

L42-1 Task force teleconference meeting 4-11-2006

Attendees:

C. Koglin
B. Koehler
Kenny Miller
Robert Burrow
Don Lind
Dale Smith
Don Bartlett
Chris Schenkenberger
Steve Bird
Gene Lawrence
Derek Ottley
Don Kerinbring

Dana model 44 2006 axle build

Ken Miller has provided 2 summaries for the group to explain the current progress on the 2006 model 44 axle build. The initial build drive side contact pattern to be too near to the toe, i.e. L1 to L0.5. This occurred on 10 built carrier assemblies before the assembly stopped. Investigation found that the carriers, while made to print, do not have any Geometric dimensioning tolerances and this is a large reason for the assembled contact pattern differences. Please see attached explanation on pages 3-4

Dana's suggestion was to send the gearsets back to Ft. Wayne to re-lap the driveside to a L4 pattern, which should give an assembled pattern closer to the specification provided (L2/L3 F0, F+1, F-1).

The re-lap occurred on 10 ring/pinion sets and the result was a L1-L3 pattern on the drive side and no change on the coast side pattern. However, the backlash has now increased to .01"-.13". Please see attached explanation on pages 5-6

General information

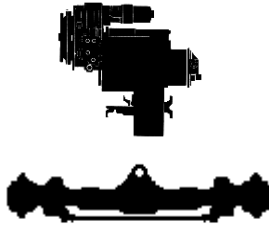
- The original build parts were made from the beginning of the ring/pinion batch
- The relapped parts were made from the end of the ring/pinion batch.
- Total pieces on PO's=959
- Kenny Miller's experience tells him that backlash is a non-issue, with respect to scoring, compared with flank position change.
- The lab consensus was that backlash would not be an issue as well, but would like to present information to Surveillance Panel

Questions the panel members raised:

- Has Dana measured a sample of carriers to make sure they are consistent?
 - **Action Item:** Don Kreinbring work with Ft. Wayne to get X number of carriers measured throughout the lot.
- Is there any current data comparing backlash to scoring severity?
 - **Action Item:** Don Lind plot backlash vs scoring from data dictionary (attached pages 7-9)
- For the next Dana 44 build, can Dana re-develop the drive side tooth profile to not get scoring?-
Surveillance panel discussion

Alternatives:

- Can Dana build up X number of gearsets to run in test stands?
- Can Dana use the current carriers for a different axle build? Get new GD&T spec'd carriers for ASTM build?
 - Timing and cost could be an issue



Spicer Off-highway Products
1293 Glenway Drive
Statesville, NC 28625

Tel: (704) 878-5762
Fax: (704) 878-5760

To: Cory Koglin
From: Kenny Miller
Date: April 7, 2006
Subject: Problems / progress with current L-42 order.

Page 1 of 2

Cory,

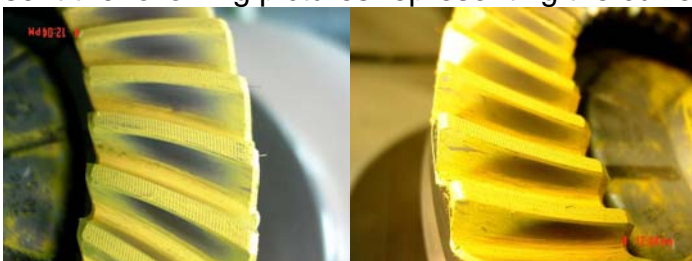
The following is a summary of the current L-42 order axle assembly issues / responses, ref. gearset P/N 044GA103X:

I went to the Lugoff plant last Monday, April 3rd to work with Derek Ottley and the Lugoff assembly team to build the L-42 axle hardware. Through the course of the day, we built 9 diff carrier assemblies. From the start we had an issue of the drive-side contact pattern too near to the toe, i.e. L1 to L0.5. While L1 may have been a deviation-allowed contact pattern, L0.5 was not. The majority of the 9 carriers were the latter. Please see the following pictures:



Picture 2 and 4 above represent the range of drive side variance (includes assy variance for trying to correct the DS toe pattern).

