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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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November 9th, 2011

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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:

- **November 2nd, 2011 L-37 Surveillance Panel Meeting**

Please direct any corrections or comments to my attention.

Sincerely,

Galen Greene, Chairman
L-37 Surveillance Panel

**Report of Meeting
L-37 Surveillance Panel Meeting
Automation Alley
Troy, MI**

November 2nd, 2011

Attendees:

SwRI -	Koehler
Lubrizol -	Greene , Venhoff, Hamilton, Gropp
Afton -	Koglin , Bell, Higuchi, Kearney
Intertek -	Smith
TMC -	Parke
Meritor -	McGlone , Muransky
Dana -	Guzikowski ,
Volvo -	Bryson , Athey
AAM -	Dharte
ExxonMobil -	Eliot, Kanga
Chevron -	Zakarian
GM -	Zreik, O'Brien

Voting Members in **BOLD**

The meeting was called to order at 9:00 am EDT.

1.0 Approval of Meeting Minutes

- **August 11th, 2011 Surveillance Panel Meeting (Warrendale, PA)**
- **October 11th, 2011 Surveillance Panel Meeting (Teleconference)**

Motion # 1 → Mr. Zakarian / 2nd Mr. Dharte to approve the minutes as presented. Motion for approval was passed with a vote of 9-Yes, 0-No, and 0-Abstentions.

2.0 Summary of Meeting Discussions

2.1 Hardware Update – Full Batch Progress

The group reviewed the current hardware situation. The current estimate for completion from the manufacturer was anywhere from mid-November to early December. The labs must still decide how many gear sets to Lubrite and how many leave uncoated. They also must still decide how many new housings to purchase. Due to the high cost of the housings (\$2300 each), the labs deferred this decision to a later meeting. This is because the timing of the next generation test is currently being discussed and this information will guide the labs on how much hardware will be needed in the current test.

ACTION ITEM #1: The chairman is to setup a teleconference with the labs to discuss the issue of new housings soon after this meeting.

2.2 Next Generation L-37 Test

The panel next reviewed the development of a next generation L-37 test. This development was started at the November 3rd, 2010 meeting. The minutes from that meeting stated, *“This group will begin working with the*

intent of having a realistic test option(s) identified within approximately 1 year. This group will work to identify hardware and conduct test development in this timeframe.”

The Chairman commented that one year has now passed and emphasized that it is now time to make decision on the next generation test. Several other decisions are potentially influenced by the timing of the next generation test and the group should make sure we continue to make progress.

Two options have been discussed to date. One option is to use American Axle Hardware and the other uses Gleason ground gears and the current L-37 housing. The group began the discussion by going over and agreeing to a pros/cons list of each option. The pros and cons list is in attachment 2.

Key discussion points that came out of the pros and cons list were:

- Several opening comments were:
 - Ground gears would be very repeatable to build, especially batch to batch
 - It is true that lapped gears are more common
 - Assembly is easy with ground gears and there is no need to match ring and pinion, but in order to take advantage of this a test fixture would need to be designed
 - Pitting/spalling can pop up with lapped gears while the loss of compressive residual stress is a possible issue with ground gears
 - Gear manufacture is a side business for Gleason, and they may not be able to devote as much attention when compared to a company in which gear manufacture is the primary business
- Mr. Koglin expressed preference to move forward with custom gear sets.
- Mr. Gropp mentioned that these gear sets would need to represent the field, and lapped gears are dominant in the field
- Mr. Koglin shared a presentation on some additional testing on the Gleason gears and also some testing on the AAM ‘zeta’ hardware:
 - Afton purchased some AAM axle from a dealership and ran some testing on some “off the shelf” fluids
 - 2 of 7 “GL-5” or “SAE J2360” fluids did not pass the test
 - Mr. Gropp shared that he was encouraged by the results; he mentioned that the dealer axles were Lubrited and that GL-5 does not have a Lubrited test requirement. He felt it was encouraging that some fluids did not pass the test. GL-5 oils are only required to pass the non-lubrited version of the test. Even on SAE J2360, not all oils are created equally.
 - Some of the dealer axles showed very low backlash (<0.004”)
 - There was also a concern about the color of the fluid at EOT (black)
 - Mr. Bryson commented that the color alone isn’t important, but what is causing it is
 - Mr. Gropp commented that the used oil in the Lubrizol work did not show any signs of excessive oxidation, and as far as any deposits, this test does not focus on deposits, the L-60-1 test is in place for this. Mr. Greene shared some data on viscosity of end of test drains on pass and fail oils and there was little change pre to post test signifying little oxidative degradation.
- Mr. Zakarian stated that he had some concerns over the AAM proposal but it might be our best option now
- Mr. Smith commented that the cost seemed the best with the AAM option
- Mr. Bryson commented that moving forward with the AAM option would be a positive step because the axle is available, he commented that moving towards a ground gear could be considered in the future
- Mr. Koehler stated that he had not seen any problems in running the test at his lab, he commented that SwRI would suggest we proceed with the AAM axle. He would have no problem exploring ground gears at some point in the future

At this point the following motion was made:

Motion # 2 → Mr. Zakarian / 2nd Mr. Koehler to move forward with the AAM 'Zeta' next generation L-37 test proposal. At this time, the group will not be seeking further Dana hardware after the current situation is resolved. The labs will work together to effectively use the remaining Dana hardware. The labs will also investigate any concerns with the proposal as they work to implement the test. Motion passed with a vote of 7-Yes, 1-No, 1-Abstention.

As a future item for consideration, Mr. Zakarian requested that the group continue to investigate hardware variability.

