

ASTM Gear Calibration Workshop

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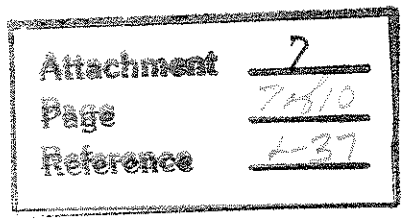
L-33 GEARS

		RATER															
SET No.	AREA	1	2	4	6	7	10	11	22	24	25	26		MAX	MIN	AVG	Std Dev
RE-Rate																	
2/R1	1	8	9	9	8		8	8	8					9.0	8.0	8.29	0.488
2/R1	2	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
2/R1	3	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
2/R1	4	8	8	9	10		9	8	10					10.0	8.0	8.86	0.900
2/R1	5	10	10	10	10		10	10	9					10.0	9.0	9.86	0.378
2/R1	6	10	10	10	8		10	10	10					10.0	8.0	9.71	0.756
2/R1	7	10	10	10	10		10	10	9					10.0	9.0	9.86	0.378
2/R1	8	10	10	10	10		10	10	9					10.0	9.0	9.86	0.378
2/R1	9	10	9	10	10		9	10	10					10.0	9.0	9.71	0.488
2/R1	10	8	8	8	8		8	8	8					8.0	8.0	8.00	0.000
	Total Rust	8.73	8.74	8.98	8.91	0.00	8.82	8.73	8.85	0.00	0.00	0.00		8.98	0.00	5.61	4.452
	Yi	0.7	0.8	1.8	1.5	-37.2	1.1	0.7	1.3	-37.2	-37.2	-37.2					



ASTM Gear Calibration Workshop
San Antonio, TX July 12, 13, & 14, 2005

L-60 GEARS Sludge (Large Gear Only)

	RATER																		
SET #	1	2	3	4	6	7	10	11	16	21	22	23	25	27		MAX	MIN	AVG	Std Dev
1C	9.75	9.75		9.63			9.75	9.50	9.63		9.74			9.75		9.75	9.50	9.69	0.093
2C	9.65	9.75		9.52			9.75	9.50	9.57		9.74			9.70		9.75	9.50	9.65	0.104
3C	9.75	9.75		9.75			9.75	9.50	9.75		9.75			9.75		9.75	9.50	9.72	0.088
4C	9.7	9.50		9.67			9.75	9.50	9.50		9.74			9.73		9.75	9.50	9.64	0.116
5	9.75	9.75		9.63			9.75	9.50	9.50		9.75			9.72		9.75	9.50	9.67	0.112
6	9.65	9.75		9.69			9.74	9.50	9.56		9.72			9.72		9.75	9.50	9.67	0.091
7	9.75	9.75		9.80			9.73	9.70	9.63		9.75			9.75		9.80	9.63	9.73	0.050
8	9.75	9.75		9.75			9.75	9.65	9.63		9.62			9.7		9.75	9.62	9.70	0.058
9	9.75	9.75		9.75			9.75	9.6	9.5		9.74			9.73		9.75	9.50	9.70	0.094
10	9.75	9.75		9.75			9.75	9.75	9.69		9.75			9.75		9.75	9.69	9.74	0.021
RERATE																			
R1/6	9.60	9.75		9.66			9.73	9.50	9.57		9.74			9.69		9.75	9.50	9.66	0.091
R1/7	9.75	9.75		9.70			9.75	9.65	9.57		9.74			9.75		9.75	9.57	9.71	0.066

Attachment 7
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Reference L-37

ASTM Gear Calibration Workshop

San Antonio, TX July 12, 13, & 14, 2005

L-60 GEARS Varnish (Large Gear Only)

	RATER															
SET #	1	2	4	6	7	10	11	16	22	25	27		MAX	MIN	AVG	Std Dev
1C	8.68	8.00	8.63			9.03	8.19	8.86	8.91		9.10		9.10	8.00	8.68	0.394
2C	9.4	7.80	8.56			9.08	8.39	8.80	9.00		9.00		9.40	7.80	8.75	0.497
3C	8.7	7.40	7.60			7.72	8.12	8.00	8.45		9.00		9.00	7.40	8.12	0.558
4C	9.45	8.40	8.85			9.12	8.57	8.85	9.14		9.20		9.45	8.40	8.95	0.347
5	9.30	9.40	8.60			9.10	8.65	8.95	8.90		9.45		9.45	8.60	9.04	0.326
6	9.45	9.30	8.80			9.17	8.85	9.00	9.15		9.30		9.45	8.80	9.13	0.229
7	8.36	7.80	8.42			8.45	8.40	8.30	8.45		8.55		8.55	7.80	8.34	0.230
8	8.05	7.7	7.9			7.75	7.95	7.90	7.85		8		8.05	7.70	7.89	0.119
9	7.50	7.9	7.7			7.85	7.25	7.90	7.6		7.75		7.90	7.25	7.68	0.225
10	7.75	8	7.8			8	7.5	7.95	7.7		8.25		8.25	7.50	7.87	0.230
RERATE																
R1/6	9.29	9.20	8.95			9.20	8.90	9.00	8.85		9.20		9.29	8.85	9.07	0.167
R1/7	8.55	7.90	8.54			8.86	8.60	8.70	8.75		8.45		8.86	7.90	8.54	0.291

Attachment 7
Page 9 & 10
Reference L-37

* Calibration Set

ASTM Gear Calibration Workshop

San Antonio, TX July 12, 13, & 14, 2005

L-60 GEARS Varnish (Large Gear Only)

	RATER														
SET #	1	2	4	6	7	10	11	16	22	25	27	MAX	MIN	AVG	Std Dev
1C	8.68	8.00	8.63			9.03	8.19	8.86	8.91		9.10	9.03	8.00	8.68	0.394
T.U.	1.88	1.39	1.84	####	####	2.23	1.51	2.05	2.10	####	2.31				
Yi	0.18	-1.06	0.08	####	####	1.05	-0.75	0.60	0.73	####	1.26				
2C	9.4	7.80	8.56			9.08	8.39	8.80	9.00		9.00	9.40	7.80	8.75	0.497
T.U.	2.75	1.27	1.78	####	####	2.29	1.65	1.99	2.20	####	2.20				
Yi	2.35	-1.36	-0.07	####	####	1.20	-0.40	0.46	0.97	####	0.97				
3C	8.7	7.40	7.60			7.72	8.12	8.00	8.45		9.00	8.70	7.40	8.12	0.558
T.U.	1.90	1.05	1.15	####	####	1.22	1.46	1.39	1.70	####	2.20				
Yi	0.23	-1.91	-1.64	####	####	-1.48	-0.87	-1.06	-0.29	####	0.97				
4C	9.45	8.40	8.85			9.12	8.57	8.85	9.14		9.20	9.45	8.40	8.95	0.347
T.U.	2.84	1.66	2.04	####	####	2.34	1.79	2.04	2.36	####	2.44				
Yi	2.58	-0.38	0.58	####	####	1.32	-0.05	0.58	1.38	####	1.58				
5	9.30	9.40	8.60			9.10	8.65	8.95	8.90		9.45	9.40	8.60	9.04	0.326
T.U.	2.59	2.75	1.82	####	####	2.31	1.86	2.14	2.09	####	2.84				
Yi	1.94	2.35	0.01	####	####	1.26	0.12	0.83	0.70	####	2.58				
6	9.45	9.30	8.80			9.17	8.85	9.00	9.15		9.30	9.45	8.80	9.13	0.229
T.U.	2.84	2.59	1.99	####	####	2.40	2.04	2.20	2.38	####	2.59				
Yi	2.58	1.94	0.46	####	####	1.48	0.58	0.97	1.42	####	1.94				
7	8.36	7.80	8.42			8.45	8.40	8.30	8.45		8.55	8.45	7.80	8.34	0.230
T.U.	1.63	1.27	1.67	####	####	1.70	1.66	1.59	1.70	####	1.77				
Yi	-0.45	-1.36	-0.34	####	####	-0.29	-0.38	-0.56	-0.29	####	-0.09				
8	8.05	7.7	7.9			7.75	7.95	7.90	7.85		8	8.05	7.70	7.89	0.119
T.U.	1.42	1.21	1.32	####	####	1.24	1.36	1.32	1.30	####	1.39				
Yi	-0.37	-0.81	-0.56	####	####	-0.75	-0.50	-0.56	-0.63	####	-1.06				
9	7.50	7.9	7.7			7.85	7.25	7.90	7.6		7.75	7.90	7.25	7.68	0.225
T.U.	1.10	1.32	1.21	####	####	1.30	0.97	1.32	1.15	####	1.24				
Yi	-1.05	-0.56	-0.81	####	####	-0.63	-1.32	-0.56	-0.93	####	-1.43				
10	7.75	8	7.8			8	7.5	7.95	7.7		8.25	8.00	7.50	7.87	0.230
T.U.	1.24	1.39	1.27	####	####	1.39	1.10	1.36	1.21	####	1.55				
Yi	-0.75	-0.43	-0.69	####	####	-0.43	-1.05	-0.50	-0.81	####	-0.65				

