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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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April 04th, 2013

Reply to:
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ASTM D02.B0.03 L-37-1 Next Generation Hardware Task Force
Members and Guests:

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

- **March 27th, 2013 Next Generation Hardware Task Force Meeting (Teleconference)**

Please direct any corrections or comments to my attention.

Sincerely,

Chris Prengaman, Chairman
L-37-1 Hardware Taskforce Chairman

Report of Meeting
L-37-1 Hardware Task Force Meeting
Teleconference
March 27th, 2013

Attendees:

Voting Members in **BOLD**

Gottwald, Thomas – Afton Chemical

Gropp, Jerry – Lubrizol

Guzikowski, Joe – Dana

Koehler, Brian – Southwest Research Institute

McGlone, Bruce – Meritor

Parke, Scott – ASTM TMC

Prengaman, Chris – Lubrizol

Bubonic, Brad – Lubrizol

Green, Galen - BASF

Smith, Dale – Intertek Automotive Research

Trader, Angela – Intertek Automotive Research

Marsh, Greg – American Axle

The meeting was called to order at 10:05 am EST.

1.0 Agenda Review

2.0 Review Break-In Proposal

B. Koehler reviewed the modified break in proposal sent out prior to the meeting.

All labs agreed that this profile would be able to be programmed and run given their stands current capability.

G. Marsh recommended that higher speed data sampling occur as the desired test load is reached at the end of the ramp conditions. For 1 min at 100 Hz to ensure that no strange oscillations are occurring. B. Koehler will correct and re-send the conditions to the group.

B. Koehler shared that the stand is currently set up for data collection of once every 10 seconds during break in conditions, and once every 30 seconds during test conditions.

G. Marsh agreed with statement #3 that the break-in slowly over time changes the pattern and should allow for a smoother break-in.

T. Gottwald – after reviewing internally, the group should use 1B as the fluid to look at initially. This is a correction to the recommendation of 1A during the 20130320 teleconference.

Motion #1:

Dale Smith 1st / Thomas Gottwald 2nd **Approved by voice vote – no objections.**

SwRI to run the 1B fluid under the attached modified break-in conditions. If the results are a pass or borderline pass, Lubrizol will follow that with a 134 run under the same conditions.

3.2 Review Run to Failure Data

C. Prengaman shared and reviewed the run to failure data that was done during the development process of the test. The goal at this time is just to keep this data available if the group feels that modification of test load is needed during the upcoming development.

4.0 New Business

Data Dictionary / Data Transmission

C. Prengaman requested that labs start thinking about / working towards the ability to upload data to TMC using a starting point of the L-37 data dictionary.

S. Parke shared that TMC is currently setup for L-37-1 incoming data using a copy of the L-37 data dictionary.

C. Prengaman shared that there will be a couple fields that will need changed (field size) that Lubrizol is aware of so far. Lubrizol will test the upload with TMC in the near future.

All labs shared that this is possible, but involves some amount of work to do so.

B. Koehler – asked if we could just do a limited upload of just critical parameters for now, since it is a lot of work to redo data definitions on the labs side. The group verbally agreed that this should be acceptable to start with.

Afton Demonstration Oils

T. Gottwald – Asked the group if we needed to formally vote to approve using either 1A or 1B as “demonstration oils” as we develop the test.

The group verbally agreed that the oil was approved for use for test development, however no formal vote was taken.

C. Prengaman – Agreed that this would be a good idea to do so formally – requested that T. Gottwald, S. Parke, and C. Prengaman review offline to ensure data is correctly labeled in the spreadsheets we are currently using, and bring this up as an action item during the May Surveillance Panel meeting in Pittsburg on May 15th.

T. Gottwald shared that some data was presented back in the 20120509 meeting minutes.

5.0 Adjournment

Motion to adjourn .

Respectfully Submitted

Chris Prengaman

L-37-1 Task Force Meeting

March 27th, 2013
10:00 am – 11:00 pm EST
Teleconference

Agenda

- 1) Call to order/Agenda review
- 2) Review Break-In proposal
- 3) Review Run to Failure Data
- 4) New business
- 5) Adjournment

Call in number → **216-706-7052 code 324160**

SwRI offered to propose a modified break-in procedure and offer one test on oil 1B, at standard temps, 950 ml oil charge, Non-lubrited axle, using the modified break-in listed below.