Mr. Bryson commented that the group should meet with AAM and clearly specify our requirements. The group agreed that they should work to have the AAM test proposal ready for adoption within 1 year from this meeting. This includes formalizing a procedure and test stand setup.

The labs will work together to decide how to best bridge the gap between the new and old test with respect to hardware inventory. This will include the discussion of how many new housings are needed with each lab.

2.3 Clarification on Broken Tooth Definition

The panel approved a definition for a broken tooth at the May 11th, 2011 meeting. Mr. Parke has since received a comment for clarification from the rating group. Mr. Parke wanted confirm that the group meant for the definition to only consider a tooth broken when the broken area included the drive side. For example, if a tooth was missing some material from the coast side, but not the drive side, it would not be considered broken. The group agreed that a tooth must have some portion of the drive side missing to be considered broken. The definition needed no further changes and Mr. Parke commented that he will now be issuing an information letter.

3.0 Adjournment

Motion to Adjourn by Mr. Bryson, 2nd Mr. Smith. Meeting Adjourned at 12:10 pm EDT

Respectfully submitted,

Galen Greene
L-37 Surveillance Panel Chairman

ASTM L-37 Surveillance Panel Membership/Mailing List

Meeting Date: November 2nd, 2011

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Next Generation L-37 Test

Pros - Cons

Next Generation L-37 Test

Pros - Cons

Items for Consideration

1. Gear Technology
2. Axle Ratio
3. Axle Configuration/Size
4. Manufacturer
5. Relationship to Current Test
6. Timing

1. Gear Technology

AAM Hardware:

Lapped gear technology

Pros:

- Representative of high-volume field axles
- Very common global manufacturing process
- Test stresses lubricant more

Cons:

- Greater surface finish and dimensional tolerance variability
 - Ring and pinion must be matched because of this

Gleason/Dana Hardware:

Ground gear technology

Pros:

- Modern manufacturing process
- No need to match ring and pinion
- Better control over tooth geometry

Cons:

- Manufacturing process not widely used
- Smooth surface finish may not represent typical field applications
- Not representative of current processes
- Appetite of ground gears vs lapped gears
- Development of hardware not complete, Significant amount of work needed
- Loss of compressive residual stress, weaker teeth

2. Axle Ratio

AAM Hardware:

Modern axle ratio (3.45:1)

Pros:

- Representative of high-volume, current production hardware

Cons:

- Test not identical to current L-37

Gleason/Dana Hardware:

Same as current L-37 (5.86:1)

Pros:

- Tie to past

Cons:

- Not representative of current axle ratios
- Changes in hardware needed further reducing tie to the field and current test

3. Axle Configuration/Size

AAM Hardware:

Independent rear axle design (RDM)

Pros:

- Representative of high-volume, current production hardware
- Gear set more isolated, simpler design
- Fill volume more representative of current field applications
- No oil exchange down axle tubes
- Early evidence that temperature control with aluminum housings is better vs steel
- Limited slip helps 'lock' the differential, possible better control

Cons:

- Labs will need to adjust stand mounting fixtures
 - Will need to occur with any new test hardware
- RDM not historically used

Gleason/Dana Hardware:

Same as current L-37 (beam axle)

Pros:

- Could be built into current L-37 housing
 - Labs could use current stand fixtures
- Labs could rebuild axles using current L-37 housings
 - Possible cost savings

Cons:

- - Logistical issues obtaining housings, shims, bearings, etc.
 - Increased cost and complexity
 - Multiple vendors needed
 - Recent quote is for \$2300 per housing plus gear sets
- Potential source of variability
 - Wear & tear on reused housings
 - Lab-to-lab and build-to-build variations
 - Labs will not have the expertise of the manufacturer
- Labs have labor cost of rebuilding axles
- Potential need for a CPD

4. Manufacturer

AAM Hardware:

Large current production manufacturer

Pros:

- Representative of high-volume, current-production hardware
- Eager to support industry activity
- Relationship already established with L-37 Panel and LRI
- Manufacturer has vested interest in test activity and development of lubricants for the marketplace
- Only need to issue one PO for hardware, One company to work with

Cons:

- Tied to manufacturers willingness to make test axles
- New supplier to industry testing

Gleason/Dana Hardware:

Specialty gear manufacturer, Parts from other manufacturers

Pros:

- Receptive to working with ASTM
- Industry recognized gear expert

Cons:

- Hardware manufacture is not their core business
- No experience working with this manufacturer
- Manufacturer has no experience with L-37 and expectations of group, does not currently sit on ASTM L-37 panel or LRI
- Multiple PO's needed (bearings, shims, housings, gears, assembly, CPD?)

5. Relationship to Current Test

AAM Hardware:

Contact stress similar

Pros:

- L-37 Loading matched with current hardware representative of field
- Good replication of current L-37 data on distress (ridge, ripple, etc.)

Cons:

- Test hardware not identical to current L-37

Gleason/Dana Hardware:

Wheel load/speed fixed

Pros:

- No test procedure (conditions) development needed

Cons:

- Starting with old L-37 Test
- Link to old L-37 weak (contact stresses)
- Test hardware not representative of field

6. Timing

AAM Hardware:

Ready for final validation matrix, test stand audits, and order

- Test development essentially complete
- Outside verification underway
- Supply established
- Build completed with one manufacturer (labs issue one PO)

Gleason/Dana Hardware:

Specific timing unknown

- Hardware development ongoing
- Eventual move to a test fixture will require extra work
- Supply of housings, bearings, etc. unknown
 - Assembly undecided

Others?

AAM Hardware:

Pros:

Cons:

Gleason/Dana Hardware:

Pros:

Cons: