
Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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January 23, 2006

Reply to:
Donald T. Bartlett
The Lubrizol Corporation
29400 Lakeland Blvd.
Wickliffe, OH 44092
(440) 347-2388
(440) 347-2878 (FAX)

ASTM D02.B0.03 L-37 Surveillance Panel

Members and Guests:

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

- o **November 29th, 2005 L-37 Hardware TF visit to Dana Ft. Wayne IN. facility.**

Please direct any corrections or comments to my attention.

Sincerely,



Donald T. Bartlett, Chairman

L-37 Surveillance Panel

Attachments

Report of Dana Facility Visits by
L-37 Hardware Task Force
November 29, 2005 Ft. Wayne IN Facility Visit

I. Attendees:

Ethyl Corp:	Cory Koglin	Lubrizol Corp:	Don Bartlett
Lubrizol Corp:	Pete Kampe	Lubrizol Corp:	Chris Schenkenberger
PARC:	Dale Smith		
Dana Corp:	Bruce Hall - Production Scheduler		
Dana Corp:	Don Kreinbring - Principle Engineer, ASTM Representative		
Dana Corp:	Lou Pappademos - Quality		
Dana Corp:	Mr. Cole - Heat Treating		

II. Agenda:

- Introductions
- Recap of 2005 Non Lubrited P4T771/v1L351A Industry Order
- Review of specific requirements and concerns requested by the L-37 Surveillance Panel

III. Summary Facility Visit and Discussion, Consensus Actions, and Motions:

Mr. Bruce Hall welcomed our TF and provided a summary overview of the Ft. Wayne production facility.

Chairman Bartlett provided a summary recap of the L-37 Surveillance Panel request and the purpose of the L-37 Hardware Task Force. He stressed the importance of the Three "Cs" that we require because of our industry need; Consistency, Consistency, and Consistency. A review and the reasoning why the L-37 testing industry places a 2-year industry order as well as the cost to qualify were discussed. This hardware order represents an initial outlay of approximately 1.2 million dollar cost shared by the four labs to be used to meet industry-testing commitments through 2007.

2005 Non-Lubrited Hardware P4L792/VL417 Discussion:

2-Year Industry Axle Order Information:

	<u>Axles Ordered</u>
Afton	450
Lubrizol	400
Parc	220
SwRI	<u>300</u>
Total	1470

- **Attachment 1** - is an example summary of the L-37 Standard operating conditions.
- **Attachment 2** - The panel approved 44-test industry hardware matrix the labs will conduct/incur costs (approximately \$ 5000 each test to conduct) to approve the hardware batch.
- We reviewed CRC Manual 21 rating photos with respect to the D 6121 Test Method and the critical need to maintain the production tooling marks to support the rating definitions for wear distress defined in our test rating process.
- **Attachment 3** - details a memo and photos from Mr. Okamuro for the Ft. Wayne produced 2004 non-lubrited hardware batch we desire Dana to duplicate. These are examples of acceptable/typical tooling marks found in the P4T771/V1L351 gear batch for clarification of our expected needs.
- **Attachment 4** - Details an example of a Dana Tooth Contact Pattern Acceptability Chart (sheet 1) that is acceptable.
- **Attachment 5** - Details an example of a Dana Tooth Contact Pattern Acceptability Chart (sheet 2) that is unacceptable. We also confirmed that any other contact pattern other than as noted in Attachment # 4 is unacceptable for our testing purposes.
- **Attachment 6** - Examples of unacceptable hardware production process issues seen in past batches.
- **Attachment 7** - Is another example of manufacturing defects observed by labs in the 2004 non-lubrited order (and others as well) that can cause a test to be deemed a distress fail or results put into question related to oil formulation. The TF message to Dana was that if there is a known/observed defect, we would rather the hardware be rejected/discarded due to problems it causes after the fact. We understand that this decision may reduce the final count of available gears for assembly. In this case, the labs would share in the loss for final shipped axles based on a percentage of gears that they actually ordered.
- **Attachment 8** - was provided by Mr. Kreinbring and is an example of the 2004 non-lubrited PPAP Metallurgical Test Report from the P4T771/V1L351 2004 non-lubrited axles provided by Dana. We hope that the new batch of hardware would be similar.
- **Attachment 9** - memo from Mr. Kreinbring detailing information for the Ft. Wayne and Lugoff facility visits by the L-37 Hardware TF.