Some comments:

1. This axle currently has a limited slip diff. so we can keep the dynos in synch related to RPM without differential RPM control (as long as our torque differential is not too large). This is different than the Dana model 60.
2. The variable speed drives and electric drive motors give us break-in options that we did not have with the fired engines. The motors do a great job of speed control over a large and changing range of loads.
3. I am not a gear engineer but axle break-in does relate directly to the change of contact pattern which relates to elastic gear tooth deflection which relates to load.
4. Oil temp and gear tooth surface temp spikes significantly while the tooth surface modification is in process and then drops as it is completed.
5. The current L-37-1, at SwRI, is showing a significant amount of heat generation during the first 20 to 40 minutes of on test time (after the one step break-in).
6. The industry made the test significantly milder by independently 1. Forcing the outer housing temp (and bulk oil temp) to a lower value. 2. Adding more oil to the sump.

How SwRI currently runs the L-37-1 test (prior to 3-28-13):

Ramp pinion rpm to 2352.9 in 90 seconds with no load on dynos.

Take dynos from no load condition to 350 lb-ft each in 2 minutes (both ramp together).

Ramp load to 375 lb-ft each in 1 minute (This two step approach was originally set up to prevent torque overshoot but that has not been seen as a problem)

Stabilize speed and load for 45 seconds

Start break-in time and run for 65 minutes.

Ramp load down to 100 lb-ft on each dyno over 1 minute period.

Stabilize speed and load for 20 seconds.

Ramp pinion rpm down to 427.8 rpm over 2 minute period.

Stabilize speed and load for 30 seconds.

Ramp load to 1600 lb-ft over 2 minutes.

Ramp load to 1650 lb-ft over 40 seconds.

Stabilize for 65 seconds.

Wait for oil temp to be in spec.

Run for 11 hours.

Ramp load down to 100 lb.-ft. in 1 minute.

Ramp pinion speed to zero rpm in 1 minute.

Test over.

SwRI proposed way to run the test (modified Break-in for use after 3-27-13):

Ramp pinion rpm to 2352.9 in 90 seconds with no load on dynos. (at speed, the SwRI dynos will have about 20 to 30 lb-ft of torque displayed.)

Take dynos from existing no load torque to 375 lb-ft each in 20 minutes. (Both ramp together) Include this as break-in time.

Run steady state for 1 minute at 100 Hz data logging (Include as break-in time).

Run steady state for an additional 44 minutes while logging once each 10 seconds. (Include as break-in time).

Ramp load down to 100 lb-ft on each dyno over 1 minute period.
Stabilize speed and load for 20 seconds.
Ramp pinion rpm down to 427.8 rpm over 2 minute period.
Stabilize speed and load for 20 seconds.
Ramp load on each dyno from 100 lb-ft to 1650 lb-ft over 1 hour period. (Count this as additional break-in time?)
Wait for oil temp to be in spec. (it will be)
Run steady state for 1 minute at 100 Hz data logging. (Count as test time)
Run for 10 hours and 59 minutes while logging once each 10 seconds. (Count as test time)
Ramp load down to 100 lb.-ft. in 1 minute.
Ramp pinion speed to zero rpm in 1 minute.
Test over.

Oil temp set point control strategy will be unchanged and will follow the L-37 method.

Data logging while the axle is turning will be once each 10 seconds unless otherwise stated above.

Load and speed tuning will be fast enough to follow the ramps but not aggressive enough to cause oscillations.

When I list "ramp load" I am talking about a linear ramp of the control set point from the existing process condition at the start of the step to the target we are going to achieve.

Other future issues would be outlier calculations, plotting of data, data statistical summaries, unscheduled shutdowns during extended ramping, etc. I have not concerned myself with those yet.