Attachment 7
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Reference L-37

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Fluid technologies for a better world™

L-37 Precision

August, 2005

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Precision/Repeatability Estimates

- Rater workshop data (within rater repeatability estimates)
- Rater LTMS (within and across rater repeatability estimates --including time)
- Reference oil standard deviations (calculated by TMC) to estimate test variability

Attachment 8
Page 26 of 28
Reference 4-37

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July 2005 Workshop Data

- This data set had 28 pairs of measurements (a pair is a repeat measurement made by the same rater on the same pinion)
- There were 7 raters and 4 pinions (Rater LTMS codes 2, 3, 14, 40) used in this analysis
- Wear, rippling, ridging, and spitting were analyzed

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7/05 Workshop Wear

Average	Set/Pinion #	% Not Matching
6.0	12/3	0
5.9	5/2	14
6.1	9/40	0
6.0	8/14	0
	Overall	**4**

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7/05 Workshop Rippling

Average	Set/Pinion #	% Not Matching
7.0	12/3	28
7.8	5/2	14
9.1	9/40	14
8.5	8/14	71
	Overall	32

Attachment 8
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Reference L-37

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7/05 Workshop Ridging

Average	Set/Pinion #	% Not Matching
8.4	12/3	28
8.8	5/2	14
5.7	9/40	57
6.7	8/14	57
	Overall	39

Attachment 8
Page 6 of 26
Reference L-37

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Rater LTMS

- Data analyzed were validity codes OC, AC, AG (workshop)
- Rater codes for this presentation do not match codes in database, since focus is on overall industry rater repeatability

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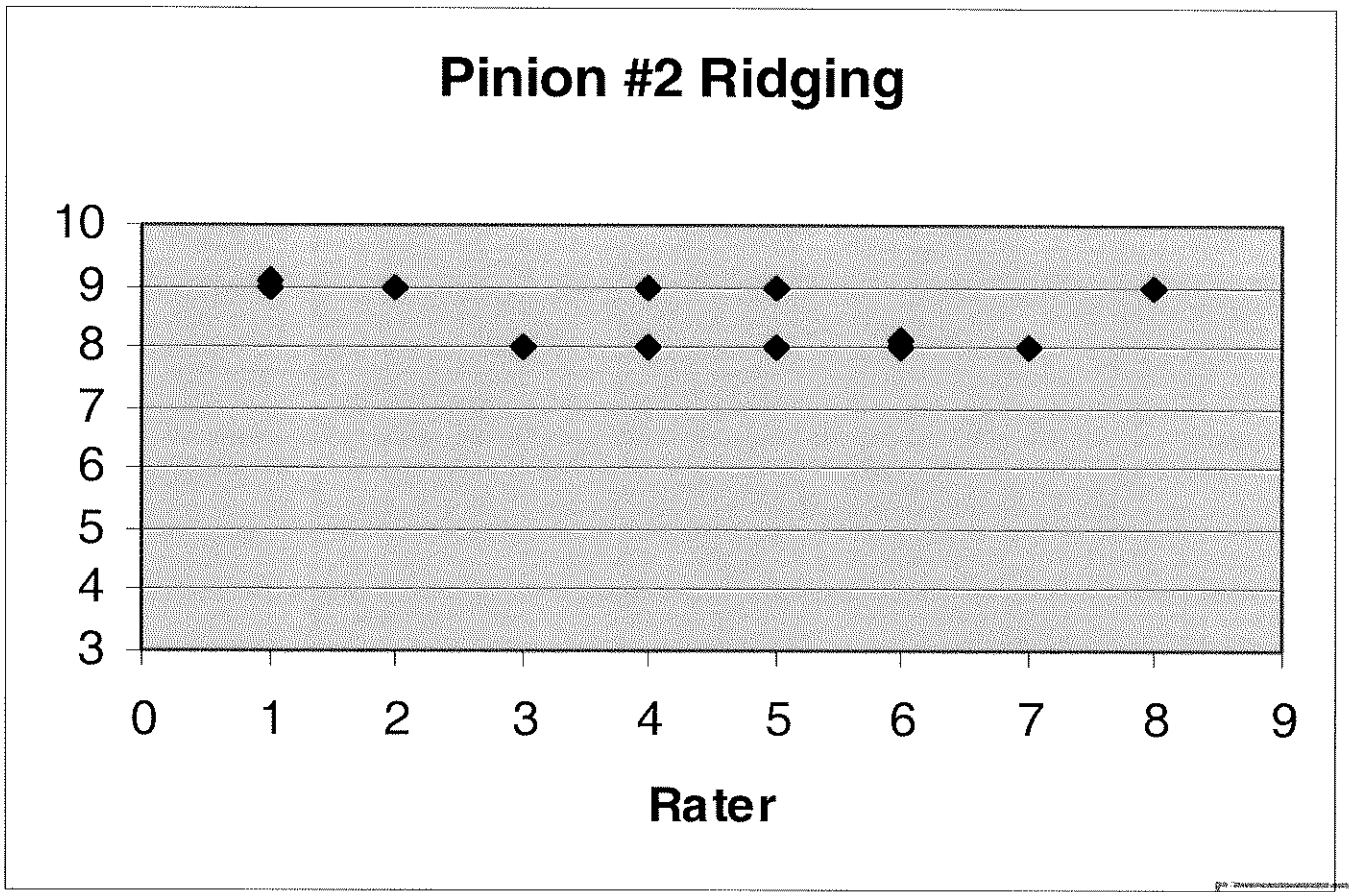
Rater LTMS Ridging for Pinion #2



Attachment 2
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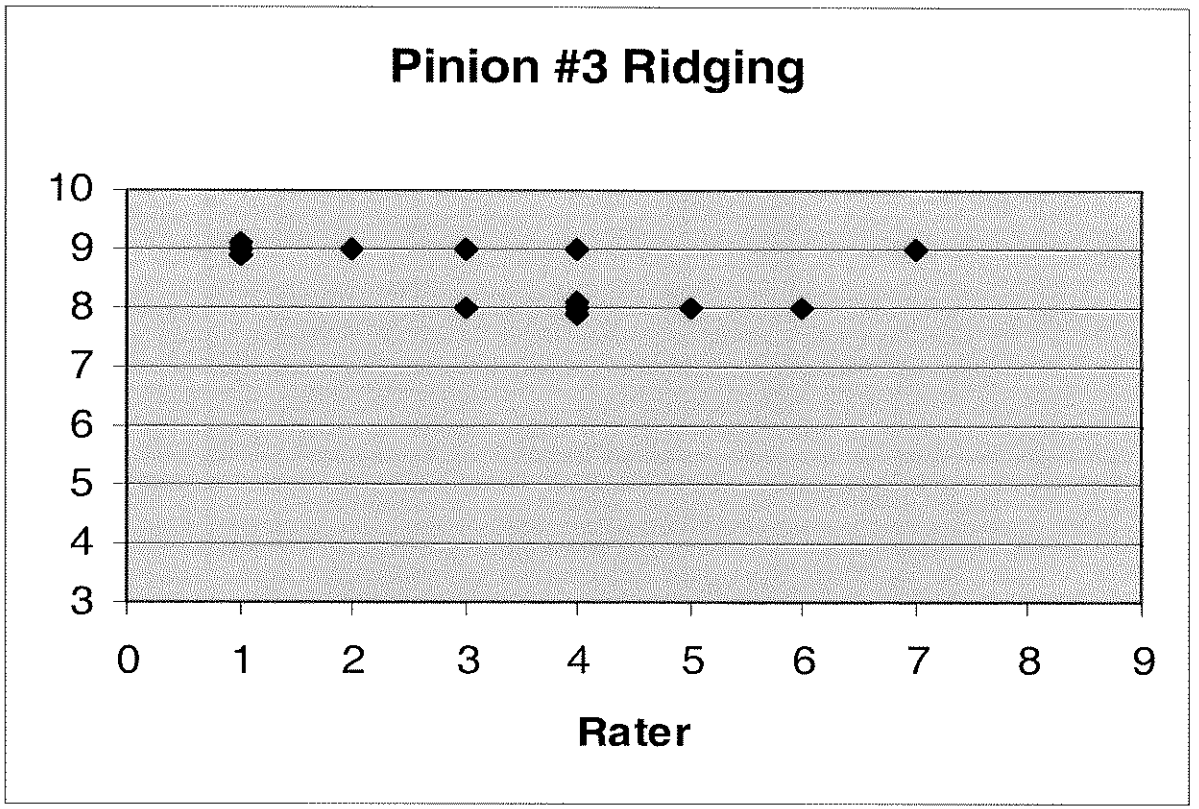
Rater LTMS Ridging for Pinion #3



