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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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April 22, 2003

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Unapproved Minutes of the April 16, 2003 Sequence IIIF Surveillance Panel Meeting held in Romulus, MI

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Chairman Nahumck called the meeting to order at 1:05pm. A copy of the agenda (Attachment 1) was handed out and reviewed.

Secretary and Motion & Action Item Recorder – Ben Weber volunteered to be Motion & Action Item Recorder for this meeting. The Motions & Action Items for this meeting are attached (Attachment 2). Since Frank Farber, who is now permanent secretary for this Surveillance Panel, was not in attendance Michael Kasimirsky volunteered to perform secretary duties for this meeting.

Membership changes – An attendance list was circulated and is attached (Attachment 3). Patrick Lai's email address domain name has changed; his new email address is: *patrick.k.lai@esso.ca*. Barbara Dennis is sitting in for John Moffa as the Castrol representative for this meeting.

Sequence IIIG Test Development Task Force Report – Sid Clark presented the Test Developer Report (Attachment 4) on the status of Sequence IIIG test development. He reviewed the latest refinements to the procedure made in preparations for the start of the Sequence IIIG GF-4 Matrix and also reviewed inspections made at the matrix laboratories in preparation for the matrix. He then reviewed the results of the two tests conducted as part of Experiment Phase I. He noted that the oil consumption listed for the second test, lab/run number SR/25, was 4.19L at 80 hours, rather than 100 hours, and as such should not have been included on that slide. He went on to give an overview of the testing and refinements involved with Experiment Phase II and the results of Phase II testing. He noted that both of the tests conducted as part of Phase II experienced oil filter plugging. In each

test, the filter was replaced and the test continued according to procedural guidelines with no additional changes allowed. *{Secretary note: Mr. Clark's presentation, shown in Attachment 4, has been revised to correct the errors noted during the meeting.}*

Mr. Clark then commented on the ongoing Oil Filter Plugging Investigation in Sequence IIIG test development. The Test Developer is investigating an alternate coolant additive to introduce a tracer element (Potassium) that will be identifiable through ICP analysis of the used oil samples. Development runs have been checked for glycol contamination using FTIR and Gas Chromatography and neither method has shown substantial amounts of glycol contamination in development testing. The Central Parts Distributor has had 12 randomly selected oil filters sent back to the vendor for analysis. The vendor found no problems with the materials and construction of those filters. The development team is looking at an alternate oil filter but no decision has been made at this time.

The Final Development Runs were then reviewed. The final two runs both generated uniform wear on all camshaft lobes and lifters. Both tests used PF-47 oil filters and neither test experienced oil filter plugging.

Pat Lang then commented on the differences in rated deposit levels between the two laboratories and the results of investigations into this issue. The raters at the development laboratories have been performing dual ratings on Sequence IIIG test parts to help eliminate differences between the two laboratories. Mr. Lang commented on rating differences he found that related to lighting while rating, tooling marks on the pistons and the effects of rating, and other issues. Both he and Mr. Clark think that they have this item resolved and are ready to move forward. Some type of Rating Workshop will be necessary to propagate these refinements to the rest of the industry.

Gordon Farnsworth raised a question about what actions are being planned to investigate the presence of trace elements (Sodium, for example) that have been found in the used oil samples. Sodium has been identified as a potential indicator of cleaning agent carryover since it is found in the PDN-50 and NAT-50 soaps used in the Better Engineering "dishwasher-type" parts washers. There is a concern that the soap used in this machine is not being fully removed in the final solvent wash of test parts after they are removed from the washing machine. Bob Olree noted that the Test Development Group was originally concerned that the sodium found in the used oil was from the coolant additive and was indicative of an internal coolant leak in the test engine. Subsequent investigation has led them to the conclusion that the more likely source of sodium is the cleaning agent and not the coolant additive. Further investigation into this issue is ongoing. The discussion then moved on to cleaning methods, required maintenance intervals on parts cleaning machines, and other cleaning-related issues. The consensus of the group was that this issue needs further work.

Motion (Dwight Bowden/Gordon Farnsworth) The panel tasks the O&H Subpanel with reviewing the cleaning procedures listed in the Sequence IIIF & IIIG procedures. The motion passed unanimously by voice vote.