Regards,
Brian P. Koehler
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Industry Oil Code (TMC Oil)	Test Version (Standard or Canadian)	Hardware Identification	Lab	Stand	Test Hardware	EOT Date	Pinion Rating					Ring Rating					Free-form Comment
							WEAR	RIDG	RIPP	SPIT	SCOR	WEARR	RIDGR	RIPPR	SPITR	SCORR	
IND	TVERSION	SERIALNO	LTMSLAB	LTMSAPP	TESTHARD	LTMSDATE	WEAR	RIDG	RIPP	SPIT	SCOR	WEARR	RIDGR	RIPPR	SPITR	SCORR	COMMENT
16.5 hour, 1650 lb-ft torque																	
134	STANDARD	GGAD12063130725	D	3	LUBRITED	20120505	7	6	9	9.9	10	7	7	10	10	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. 7 spat on inner cone of head bearing.
134	STANDARD	GGAD12063122708	A	5	LUBRITED	20120720	6	5	10	10	10	6	6	10	10	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
134	STANDARD		G		LUBRITED	20120804	6	5	9	9.9	10	7	6	8	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
155	STANDARD	GGAD12063132945	B		LUBRITED	20120406	7	7	9	9.9	10	7	8	10	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
155	STANDARD	GGAD12063124110	A	5	LUBRITED	20120425	7	8	9	9.9	10	8	9	10	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
155	STANDARD	GGAD12063140809	D	3	LUBRITED	20120517	7	7	10	9.9	10	7	8	10	10	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
155	STANDARD	GGAD120631- - - -	D	3	LUBRITED	20120518	7	8	10	9.9	10	7	8	10	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. Last 5 digits of serial number missing.

Industry Oil Code (TMC Oil)	Test Version (Standard or Canadian)	Hardware Identification	Lab	Stand	Test Hardware	EOT Date	Pinion Rating					Ring Rating					Free-form Comment
							WEAR	RIDG	RIPP	SPIT	SCOR	WEARR	RIDGR	RIPPR	SPITR	SCORR	
IND	TVERSION	SERIALNO	LTMSLAB	LTMSAPP	TESTHARD	LTMSDATE	WEAR	RIDG	RIPP	SPIT	SCOR	WEARR	RIDGR	RIPPR	SPITR	SCORR	COMMENT
16.5 hour, 1650 lb-ft torque																	
134	STANDARD	GGAD120036- - - -	B		NONLUBRITED	20120413											AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. Test ran for 11hrs. - all teeth broken, catastrophic failure. Last 5 digits of serial number missing.
134	STANDARD	GGAD12063093932	A	5	NONLUBRITED	20120414	6	6	8	9.9	10	6	6	10	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
134	STANDARD	GGAD12063092414	B		NONLUBRITED	20120427						5	6	10	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. Test ran for 11.25hrs. - all teeth broken, pinion unrateable.
134	STANDARD	GGAD12047090125	D	3	NONLUBRITED	20120515	7	7	7	9.9	10	7	8	9	10	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. Broken teeth on pinion. Damage to ring. Shut down due to vibration at 15 hrs 37 min (on test).
134	STANDARD	GGAD12063112723	D	3	NONLUBRITED	20120519	7	7	9	9.9	10	7	7	9	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
134	STANDARD	GGAD12063134922	B		NONLUBRITED	20120521	6	4	7	5	10	6	4	10	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. High vibration at 8.5hrs. - pinion teeth cracked.
134	STANDARD	GGAD12047081449	D	3	NONLUBRITED	20120524	7	7	10	9.9	10	7	8	10	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. Shutdown due to excessive vibration at 5:01 test hours.
134	STANDARD		G		NONLUBRITED	20120822	7	5	9	9.9	10	7	5	9	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. Light coast side scoring observed
152-1	STANDARD		B		NONLUBRITED	20121101	7	10	10	9.9	10	7	10	10	9.9	10	Non-lubrited AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
152-1	CANADIAN		B		NONLUBRITED	20121103	7	10	10	9.9	10	7	10	10	9.9	10	Non-lubrited AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
155	STANDARD	GGAD12047090210	D	3	NONLUBRITED	20120504	7	7	10	10	10	7	7	10	10	10	Non-lubrited AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. Cracked tooth on ring gear
155	STANDARD	GGAD12063093332	B		NONLUBRITED	20120621	8	9	10	9.9	9	8	9	10	9.9	10	Non-lubrited AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
155	STANDARD	GGAD12063092600	A	5	NONLUBRITED	20120721	7	8	10	9.9	10	7	8	10	9.9	10	This is a non-lubrited AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
1-A	STANDARD		A	5	NONLUBRITED	20120804	6	6	8	9.9	10	6	7	9	9.9	10	Non-lubrited AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
1-A	STANDARD		G		NONLUBRITED	20120830						6	6	8			Non-lubrited AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. Non-interprettable. Distress - Heavy to Catastrophic. Broken teeth on pinion and ring.
1-B	STANDARD		A	5	NONLUBRITED	20120807	3	6	7	9.9	10	5	6	9	10	10	Non-lubrited AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
1-B	STANDARD		G		NONLUBRITED	20120905	5	3	9	9.8	10	6	5	8	9	10	Non-lubrited AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure.
16.5 hour, 1350 lb-ft torque																	
134	STANDARD	GGAD12063093015	A	5	NONLUBRITED	20120830	6	6	8	9.9	10	7	7	10	10	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. This ran at 1350 lb-ft torque.
134	STANDARD	GGAD12063093135	B		NONLUBRITED	20120830	7	10	9	9.9	10	7	10	10	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. This ran at 1350 lb-ft torque.