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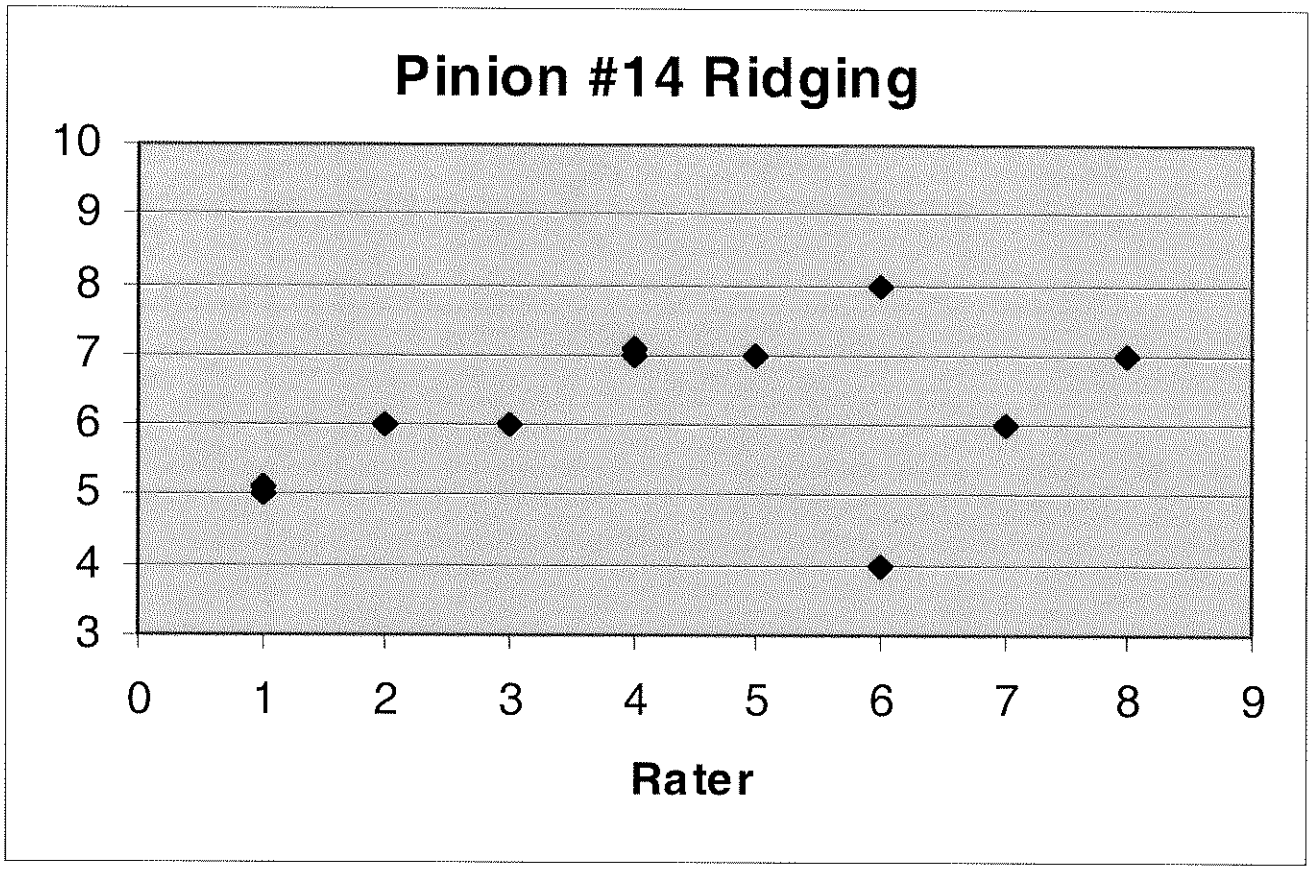
Rater LTMS Ridging for Pinion #14



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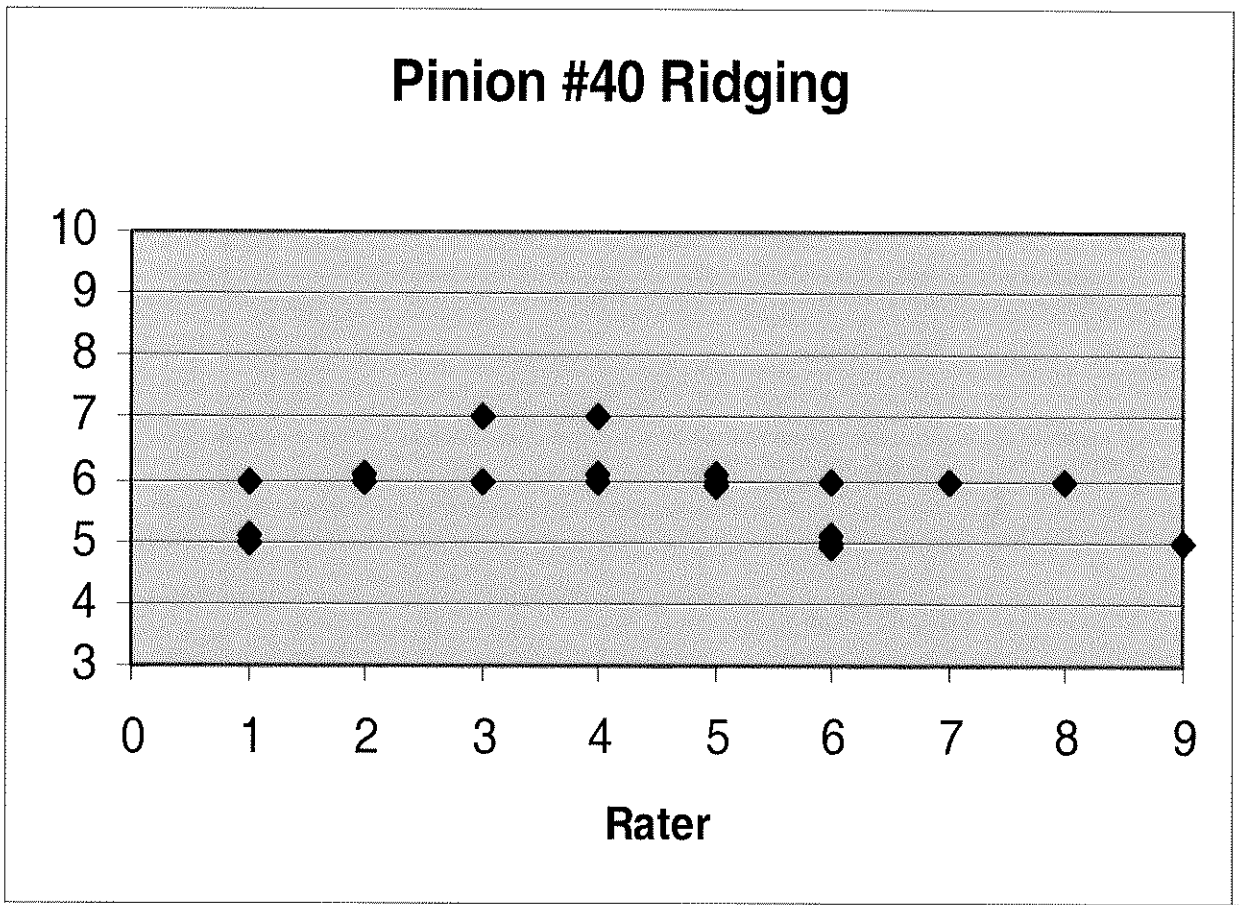
Rater LTMS Ridging for Pinion #40