Cam Batch Concept Task Force Report – Charlie Leverett presented the Cam Batch Concept Task Force Report on the recommendations resulting from this work group. The group recommends that all test parts be used on a first-in, first-out (FIFO) basis, suppliers maintain a minimum six-month inventory, and that laboratories should not exceed a sixty-day internal inventory of Critical Parts. In addition, Critical Parts are to be identified by serial number and/or batch code identification. All parts are to be used as received unless specific modifications are specified in the procedure. Rejected Critical Parts are to be reported to the supplier and Test Developer as they are found. The Central Parts Distributor will be the sole point of information on camshaft phosphate batch information. Dwight Bowden also asked that the minutes reflect the panel's appreciation to Mr. Leverett and the members of the Task Force for their efforts on this issue.

Action Item – The TMC is to revise Form 12 of the Standard Report Form Set to include all the Critical Parts listed in Mr. Leverett's presentation.

Matrix Design Task Force – Frank Fernandez presented an overview of the final IIIG Matrix (Attachment 6).

ACC Template Update – Phil Scinto did not present the entire ACC Template, but he did review the three main concerns that ACC has noted regarding the IIIG test prior to starting the IIIG Matrix. The ACC believes that the oil filter plugging issue needs to be resolved prior to starting the matrix. The ACC also feels that there is not enough data available to show that the wear difference between the two laboratories has been addressed. Finally, the ACC would like the final, updated MRV data table to be analyzed prior to the start of the matrix. The issues raised by the ACC were extensively discussed, but final resolution wasn't possible since there was no representation from PAPTG present at this meeting. There was extensive discussion of the development runs made to date and how this data relates to the concerns raised by the ACC.

Process for Drain Analysis and Samples to LOTRU Chairman – Chairman Nahumck then moved the discussion on to how to handle MRV & CCS measurements on the upcoming Matrix tests. The used oil samples are to be stored at $75^{\circ} \pm 10^{\circ}\text{F}$ after removal from the engine. At four hours (± 30 minutes) after Sequence IIIG EOT, the CCS measurement will be started. The MRV test will be performed on the sample four hours (± 30 minutes) after the CCS result has been completed. Ben Weber discussed the planned measurement procedure for MRV & CCS measurements as part of the Matrix, which is attached (Attachment 7). The current plan is that all samples are to be run according to the plan outlined above. In addition, all samples are going to be run again at 168 hours for MRV only. See the attachment for the final specifics of the plan.

Chairman Nahumck again reiterated the request by Chris May for used oil samples. The panel has been aware of this request for some time. Used oil samples from the matrix will be provided to Mr. May as soon as possible after completion of each matrix test.

Motion (Charlie Leverett/Sid Clark) The Sequence IIIF Surveillance Panel recommends to the PCEOCP that the Sequence IIIG test is ready to start the GF-4 Matrix. The motion passed 11-0-3.

Discussion: Dwight Bowden commented on the ongoing investigation into oil filter plugging and the data generated to date in that investigation. He is currently investigating three different oil filters: the current Wix filter & two other similar models of oil filter, using the three reference oils being used in the Sequence IIIG Matrix. Mr. Bowden expects to have results from this investigation in the next few weeks.

O&H Issues: Sequence IIIG Test Report – This issue was discussed earlier in the meeting. Any last minute changes should be sent to Frank Farber at the TMC as soon as possible. The revised forms will be put into effect by April 28, 2003.

O&H Issues: Oil Consumption Form – Sid Clark presented the revised Oil Consumption Form for Sequence IIIG testing. Mr. Clark offered his thanks to Mark Mosher and ExxonMobil Corp. for the revised Oil Consumption Form that he used as a basis for the revised form. The revised form will be available on the TMC Web Page. A new, longer dipstick is being developed and the form will be revised again when the new dipstick is available.

Old Business – There was no old business.

New Business: Release of Obsolete Reference Oils

Sequence IIIF Surveillance Panel Meeting
April 16, 2003 – Romulus, Michigan

Motion (Michael Kasimirsky/Charlie Leverett) Release any obsolete Sequence IIIIE and IIIF oils from the control of the Sequence III Surveillance Panel. The motion passed unanimously by voice vote.

New Business: Data Dictionary for CCS/MRV – Charlie Leverett brought up the issue of MRV & CCS fields for reporting this data in the Sequence IIIF Report Package.

Motion (Charlie Leverett/Gordon Farnsworth) Delete the second CCS temperature field from Form 6 and add a connecting rod field to Form 12 to capture the information on the new rods. The motion passed unanimously by voice vote.

New Business: Connecting Rod Change – Sid Clark commented that in June or July the plant will be swapping over from cast connecting rods to powered metal rods with fractured rod caps. There is not sufficient time to do a build-out of the current materials.