Other Dana and TF comments and discussion:

- Confirmed that the ring and pinions were made from 8625 steel.
- That it will take approximately 13 days to cut the ring and pinions. We asked that the rough cutters be changed out after every 200 pieces and the finish cutters be changed out after every 300 pieces.
- It will take one full day to carburize the ring and pinions. That will be after they are all cut and ring and pinions will both be done at the same time.
- It will take 1 to 2 days to shot peen the gears.
- It will take 1-2 days for lapping the gears. We also specified that we wanted Ft. Wayne to use a 280-grit compound for lapping the gears. That was a strong recommendation use on past gears as requested by Mr. Okamuro. The Ft. Wayne facility typically uses a different grit compound to lap typical gears, but did have the 280-grit compound and would use it.
- The shipping of ring and pinions to the Lugoff facility is tentatively set for 12-9-05.
- We asked that the drawings be confirmed and updated to the current specification in all details to avoid future differences. Mr. Kreinbring did provide a few examples of the drawing. Those will be included with others that are being provided by Mr. Kreinbring in the future and will be included as part of the Lugoff Facility visit minutes.
- Reviewed gear # stamping requirements.
- Mr. Hall, Mr. Pappademos and others took us on a full tour of the Ft. Wayne production facility that was quite detailed. We especially focused on the cutting, quality, heat-treating, and shot peening areas of the facility.

The Hardware TF would like to take the opportunity to thank the Ft. Wayne facility group for their hospitality, time taken time out of their busy schedules to meet with us and their open, sharing, detailed discussion, and desire to help us better understand their gear production processes and the opportunity to communicate our needs to them.

The visit was concluded/adjourned at 5:24 p.m.

Respectfully submitted,



Donald T. Bartlett,
L-37 Surveillance Panel Chairman

010006.01 Test Specifications

(STANDARD L-37)
Standard Gear Set

View

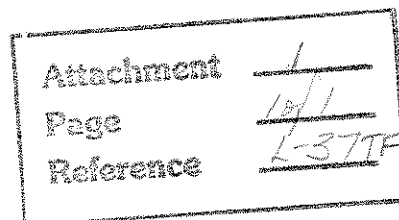
The purpose of this test is to determine the load carrying, wear, and extreme pressure characteristics of gear lubricants under high speed, low torque and low speed, high torque conditions.

Conditions

	Gear Conditioning Phase	Gear Test Phase
Duration	100 minutes	24 hours
TAXLE	297 \pm 3 °F	275 \pm 3 °F
RPMDYN & RPMDYS	440 \pm 5 rpm	80 \pm 1 rpm
LOADN & LOADS	395 \pm 15 lb•ft	1740 \pm 35 lb•ft
Transmission Gear	4th	1st
Hand Logs	Every 10 minutes	Hourly
Sample Taken	None	4 fl. oz @ EOT

Reference Information:

ASTM D 6121- Test Procedure
L37WI- L-37 Work Instructions



2005 Non-Lubrited Hardware Order and Status

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)

Attachment	<u>2</u>
Page	<u>10/1</u>
Reference	<u>L-3 TTP</u>

Bartlett, Donald

From: Bartlett, Donald
Sent: Thursday, August 19, 2004 1:58 PM
To: Tom Bryson (thomas.bryson@volvo.com); william.t.sullivan@exxonmobil.com; bkoehler@swri.edu; Bruce.McGlone@ArvinMeritor.com; Dale Smith (dsmith@parctech.com); dml@astmtmc.cmu.edu; james.l.linden@gm.com; Juan Buitrago (jabu@chevrontexaco.com); ken.okamuro@dana.com; Kevin Layton (kevin.layton@aftonchemical.com); Khaled Zreik (zreikk@tacom.army.mil); pvettel@dastuart.net; thelmaemarougy@eaton.com
Cc: Bartlett, Donald; Castanien, Chris; Schenkenberger, Chris; Slocum, Robert
Subject: FW: L37 Hardware

Attachments: 060GA105x Lapped GCV Surface.jpg; 060GA105x Lapped GCX Surface.jpg; 060GA105x Lapped PCV Surface.jpg; 060GA105x Lapped PCX Surface.jpg; PatContact.jpg



060GA105x Lapped 060GA105x Lapped 060GA105x Lapped 060GA105x Lapped PatContact.jpg (21
GCV Surface.j... GCX Surface.j... PCV Surface.j... PCX Surface.j... KB)

Note to all:

I have had several communications with Ken and the non-lubrited axle order assembly that is currently in progress. I thought I would bundle them in this one distribution. I certainly appreciate Ken's efforts to update their progress and decisions, the involvement of both Ken's, and am forwarding this to the surveillance panel members and guests in two-distribution list. These will aid in our discussions next week as well.