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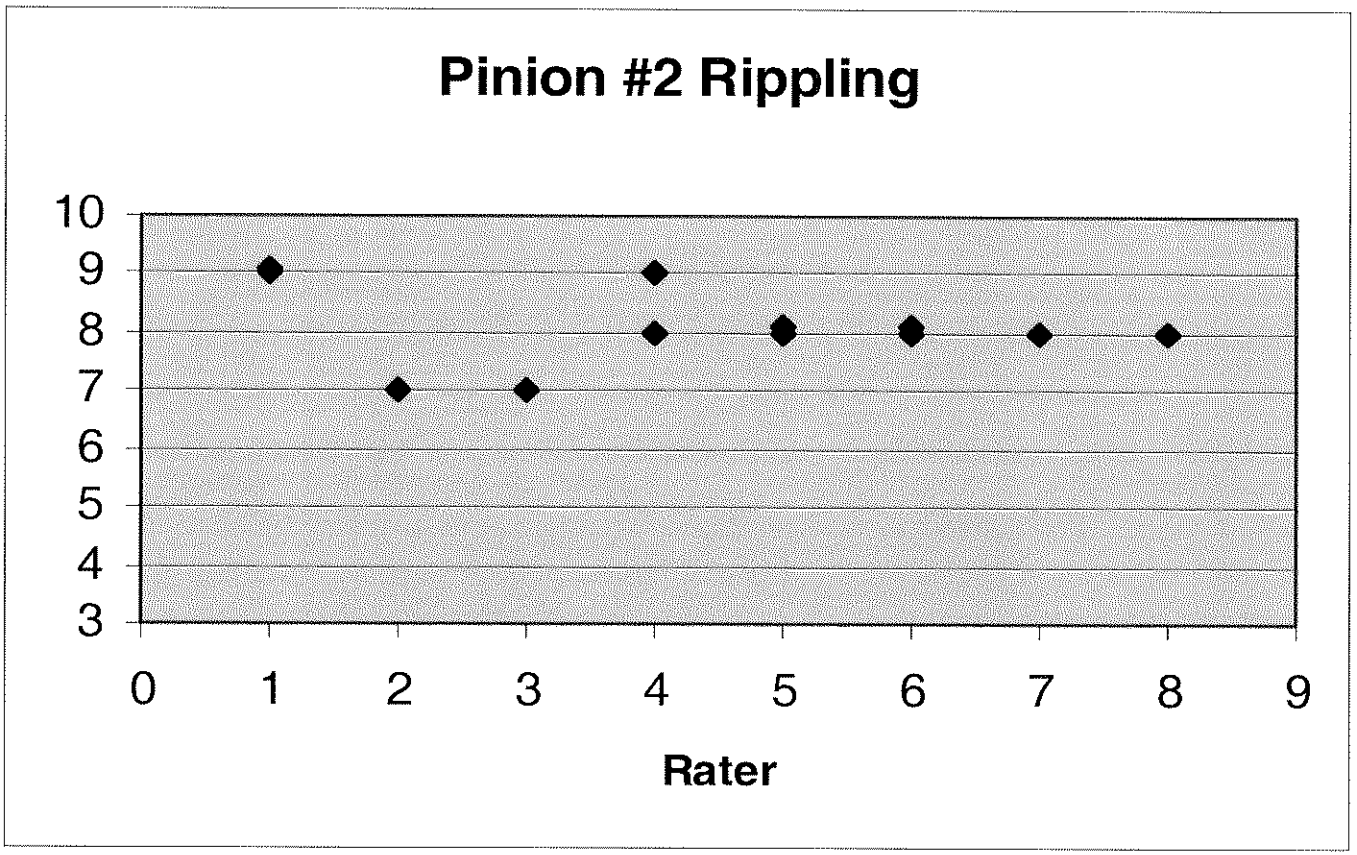
Rater LTMS Rippling for Pinion #2



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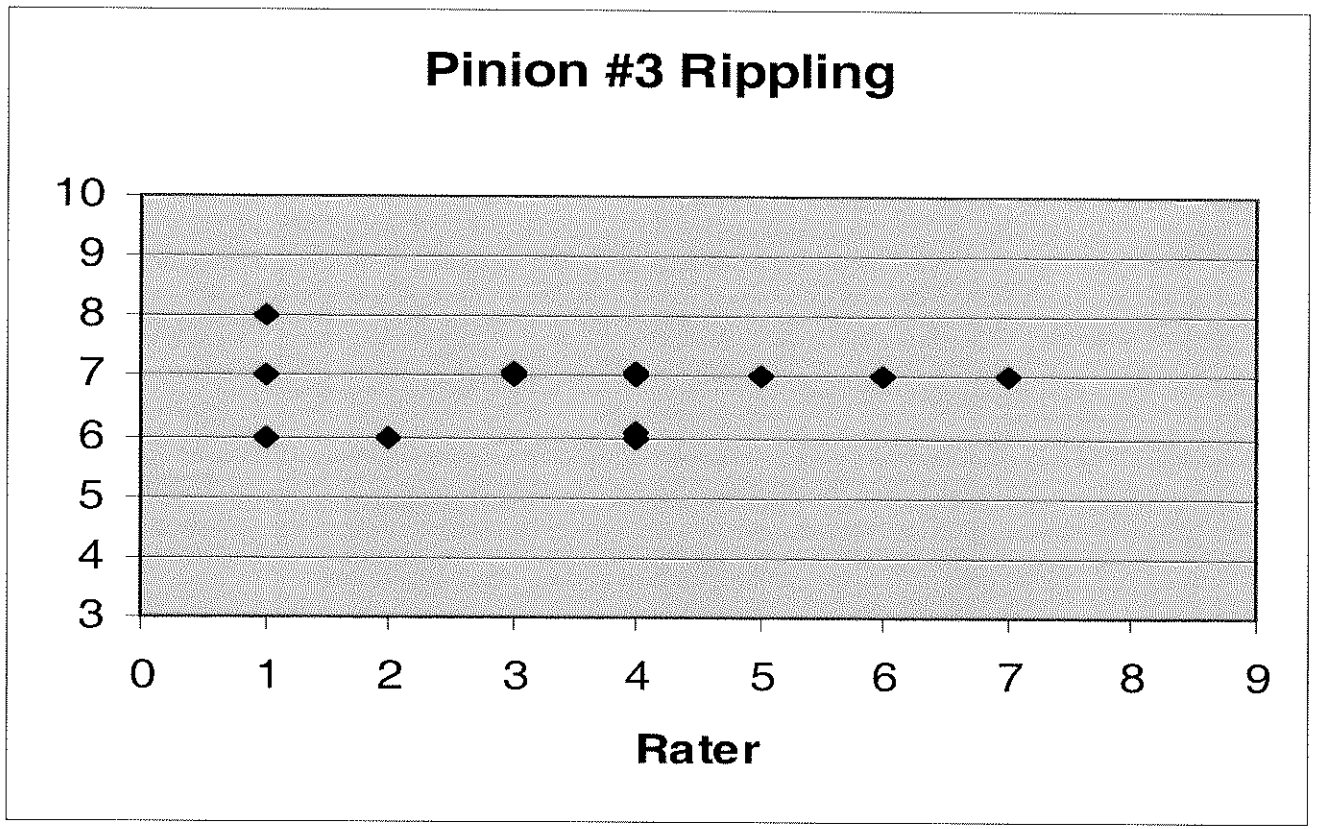
LUBRIZOL

Rater LTMS Rippling for Pinion #3



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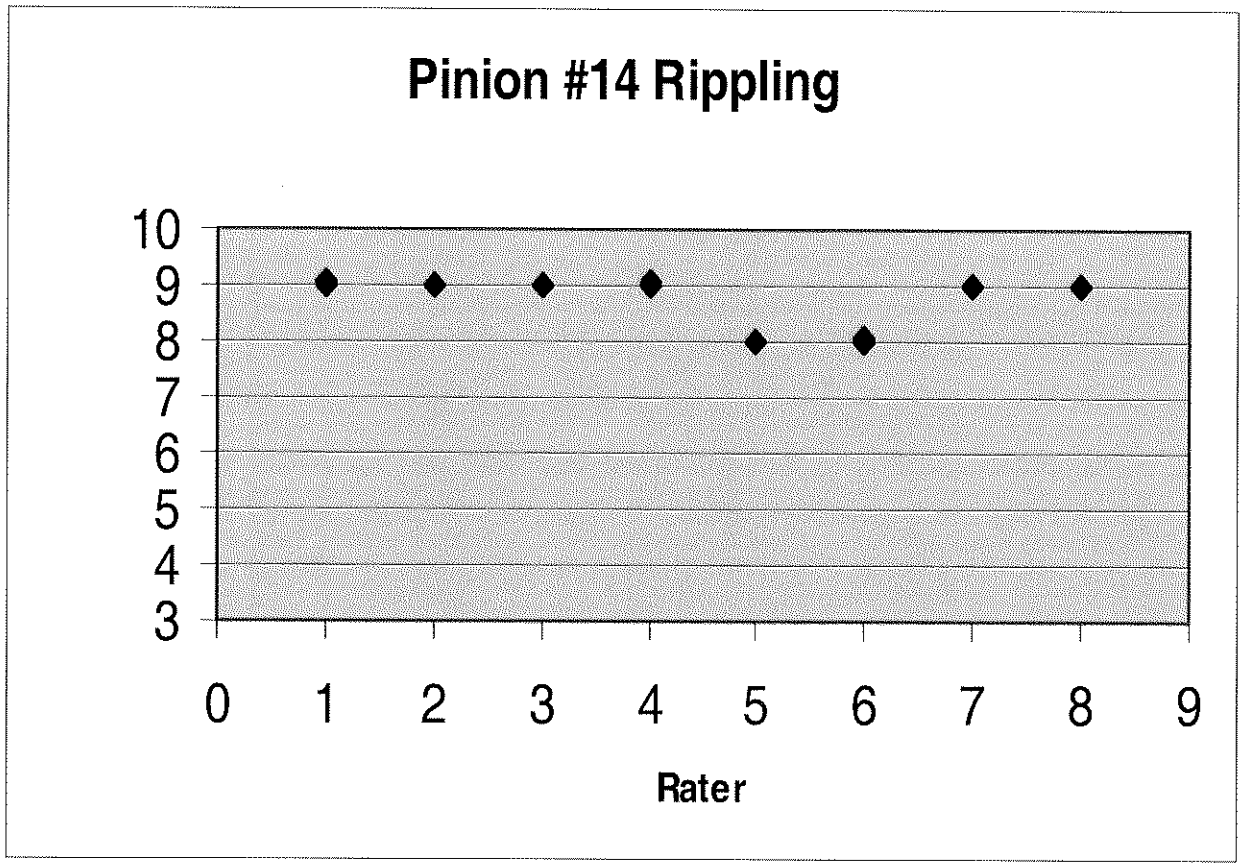
LUBRIZOL

Rater LTMS Rippling for Pinion #14



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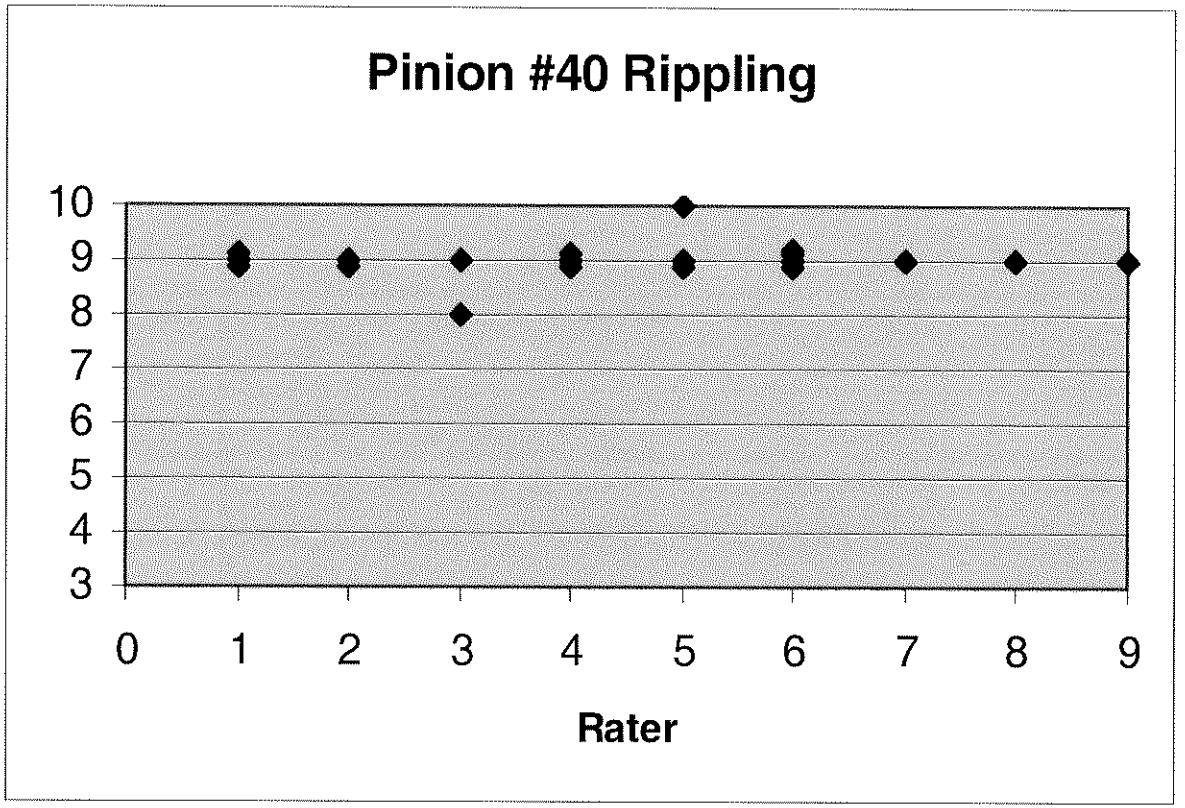
Rater LTMS Rippling for Pinion #40



Attachment 2
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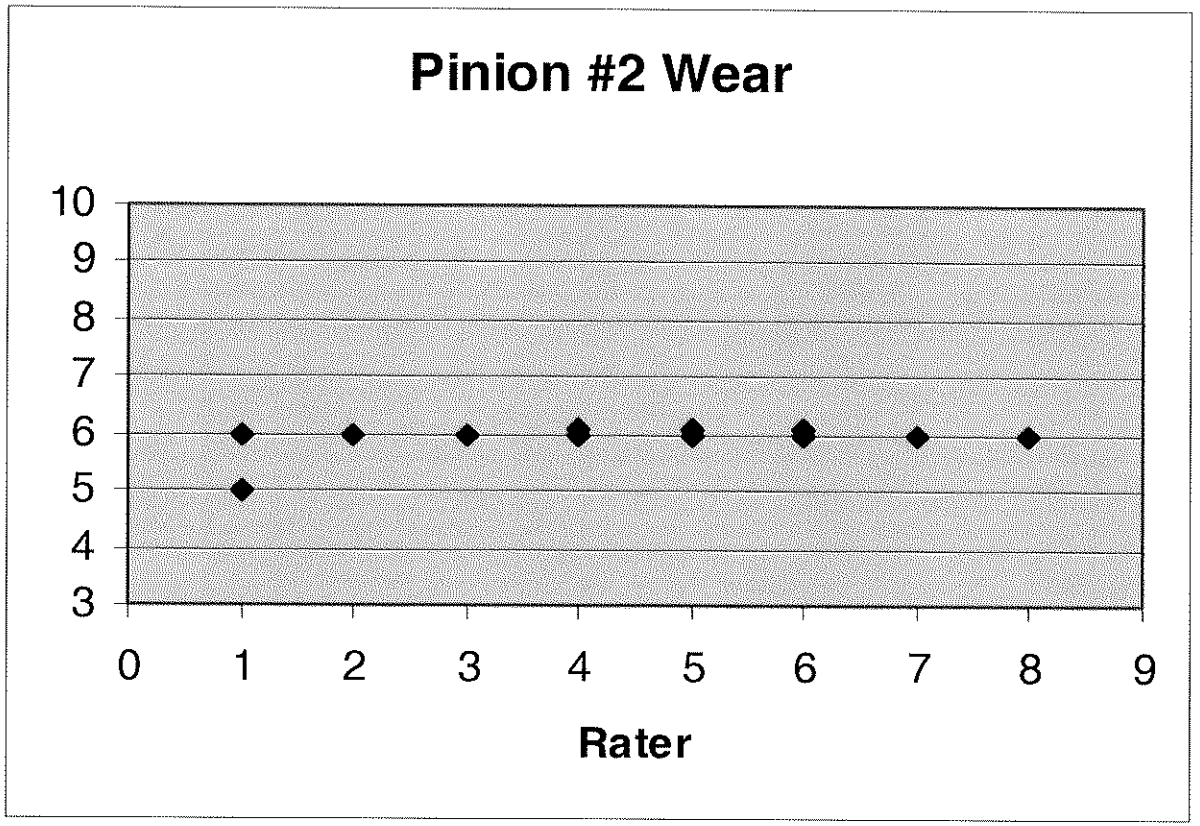
Rater LTMS Wear for Pinion #2



Attachment B
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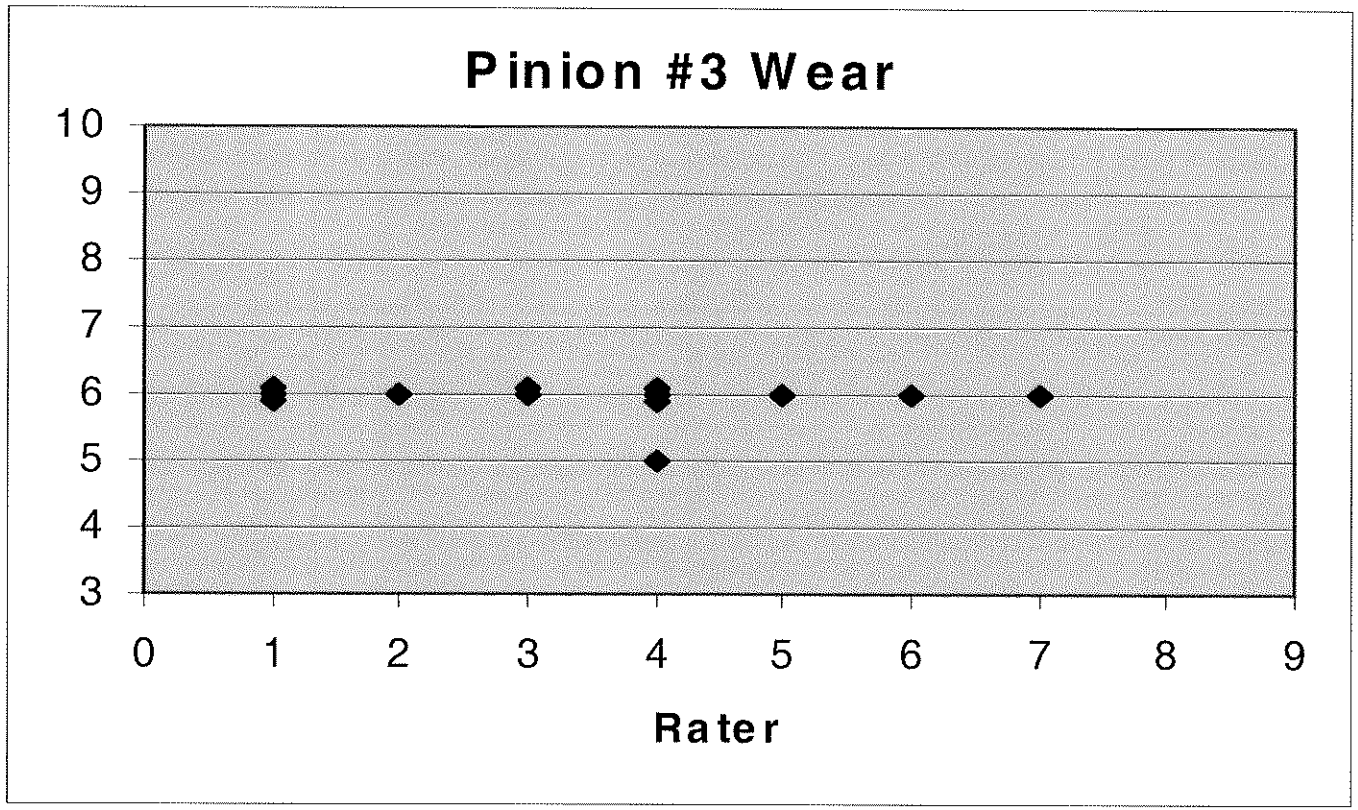
Rater LTMS Wear for Pinion #3