Motion (Michael Kasimirsky/Dave Glaenzer) Establish the IIIG LTMS in parallel to the IIIF LTMS, using similar constants, referencing requirements, etc. Dual calibration (i.e. calibrated as both a IIIF and a IIIG stand) on a stand is allowable, however if a stand is calibrated in both test methods, a full instrument calibration is required after every 15 test starts, regardless of test type. The motion passed unanimously by voice vote.

The consensus of the group is that a meeting as part of "Surveillance Panel Week" is not necessary. The next meeting is tentatively scheduled for June 10, 2003.

The meeting was adjourned at 4:53pm.

AGENDA

Attachment 1

SEQUENCE IIIF SURVEILLANCE PANEL MEETING

Marriott Hotel, Romulus, Michigan

April 16, 2003

1. APPOINTMENT OF RECORDER OF ACTIONS/MOTIONS
2. AGENDA REVIEW
3. MEMBERSHIP CHANGES
4. COLLECTION OF MEETING ROOM FEE

SEQUENCE IIIG DEVELOPMENT UPDATE

- A. IIIG Test Development Task Force Report – Sid Clark
- B. Cam Batch Concept Task Force Report – Charlie Leverett
- C. Update from the Matrix Design Task Force – Frank Fernandez
- D. ACC Template Update – Phil Scinto
- E. Process for Drain Analysis and Samples to LOTRU Chairman
- F. Is the test ready for a Precision Matrix?

O&H ISSUES

- A. Sequence IIIG Test Report
- B. Oil Consumption Form Update

OLD BUSINESS

- A. Review of ASTM Memo 03-012 – Michael Kasimirsky

NEW BUSINESS

- A. Request to release obsolete test oils from TMC inventory
- B. Next Surveillance Panel Meeting ?????

ADJOURNMENT

April 15, 2003 Sequence III Surveillance Panel Meeting
Detroit, MI

Motions and Action Items
As Recorded by Ben Weber at the meeting

1. The two test labs (SwRI & PE) are directed to thoroughly review and standardize their IIIIG cleaning process in an attempt to reduce the Na content that is believed to be coming from the cleaning solution used in the parts washer. This work shall be completed prior to the start of the IIIIG matrix. Passed unanimously. Motion made by Dwight and Gordon.
2. Sid Clark will send to the group an updated and corrected copy of all the MRV pre-matrix data on the NF200 MgP camshafts.
3. Form 12 for the IIIIG (not IIIF) needs to be updated to account for all the parts required from the Batch Concept Task Force prior to starting the matrix (later decided to be the week of April 28th).
4. Dwight will supply the final analysis from his filter experiment to the Surveillance Panel.
5. Dual ratings will be performed on all matrix tests.
6. The matrix will use the current pre-matrix Wix filter.
7. The matrix will start the week of April 28th provided all the action items are resolved.
8. Charlie Leverett motioned to accept the IIIIG test as ready for matrix start. This was seconded by Sid Clark. The motion passed 11-for, 0-against, and 3 waives.
9. The additional 168 h MRV data shall be included in the comments section of the test report.
10. A one-quart sample from each EOT IIIIG matrix test will be sent to Chris May.
11. The labs will also be using the longer oil dipsticks by April 28th. The new oil consumption tables for the IIIF and IIIIG will also be updated to account for the new dipsticks.
12. The TMC shall remove all outdated Sequence III reference oils. The item of backward compatibility for future categories was brought up, but the group decided to not keep any of the outdated reference oils for this possible purpose. Passed unanimously.
13. Drop the 'CCS2' field from form 6. Passed unanimously.

14. Sid informed the group that the connecting rods will change from cast parts to powder metallurgy parts in mid June. Form 12 will be updated accordingly.
15. Mike K motioned and Dave G seconded the motion that dual referencing for IIIF and IIIG will be treated independently with instrumentation stand calibrations occurring every 15 tests. The motion passed unanimously.
16. Next meeting probably be June 10th in Detroit along with a Sequence VG meeting on the 11th and a ILSAC/Oil meeting on the 12th.