1. See note below in red referencing the decision to build axles on two shifts.
2. **Ken also reports:**
 - a) Kenny Miller and I observed the first axles being built. What was very noticeable was that due to minimum lapping to preserve the tool marks, the contact patterns are not as filled in under the light test load we use at assembly. For this reason, I am sending this explanation on pattern interpretation.
 - b) When you see the pattern, it may look narrow and have the appearance of bias. In fact, under slightly higher load it will fill out. The V&H check of the pattern confirms it does not have bias. At assembly, they will judge the pattern with the following criteria:
 - 1) If the solid contact line is longer at the top than the bottom, the pattern is slightly flanked out (F+1).
 - 2) If the solid contact line is the same length top and bottom, the pattern is centered (F0).

Attachment	3
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Reference	L37TF

- 3) If the solid contact line is longer at the bottom than the top, the pattern is slightly flanked in (F-1). Note: See attached imbedded image patcontact.jpg.
- c) The axles are stamped with Julian date, year, and shift on the housing cover flange just above the axle tube. There is a second date stamp on the flange from our supplier that is the date the housing was machined. You do not want to use this date. Ken indicated that the second shift individual did not follow the instructions on 70 axles and that has been corrected. This really should not be an issue since the date is still there, just in a different location on the 70 axles.
- d) On another question from Ken, he asks, If a rust preventative is going to be necessary on future hardware, has the Panel studied the effect of long-term storage from these preservatives? While they may not be chemically active on steel, are there other considerations like oxidation, evaporation, hardening, hydrolytic tendency, protection period, etc. Before we spray preservative into 800 or more axles, it might be worthwhile to test this now and have an answer for the next hardware run. This needs to be a future discussion topic.
- e) Lou Pappademos in Ft Wayne sent me photos of the surface finish. The pictures are not the greatest but maybe you can tell if it appears to have sufficient tool marks for wear rating. (See attached file:
- 1) 060GA105x Lapped PCX Surface.jpg)
 - 2) 060GA105x Lapped GCX Surface.jpg)
 - 3) 060GA105x Lapped PCV Surface.jpg)
 - 4) 060GA105x Lapped GCV Surface.jpg)

Please review for next weeks meeting and come prepared for further discussions and comments.

Thank You,

Donald T. Bartlett

Office Phone: (440) 347-2388
<mailto:DTB@Lubrizol.com>

Mail drop: 121C
Fax: (440) 347-2878

E-mail

Attachment	<u>3</u>
Page	<u>2 of 6</u>
Reference	<u>L-37TF</u>

2004 8 4102

Attachment	<u>3</u>
Page	<u>346</u>
Reference	<u>L-37TF</u>



2004 8 13

Attachment	<u>3</u>
Page	<u>4 of 6</u>
Reference	<u>L-37TF</u>

Attachment

3

Page

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Reference

L-3TJF

2004 8 13

Attachment	<u>3</u>
Page	<u>6 of 6</u>
Reference	<u>L-37IF</u>

ACCEPTABLE

12

**TOOTH CONTACT PATTERN ACCEPTABILITY
CHART SHEET NO. 1**

Visual Acceptability Standards

Hard Test @ Elch Pinion Position With .0055" to .0055" Actual Backlash
Assembly @ Elch Pinion Position With .005" to .008" Actual Backlash
Note: The lowest backlash reading is the actual backlash.

Attachments
10/1
137 H/F

Page
Reference

Drive Side (Gear Convex)

Length of Pattern: $\frac{3}{4}$ of Tooth (Max.)

Lengthwise Position: Central (3) or Central Toe (2)

Profile (Flank) Position: **Flank In 0.001" to Flank Out 0.001"**

Optimum Goal:

*Central (3) Lengthwise Position
Square (0) Flank Position*

Coast Side (Gear Concave)

Length of Pattern: $\frac{3}{4}$ of Tooth (Max.)

Lengthwise Position: Central (3) or Central Toe (2)

Profile (Flank) Position: **Flank In 0.001" to Flank Out 0.001"**

Optimum Goal:

*Central (3) Lengthwise Position
Square (0) Flank Position*

Lame or Reverse Lame is Acceptable.