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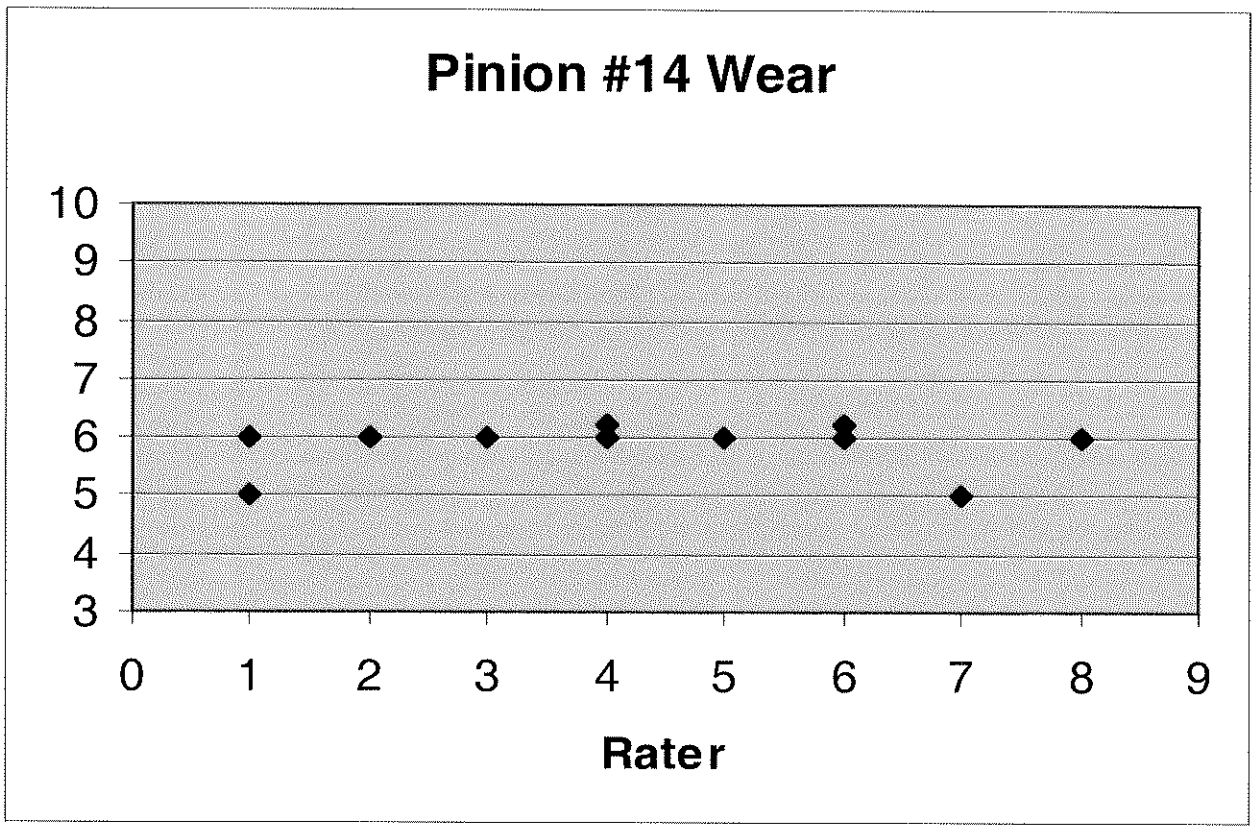
Rater LTMS Wear for Pinion #14



Attachment 2
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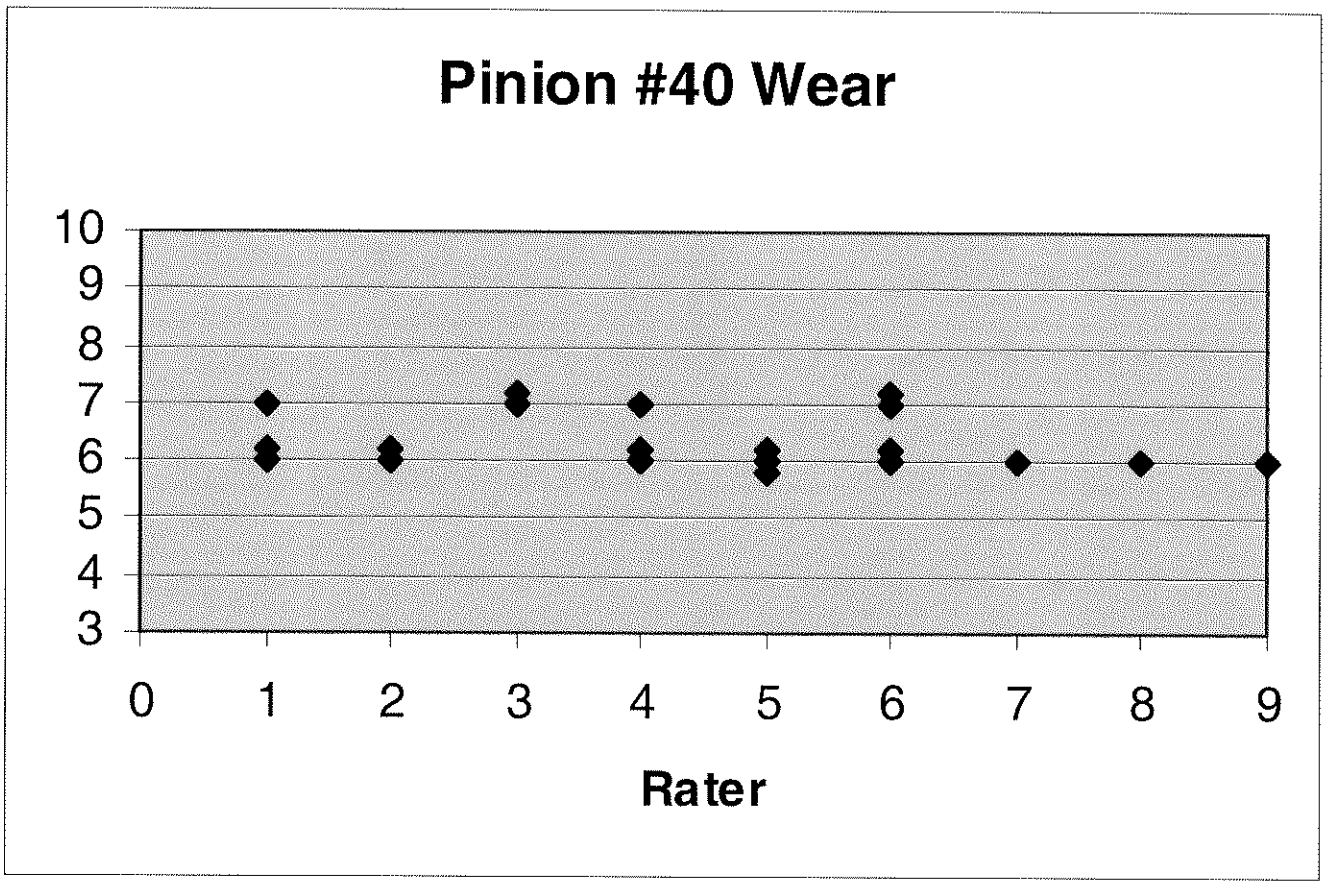
Rater LTMS Wear for Pinion #40