16.5 hour, 1500 lb-ft torque

134	STANDARD	GGAS22928327218	A	5	NONLUBRITED	20120831	6	5	9	9.9	10	6	6	10	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. This ran at 1500 lb-ft torque.
152-1	STANDARD	GGAD12063113036	G		NONLUBRITED	20120827	7	8	9	9.9	10	7	10	9	9.9	10	1500 torque, 16.5 hours. This was supposed to be 134 but we had a mix up during oil assignment and 152-1 was ran instead.

11 hour, 1650 lb-ft torque

134	STANDARD	GGAD12063111151	G		NONLUBRITED	20120912	6	4	8	9.9	10	7	5	9	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. This ran at 1650 lb-ft torque for 11hrs.
134	STANDARD	GGAD12063094027	A	5	NONLUBRITED	20120912	7	5	8	9.9	10	7	6	9	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. This ran a special test length of 11 hours.
134	STANDARD	N/A	G		NONLUBRITED	20121206	7	8	8	9.9	10	7	10	9	9.9	10	1650 torque, 11 hours - 1450 ml fill
152-1	STANDARD	GGAD12063112939	G		NONLUBRITED	20120915	8	9	9	9.9	10	8	9	8	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. This ran a special test length of 11 hours.
152-1	STANDARD	GGAD12063123814	A	5	NONLUBRITED	20120917	7	7	10	10	10	7	10	10	10	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. This ran a special test length of 11 hours.
152-1	CANADIAN	GGAD12063112848	G		NONLUBRITED	20120921	7	9	10	9.9	10	7	10	9	9.9	10	1650 torque, 11 hours, Problems controlling to Canadian conditions with current valve setup (3 nozzles @ 100% on)
152-1	CANADIAN	GGAD12063110037	B		NONLUBRITED	20120925	7	10	10	9.9	10	7	10	10	10	10	AAM Zeta axle - Batch 2012. 11 hr test length, 1650 lb-ft torque.
152-1	CANADIAN	GGAD12063113138	G		NONLUBRITED	20121009	7	9	8	9.9	10	8	10	9	9.9	10	1650 torque, 11 hours, Problems controlling to Canadian conditions with current valve setup (3 nozzles @ 100% on)
155	STANDARD	GGAD12063111331	G		NONLUBRITED	20120922	7	8	9	9.9	10	7	9	9	9.9	10	1650 torque, 11 hours
155	STANDARD	GGAD12063094334	B		NONLUBRITED	20120925	7	7	9	9.9	10	7	9	10	9.9	10	AAM Zeta axle - Batch 2012. 11 hr test length, 1650 lb-ft torque.
1-A	STANDARD	GGAD12063092127	A	5	NONLUBRITED	20120926	6	5	5	10	10	7	7	9	10	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. 11 hrs.
1-A	STANDARD	GGAD12063111115	G		NONLUBRITED	20121006	7	7	8	9.9	10	7	7	8	9.9	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. 11 hrs.
1-A	STANDARD	GGAD12063091633	G		NONLUBRITED	20121126	7	9	9	9.9	10	7	9	10	9.9	10	1650 torque, 11 hours - 1450 ml fill
1-A	CANADIAN	GGAD12063093512	A	5	NONLUBRITED	20121130	7	9	9	9.9	10	8	9	9	9.9	10	Ran Lubrizol recommended test conditions except ran oil set points as L-37 Canadian. Used Oil 1-A. Non-lubricated AAM Zeta axle - Batch 2012.
1-B	STANDARD	GGAD12063093822	A	5	NONLUBRITED	20120927	6	6	7	9.9	10	6	7	10	10	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. 11 hrs.
1-B	STANDARD	GGAD12063103742	G		NONLUBRITED	20121005	5	4	9	9.7	10	6	5	9	9.7	10	AAM Zeta axle - Batch 2012. Conducted per Lubrizol proposed procedure. 11 hrs.
1-B	STANDARD	N/A	G		NONLUBRITED	20121128	7	10	9	9.9	10	7	10	9	9.9	10	1650 torque, 11 hours - 1450 ml fill
1-B	CANADIAN	GGAD12063093242	A	5	NONLUBRITED	20121214	7	9	9	9.9	10	7	9	9	9.9	10	Ran Lubrizol recommended test conditions except ran oil set points as L-37 Canadian. Used Oil 1-B. Non-lubricated AAM Zeta axle - Batch 2012.