Lame = Coast Side is Flanked Out in Relation to the Drive Side
Reverse Lame = Coast Side is Flanked In to the Drive Side

Lengthwise 3, Flank 0	Lengthwise 3, Flank -1	Lengthwise 3, Flank +1
Lengthwise 2, Flank 0	Lengthwise 2, Flank -1	Lengthwise 2, Flank +1
Lengthwise 3, Flank 0	Lengthwise 3, Flank -1	Lengthwise 3, Flank +1
Lengthwise 2, Flank 0	Lengthwise 2, Flank -1	Lengthwise 2, Flank +1

UNACCEPTABLE

TOOTH CONTACT PATTERN ACCEPTABILITY CHART SHEET NO. 2			Visual Acceptability Standards		
			Hard Test @ Etc Pinion Position With .005" to .0055" Actual Backlash Assembly @ Etc Pinion Position With .005" to .008" Actual Backlash Note* The lowest backlash reading is the actual backlash.		
			Drive Side (Gear Convex)		
			Length of Pattern:	1/2 of Tooth (Max.)	
			Lengthwise Position:	Bunched Toe 0.002" Max to Toe (1)	
			Profile (Flank) Position:	Flank In 0.001" to Flank Out 0.001"	
			Optimum Goal:	Bunched Toe 0.002" Lengthwise Square (0) Flank Position	
			Coast Side (Gear Concave)		
			Length of Pattern:	1/2 of Tooth (Max.)	
			Lengthwise Position:	Bunched Toe 0.002" Max to Toe (1)	
			Profile (Flank) Position:	Flank In 0.001" to Flank Out 0.001"	
			Optimum Goal:	Bunched Toe 0.002" Lengthwise Square (0) Flank Position	
			Lame or Reverse Lame is Acceptable.		
			Lame = Coast Side is Flanked Out in Relation to the Drive Side Reverse Lame = Coast Side is Flanked In to the Drive Side		
			Gear Quality Approval By: Duane DeVaux 10-19-98		

Attachment
Page
References

5
1981
4-37411

Bartlett, Donald

From: Ken.Okamuro@dana.com
Sent: Wednesday, May 11, 2005 8:52 AM
To: Bartlett, Donald
Subject: Re: FW: L37
Attachments: TRNKZ2BKB-03.jpg; TRNKZ2BKB-04.jpg

Don,

I looked at your pictures and it is obvious that the top land damage is the result of a rework attempt to grind out handling damage. The spall at the heel is less clear. It does look 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 for me 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.

This invalidated test is likely the result of improper manufacturing technique by the responsible Dana factory. Hopefully this is a fairly isolated incident.

Ken

"Bartlett, Donald" <DTB@Lubrizol.com>

To <ken.okamuro@dana.com>

cc

05/10/2005 11:52 AM

Subject FW: L37

Ken,

Would you please give me a call when you get this? The pinion is from a reference test that I invalidated because I believe it to be a manufacturing defect that our technician did not catch during cleaning. I will try to teleconference in Mr. Lind if we can do it early this afternoon.