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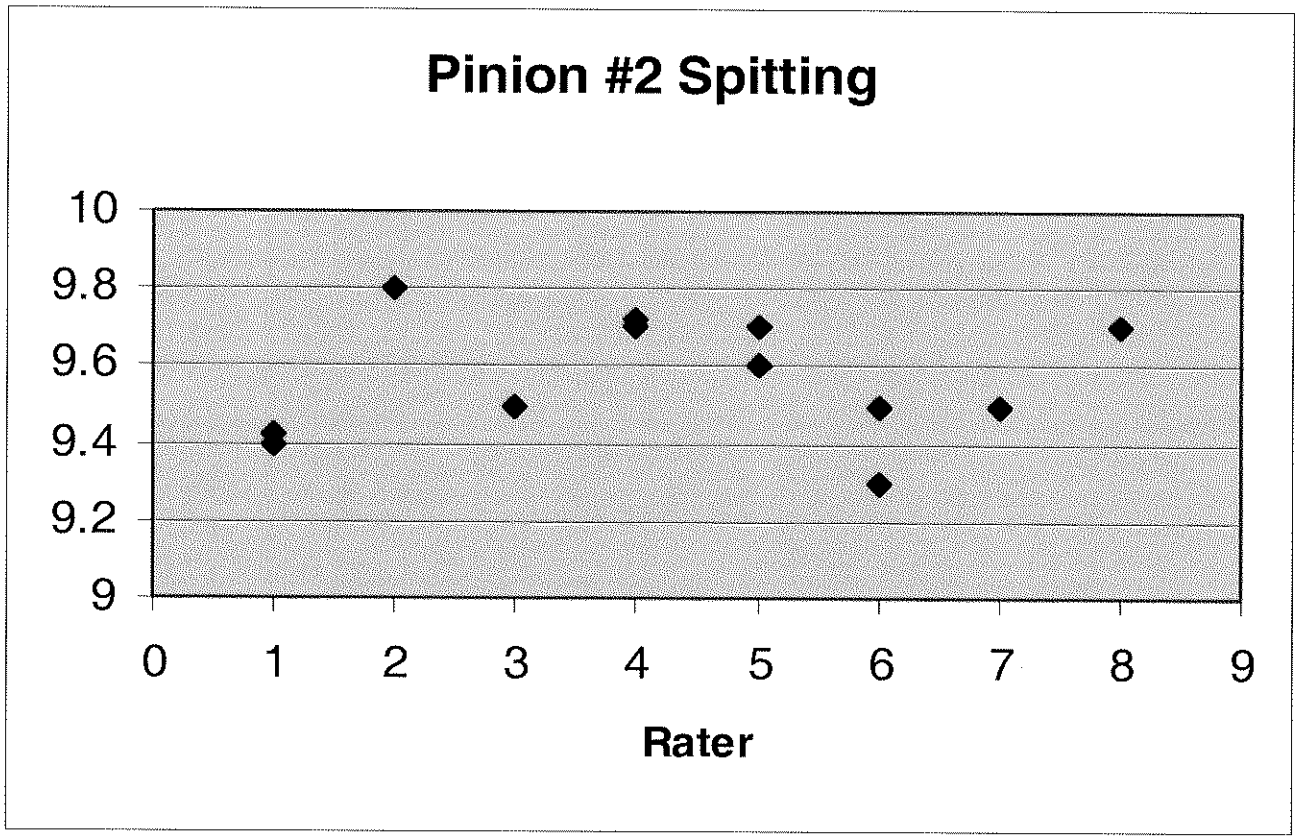
Rater LTMS Spitting for Pinion #2



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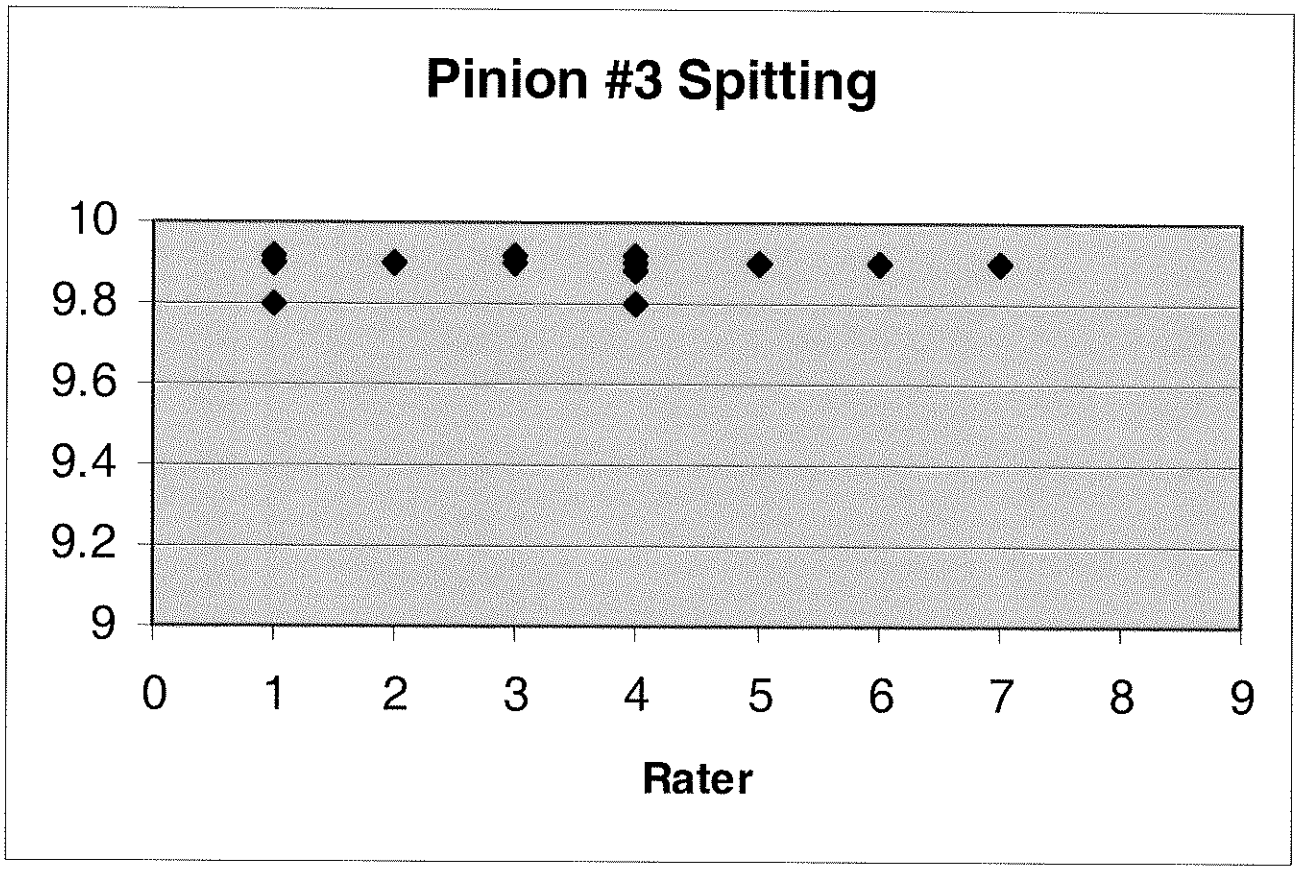
Rater LTMS Spitting for Pinion #3