We contacted Lou Pappademos (Quality Mngr, Bevel Gr Products) at Fort Wayne to determine the current lot 'as-manufactured' Gleason test machine contact pattern for the L-42 gearset. Lou sent the following pictures representing the current run of 044GA103X:



The contact pattern development exhibits exactly the desired goals, drive side L2F0 and coast side L3F+1.

We then turned our attention to the differential carrier, ref. P/N 044CF100. This investigation is still ongoing, but some facts have become clear. We measured several carriers at Lugoff and found the combination of offset values and pinion bore-to-bore angularity were combining to



Spicer Off-highway Products
1293 Glenway Drive
Statesville, NC 28625

Tel: (704) 878-5762
Fax: (704) 878-5760

To: Cory Koglin
From: Kenny Miller
Date: April 7, 2006
Subject: Problems / progress with current L-42 order

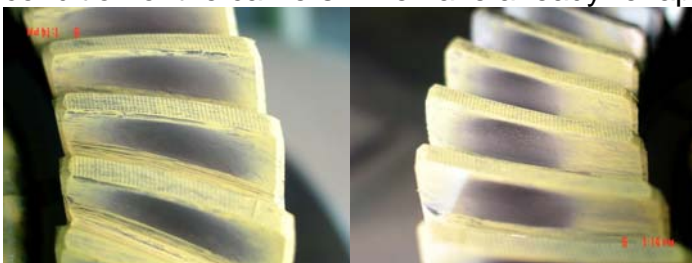
Page 2 of 2

(continued)

cause this issue of too much toward toe drive-side pattern. Please note that the carrier dimensions were NOT out of print. To quantify this statement, this carrier design was released for production in Mar 1978 and contains no geometric tolerances. I reviewed one of our modern M44 carrier drawings and found that the geo controls on that drawing are much more stringent. I believe these to be the reasons for our current situation.

The reason the carrier tolerances are so critical to this gerset design is that the contact pattern requirement is very conjugate, i.e. relatively long pattern and very sensitive to build and process induced mounting errors (even ones which are to print in this case). The drive side is especially vulnerable, while the coast side is significantly less sensitive (lengthwise direction). This is inherent to the design. This development also has relatively sensitive profile ease-off, meaning the difference from F+1 to F-1 is a small number. We are sending (6) carriers to Fort Wayne to have measured relative to their tolerancing standards. I believe the result of the FW measurements is going to point to the need to revise the 044CF100 carrier drawing to the more stringent geo tolerancing to control the very sensitive gerset development for future builds.

In summary, the L-42 differential carrier assembly is critical to have adequate gerset contact pattern development along with very accurate carrier machining for those features locating the ring and pinion. My assessment is that Fort Wayne met the required development, but due to carrier tolerance stack error, we need to re-lap the drive side of the gerset to account for the condition of the carriers. We have already re-lapped (10) gersets with the following result:



I believe this rework will build correctly (drive L2F0 and coast L3F0 or +1). Note that no re-lapping of the coast was done. I will be traveling back to Lugoff first of next week to build these. Upon achieving successful build patterns (and with your permission), we will proceed with re-lapping the remaining sets to resolve this issue. I perceive this rework will cause no detrimental effects to the labs' testing. Should you have questions or comments, please call.



#1 CS L2.7 F0 B/L =.010



#2 CS L2.7 F0 B/L =.010



#3 CS L3 F0 B/L =.012

044GA103X, 4.09 LH (11 x 45) (Axle assy 044AA100-1) ASTM 4/11/2006

This report represents sampling from (10 qty) diff builds of re-lapped (drive side only) gearsets. Re-lap was done to correct too much toe-ward contact pattern position on the drive side. 5 gearsets were recorded and represent the total build variance of all 10 sets.

#1 DS L2 F0 B/L =.010

#2 DS L1 F0 B/L =.010

#3 DS L1.5 F0 B/L = .012





#4 CS L2 F0 B/L =.011

#5 CS L3 F0 B/L =.012

044GA103X, 4.09 LH (11 x 45) (Axle assy 044AA100-1) ASTM 4/11/2006

This report represents sampling from (10 qty) diff builds of re-lapped (drive side only) gearsets. Re-lap was done to correct too much toe-ward contact pattern position on the drive side. 5 gearsets were recorded and represent the total build variance of all 10 sets.