Best regards,

Donald T. Bartlett

The Lubrizol Corporation

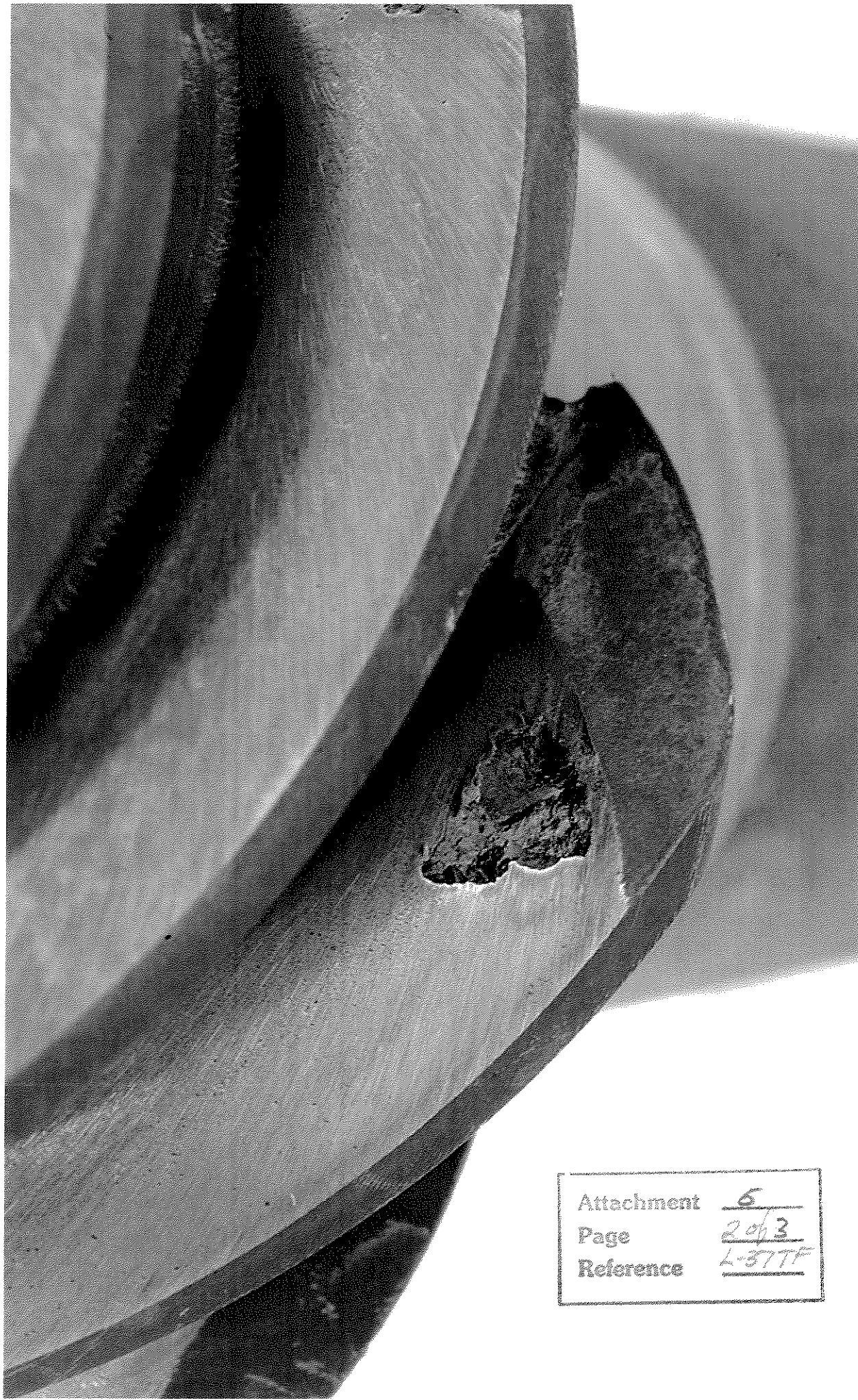
29400 Lakeland Blvd, Mail Drop 121C

Wickliffe, Ohio 44092


e-mail: dtb@lubrizol.com

Attachment	<u>5</u>
Page	<u>1 of 3</u>
Reference	<u>L-37 TF</u>

01/18/2006



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Defect

FT Wayne

11/29/05

Attachment

7

Page

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Reference

L-377F

FT Wayne
11/29/05



Dana Corporation
Fort Wayne Plant
Metallurgical Lab
P.O. Box 750
Fort Wayne, IN 46801

PPAP Metallurgical Test Report

Part Name: Pinion	Lab No: Y811
Part No: 060GP105	Chem No:
Vendor: Dana FWP	Date: 8/13/04
Heat Code: V1L351	Revision Level: D

Reasons for PPAP

New Part #: X	Print or Specification Change: List:
New Vendor: X	Process Change: List:
Routine Check:	Other: List:

PPAP Test Results

Test Name/#	Test Performed	Test Data	Pass/Nonconforming
SAE J423-Feb 98	Case Depth @ 50 HRC .05"/.065"	.057"	P
ASTM E18-00	Root Core Hardness - 25-43 HRC	31 HRC	P
D059M-001	Case Hardness @ .003" - 61-63 HRC	64 HRC	NONCONFORMING
D059-114 NSTP-E	No network carbides in case.	None	P
D059-114 NSTP-E	10% max ferrite in core.	None	P
ASTM E-415	C - .19/.25	.20	P
ASTM E-415	Mn - .70/1.05	.84	P
ASTM E-415	Ni - .35/.75	.42	P