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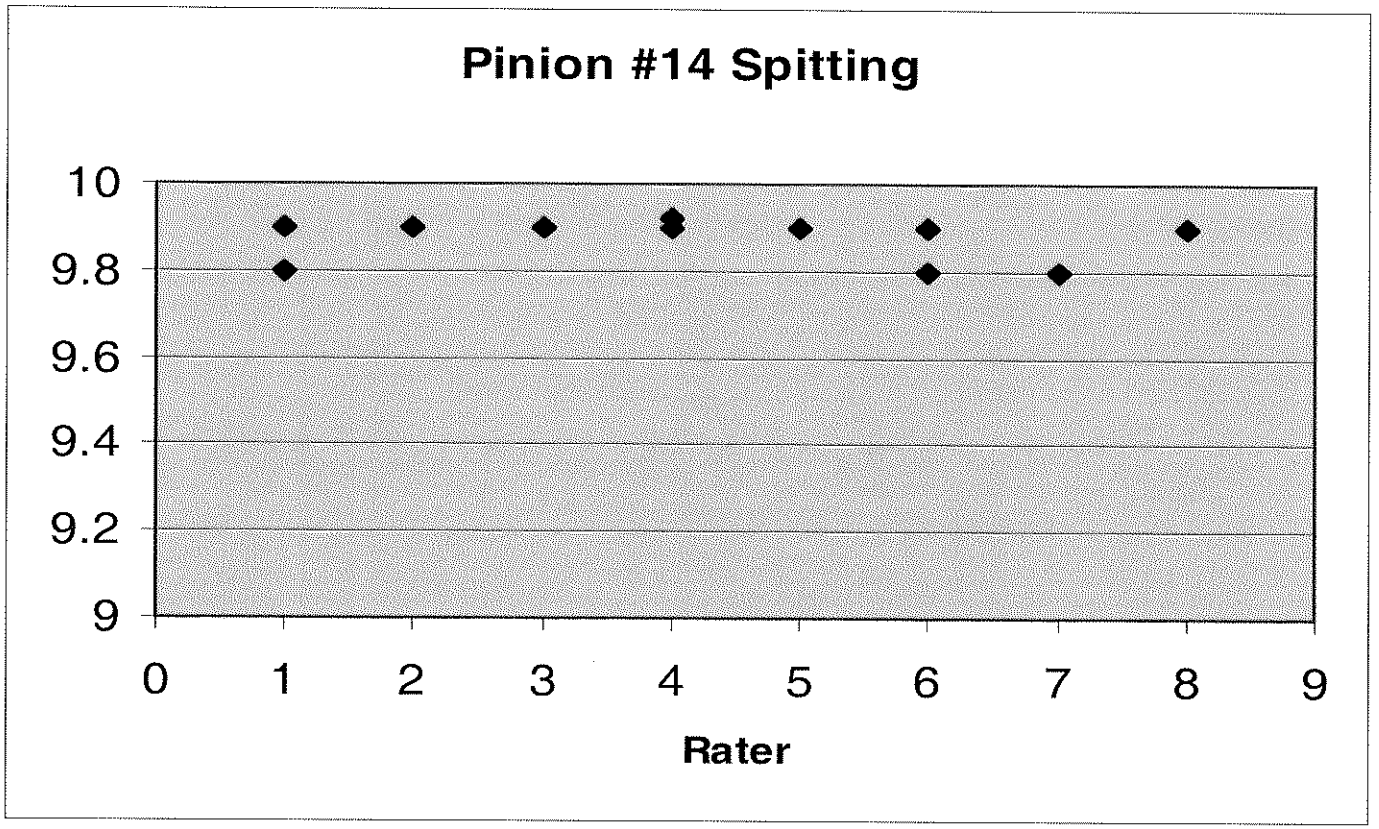
Rater LTMS Spitting for Pinion #14



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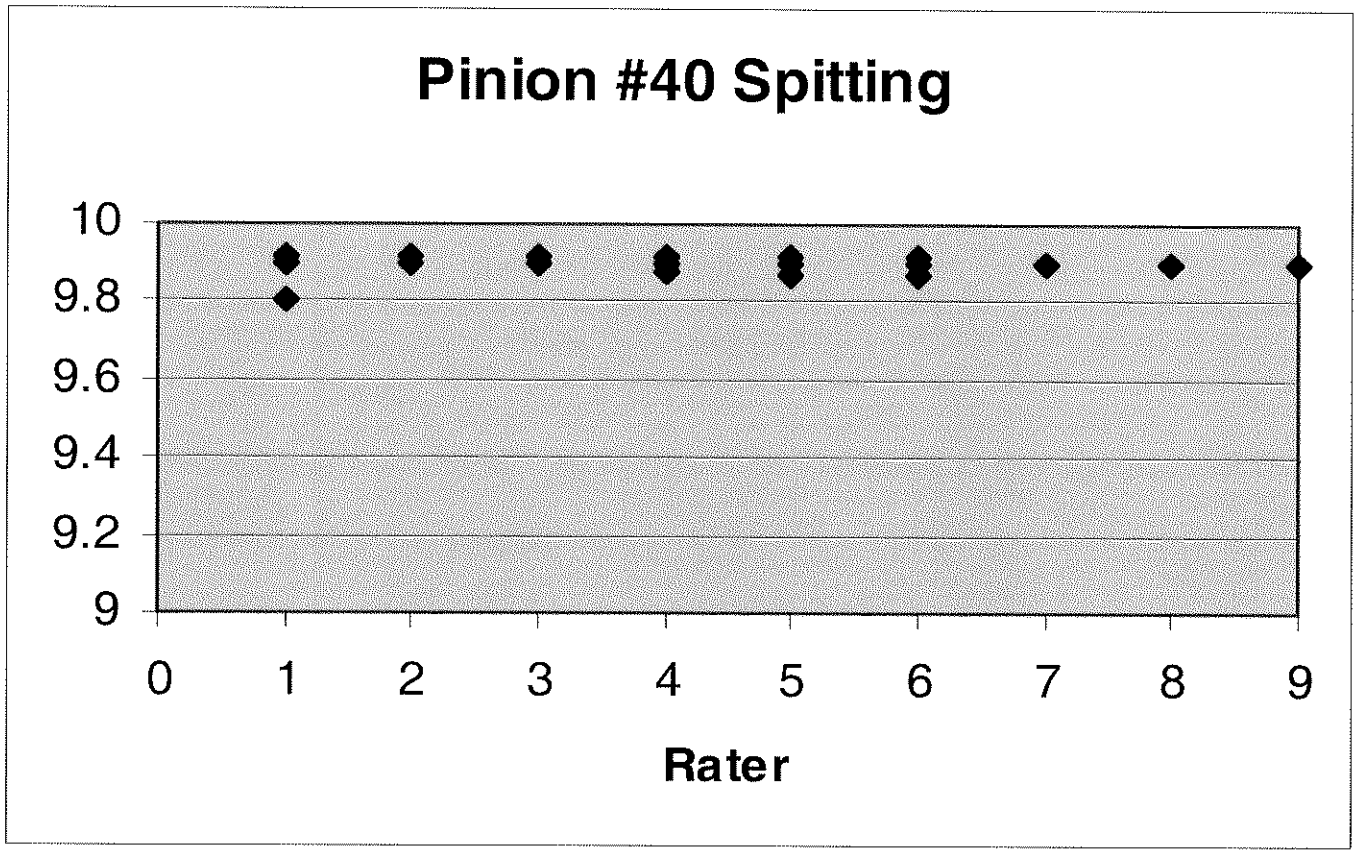
Rater LTMS Spitting for Pinion #40



Attachment 8
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Reference L-37

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Industry Reference Data

- Used TMC standard deviation calculations to make repeatability statements
- Standard deviations for Ridging, Rippling, and Spitting are stated in transformed units
- Calculated repeatability above and below the pass fail line, reversed the transformation, and averaged the result

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Avg. Repeatability Around P/F Line Merit Units

Lubrited Hardware	TMC Industry Std. Deviation	Average Repeatability
Wear	0.5480	1.5
Ridging	0.2612	2.0
Rippling	0.2341	1.8
Spitting	0.4038	1.7

Attachment 5
Page 25 & 28
Reference L-37

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What Repeatability Estimates Mean

Lubrited	Cannot tell the difference between true performance of	Cannot tell the difference between true performance of
Wear	3.5 and 5	5 and 6.5
Ridging	5.3 and 8	8 and 9.3
Rippling	5.6 and 8	8 and 9.2
Spitting	6.7 and 9.3	9.3 and 10.0

Attachment 8
Page 26 of 28
Reference L-37

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Conclusions

- Rater variability is a significant source of overall L-37 variability
- Even under the best circumstances (same rater, same time frame), the same part can easily receive a rating that differs by a unit (e.g., rater workshop)
- When time and rater-to-rater variation are added as sources of variability, the results for a particular fluid can span about 3 rating units (e.g., ridging).

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Recommendations

- Use the average of all 7 pinion teeth as the measurement for pinion ridging, rippling, wear, and spitting
- Report ring in the usual manner, since pinion distress should be more severe

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Why?

- It should improve the rating precision
- Everything that we do from control charting to severity adjustments relies on normal distribution theory
- If the worst tooth is rated and reported, the distribution of the data is the extreme value distribution, not the normal distribution
- The coverage of the 95% reference bands should also be more exact (i.e., when a reference band is from 7.8 to 9.2 the true coverage is less than 95%, because values can only be an 8 or a 9)

PRI Request for Significant Digit Precision and Reporting

- April 2005 SP meeting:
  - We started to address PRI Request for Significant Digit Precision.
  - Motion 4 - Change the reported level of precision for the Original Merit results on ring and pinion for wear, rippling, ridging, and scoring to have Original Merit Results be reported to whole numbers. Pitting/Spalling would continue to be reported to tenths because of the current rating scale for pitting/spalling.

    The Final Merit Results for all distresses would continue to be reported to tenths using Standard Practice E 29.
  - Motion 5 - Per TGC request, the SP is to implement the TMC recommendation for standardizing LTMS SA Standard Deviation and Test Method Precision on April 11th and effective the date of the information letter.

    This is effective for both lubrited and non-lubrited hardware.
  - Statistical Presentation – Denise Vermilya – What level of precision can rater's rate too?
  - Action Item – TMC pull the reference data used to develop the initial correction factors and propose new correction factors to help us better understand what happens when you round the final reported values to a whole number. The SP should then make necessary recommended changes to the current correction factors to get the same pass/fail results.