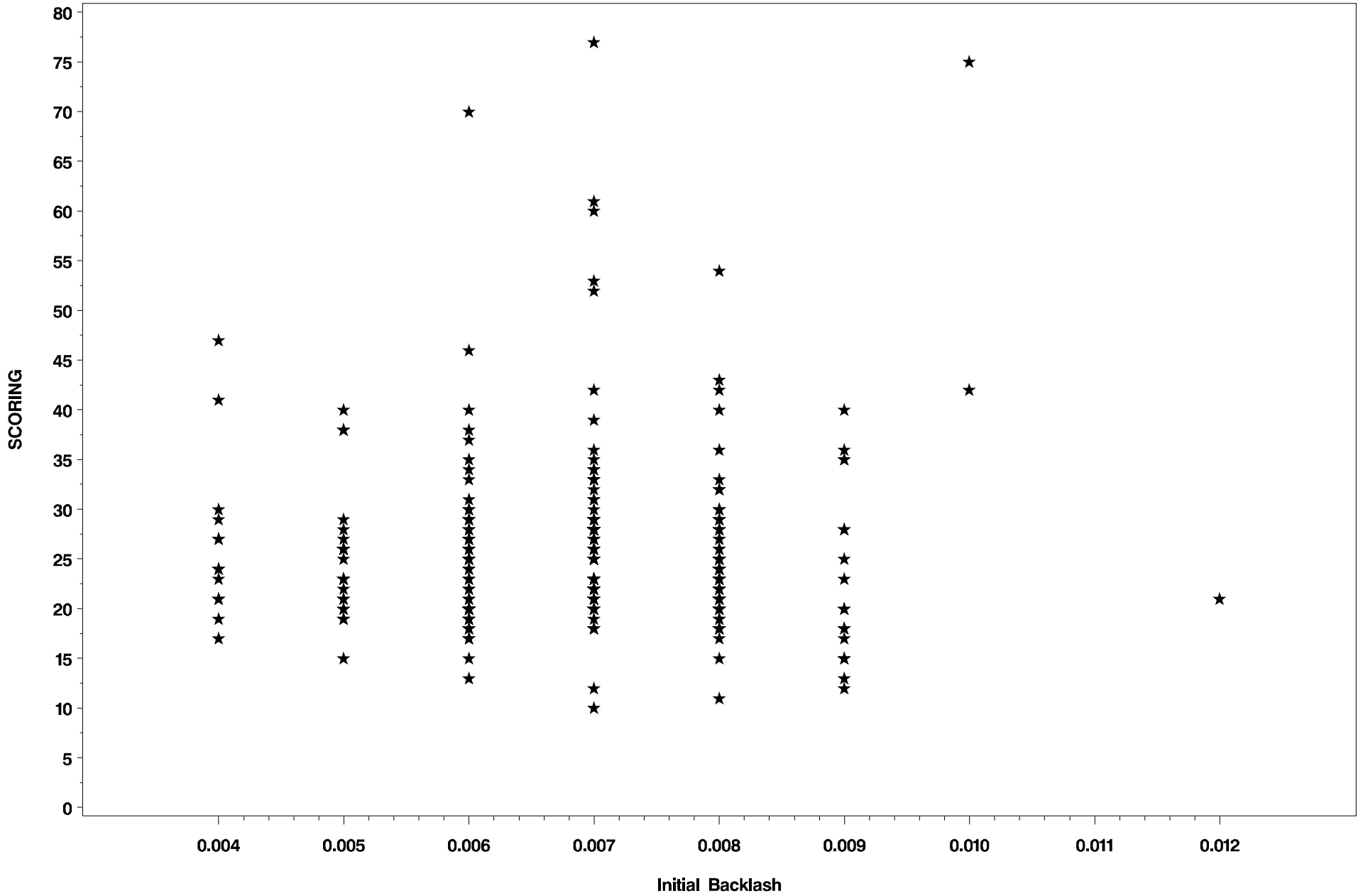
#4 DS L2 F0 B/L =.011

#5 DS L1 F0 B/L =.012

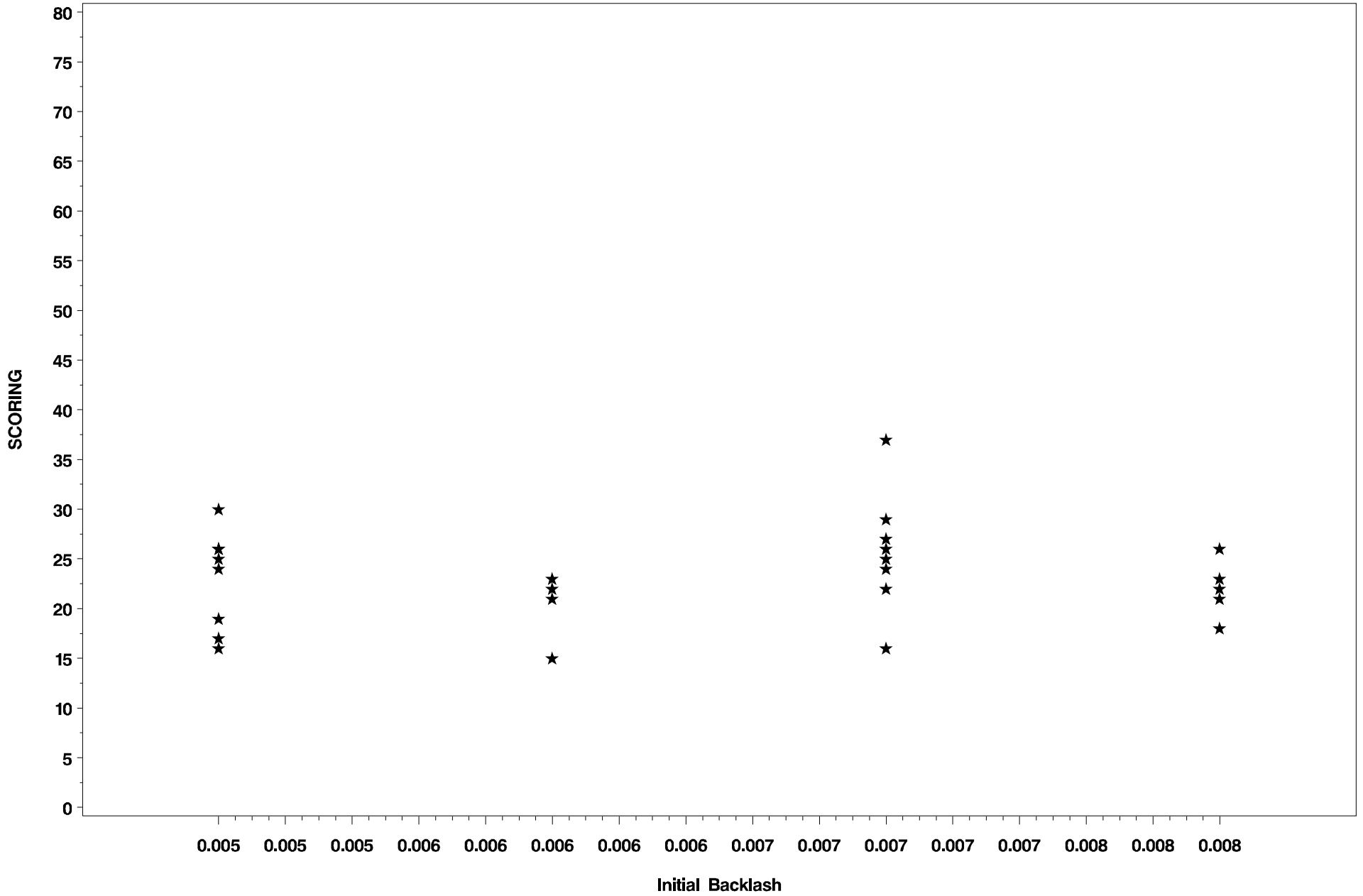


Note: Backlash is more than specified maximum of .009". This is necessary to control the coast side -F- number.

L-42
Scoring VS Initial Backlash
Reference Oil 115



L-42
Scoring VS Initial Backlash
Reference Oil 116



L-42
Scoring VS Initial Backlash
Reference Oil 114 & 114-1