Attachment 8

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Reference L-37TF

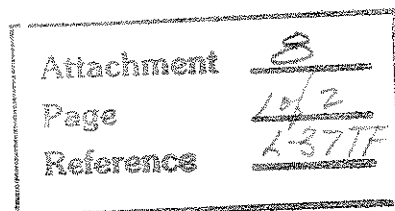
ASTM E-415	Cr - .35-.65	.57	P
ASTM E-415	Mo - .30/.40	.33	P
ASTM E-415	S - .020/.040	.017	P
ASTM E-415	P - .035 max	.012	P
ASTM E-415	Al - .015/.050	.019	P
D059-114 NSTP-E	Bainite Depth - .001" max	.0000"	P
D059-114 NSTP-E	Oxide Depth - .001 max	.0005"	P
D059-114 NSTP-E	% Retained Austenite - 10% maximum (aim)	5%	P
D059M-001	Case hardness @ .050" - 50 HRC min	53 HRC	P
D059M-001	Case hardness @ .065" - 50 HRC min	44 HRC	P
	Shot Peen - 7.5-9 C	8.5/8.5 C	P
ASTM E384-99	Thread Carburized Case Hardness 30-45 HRC per FW-306	Radius: 40 HRC, First Full Thread Root: 43 HRC	P
ASTM E18-00	FW-306 Thread Core Hardness 25 Rc max.	20 HRC	P

Conclusion: Surface hardness is 1 HRC point high. All other parameters meet metallurgical specifications.

Metallurgist: Mark Bassett

We certify: The product on the above certification substantially conforms to the SAE, ASTM or customer specifications and conditions agreed upon in writing signed by an authorized representative. The above data accurately represents values generated in the Dana Spicer Axle Fort Wayne Plant laboratory. Sample was tested as received unless otherwise stated.

This document may only be reproduced unaltered and may not be used for any purpose other than the purpose of certifying the same or lesser quantity of the product specified herein. Reproduction, alteration or use of this document for any other purpose is prohibited. Except as expressly provided in this certification, Dana Spicer Axle makes no (and disclaims all) representations, warranties and guarantees whatsoever, whether express, implied or statutory, including, without limitation, any warranty of merchantability or fitness for a particular purpose.



Bartlett, Donald

From: Don.Kreinbring@dana.com
Sent: Wednesday, November 16, 2005 3:51 PM
To: Bartlett, Donald; Bruce.Hall@dana.com; Gene.Lawrence@dana.com
Cc: Lou.Pappademos@dana.com; Rick.Treadaway@dana.com; Marko.Ojanen@dana.com; Derek.Ottley@dana.com; Steve.Bird@dana.com; Kenny.Miller@dana.com; Grant.Messmann@dana.com
Subject: Re: ASTM Panel Visit to Ft Wayne and Lugoff Facilities
Attachments: FtWayne-Lugoff Plants.doc; ASTM L-37 Axle Assy Reqs.pdf

Don,

Following is a summary of our schedule, issues, and plans for the subject plant visits as we discussed this morning. Things have been delayed slightly due to forging procurement and the desire to batch heat treat gears and pinions. This time can be picked up because axle assembly can be batched as the six per lab samples and testing delay of three weeks is not required. Also attached are directions to the plants and nearby motels.

Ft Wayne Plant	Lugoff Plant
November 29	December 8
Tuesday 1:00	Thursday 8:00
November 30?	December 9?

1. Drive pinions and gears will be carburized as a batch in the same furnace, likely on a weekend.
2. Gear sets should ship about December 5-7.
3. Bruce Hall is the primary contact/organizer in Ft Wayne.
4. Phase 1 of assembly (6 axle assys per lab) will not be required for test and approval before Phase 2 (batch completion).
5. Determine if individual parts have come from one batch as done prior.
6. Determine if bearings are TIMKEN (or at least one batch) as done prior.
7. Gene Lawrence is the primary contact/organizer in Lugoff.
8. Lists of attendees (customers & Dana) should be provided when finalized; visitors at Ft Wayne will probably be six or less.
9. Kenny Miller will be asked to attend Ft Wayne, and or Lugoff to very contact patterns, if desirable.
10. Don Kreinbring is on vacation the week of November 21, his back-up is Grant Messmann (269) 567 - 1152.

[Link Map Ft Wayne](#)

[Link Map Charlotte-Lugoff](#)

[Link Map Columbia-Lugoff](#)

Please let me know if you have any questions, corrections, additions, etc.

Thank you,

Don Kreinbring
Current Product Engineering
Spicer Off-Highway Products Division
(269) 567 - 1140 phone/fax
don.kreinbring@dana.com

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Reference	L-37 TF

01/18/2006