Oil Description	Test Version (Standard or Canadian)	Lab	Pass/Fail J2360 Limits	Test Hardware	EOT Date	Conditioning		Test		Test Length Hours	Fill Volume mL	Pinion Rating					Ring Rating				Broken Tooth	Broken Tooth Location	Free-form Comment		
						Speed	Load	Speed	Load			WEAR	RIPP	RIDG	SPIT	SCOR	WEARR	RIPPR	RIDGR	SPITR				COMMENT	
Oil Description	TVERSION	LTMSLAB		TESTHARD	LTMSDATE																				
Fail Oil (134)	STANDARD	B	N/A	LUBRITED	20110118	682	375	124	1650	22.2	950	0	0	0	0	0	7	10	5	9.9	10	YES	Pinion	4.5 TEST HOURS, SHAFT REPAIRED AND TEST RESTARTED. PINION TEETH UN-RATABLE DUE TO CATASTROPHIC DAMAGE. SHAFT FAILURE AT TEST SHUT DOWN AT 20.59 HOURS OF TEST PHASE DUE TO HIGH VIBRATION. ALL TEST PHASE LOAD = 1650 FT. LBS.	
Fail Oil (134)	STANDARD	B	N/A	LUBRITED	20110121	682	375	124	1400	27	950	7	6	5	10	10	7	9	5	10	10	NO		BACKLASH NOT POSSIBLE DUE TO HIGH BEARING WEAR. TEST SHUTDOWN AT 27 HOURS DUE TO HIGH VIBRATION. EOT BREAK AND TURN / TEST PHASE WHEEL LOAD = 1400 FT. LBS.	
Fail Oil (134)	STANDARD	B	N/A	LUBRITED	20110126	682	375	124	1200	45	950	7	5	7	10	10	7	7	8	10	10	NO		URS. EOT BACKLASH NOT POSSIBLE DUE TO HEAVY BEARING WEAR TEST WAS SHUTDOWN AT 47 HOURS DUE TO HIGH VIBRATION EVENT AROUND 40 HO TEST PHASE WHEEL LOAD = 1200 FT. LBS.	
Pass Oil (155)	STANDARD	B	N/A	LUBRITED	20110131	682	375	124	1400	102.5	950	7	10	9	9.9	10	8	10	10	9.9	10	NO		ED SHUTDOWN DURING CONDITIONING. TEST RESTARTED. TEST STOPPED AT 100 HOURS WITH NO FAILURE. VIBRATION SWITCH FAULT CAUS TEST PHASE WHEEL LOAD = 1400 FT. LBS.	
Pass Oil (155)	STANDARD	B	N/A	LUBRITED	20110204	682	375	124	1650	82	950	7	10	9	5	10	8	10	10	9	10	YES	Ring	RE. ONE LARGE PINION BEARING ROLLER HAS HVY/CAT SPALLING. RING GEAR TEETH BROKEN. EOT B/T AND BACKLASH NOT POSSIBLE DUE TO FAILU TEST SHUTDOWN AT 82 HOURS DUE TO HIGH VIBRATION. 1 PINION TOOTH AND 4 TEST PHASE WHEEL LOAD = 1650 FT. LBS.	