ASTM SEQUENCE IIIF LIST

April 16, 2003 Romulus, Michigan

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| Sid Clark GM Powertrain General Motors Corporation Mail Code 480-106-160 30500 Mound Rd. Warren, MI 48090-9055 USA | 586-986-1929 586-986-2094 sidney.l.clark@gm.com Test Sponsor Rep | <input checked="" type="checkbox"/> IIIF SURV PANEL <input type="checkbox"/> IIIF MAILING LIST <input checked="" type="checkbox"/> O&H SUBPANEL <input type="checkbox"/> O&H Mailing List | Present  |
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| Michael J. Riley Ford Motor Company 2105 Village Road POEE Building, MD44 Dearborn, MI 48121-2053 USA | 313-390-3059 313-845-3169 mriley2@ford.com | <input checked="" type="checkbox"/> IIIF SURV PANEL <input type="checkbox"/> IIIF MAILING LIST <input checked="" type="checkbox"/> O&H SUBPANEL <input type="checkbox"/> O&H Mailing List | Present <u>M. J. Riley</u> |
| Robert H. Rumford Specified Fuels & Chemicals, LLC 1201 South Sheldon Road Channelview, TX 77530-0429 USA | 281-457-2768 281-457-1469 rhrumford@specified1.com | <input type="checkbox"/> IIIF SURV PANEL <input checked="" type="checkbox"/> IIIF MAILING LIST <input type="checkbox"/> O&H SUBPANEL <input type="checkbox"/> O&H Mailing List | Present _____ |
| Philip R. Scinto The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA | 440-347-2161 440-347-9031 prs@lubrizol.com | <input type="checkbox"/> IIIF SURV PANEL <input checked="" type="checkbox"/> IIIF MAILING LIST <input type="checkbox"/> O&H SUBPANEL <input type="checkbox"/> O&H Mailing List | Present <u>PRS</u> |

ASTM SEQUENCE IIIF LIST

April 16, 2003 Romulus, Michigan

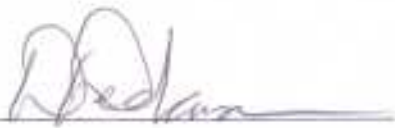




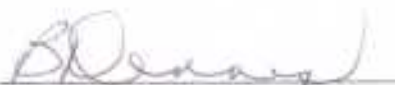

| NAME / ADDRESS | PHONE / FAX / E-MAIL | SIGNATURE |
|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0. Ben Weber Southwest Research Institute 6220 Culebra Road P.O. Box 28510 San Antonio, TX 78228 USA | 210-522-5911 210-684-7530 bweber@swri.edu Sub-Committee D02.B01 Chair | Present  |
| | | <input type="checkbox"/> IIIF SURV PANEL <input checked="" type="checkbox"/> IIIF MAILING LIST <input type="checkbox"/> O&H SUBPANEL <input type="checkbox"/> O&H Mailing List |

SEQUENCE III F SURVEILLANCE PANEL MEETING

GUEST LIST

April 16, 2003
Romulus, Michigan

Attachment 3

| <u>NAME/ADDRESS</u> | <u>PHONE/FAX/EMAIL</u> | <u>SIGNATURE</u> |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Doug Deekman 600 Millingsport Rd Paulsboro, NJ 08066 | 856-224-2658 -3613 Doug.Deekman @ ExxonMobil.com |  |
| Lowell Norris 17402 Moreton Ln Spring, TX 77379 | 281-656-5538 lowell.t.norris @ -exxonmobil.com |  |
| CLIFF VENIER 3333 HIGHWAY 6 SOUTH HOUSTON, TX 77082-2539 17082 | 281-544-8626 281-544-8150 (FAX) cliff.venier @ shell. com |  |
| MAILING LIST, PLEASE | | |
| Robert Sutherland 3333 Highway 6 South Houston, TX 77082 | 281-544-8620 281-544-8150 FAX R.Sutherland@Shell.com |  |
| Dan Pridemore Ethyl Corp 2000 Town Center Drive #1750 Southfield, MI 48075 | 248-350-0640 ph 248-350-0025 fax Dan - Pridemore @ Ethyl com |  |
| Barbara Dennis Castrol American 240 Centennial Ave Piscataway, NJ 08854 | 732-980-3613 973-686-4033 Barbara.Dennis @ castrol.com |  |
| Jean H. Barden OH Technologies, Inc P.O. Box 5039 Munich, OH 44061-5039 | 440-354-7007 440-354-7060 jhbarden @ otech.com |  |

Sequence IIF/G Surveillance Panel Report

Presented to the Sequence IIF/G Surveillance Panel

Sid Clark

April 16, 2003

IIIG Development Team Report

At the February Sequence III Surveillance Panel meeting, it was agreed that the IIIG could be considered ready for matrix testing, provided that an observed wear severity difference between SwRI and PE could be satisfactorily addressed.

The Development team met on February 21, 2003 and agreed on an experiment to try to determine what may have caused this observed wear severity difference.

IIIIG Development Team Report

Experiment Phase I outline:

- Run two tests
- Labs to build and swap engines for these tests
- SwRI to run Oil B and PE to run Oil C
- Labs to conduct an in-depth procedural review and assure standardization on engine buildup and test operating procedures prior to engine build and test start

Observations, deviations, and changes outlined:

Pre-test component preparation (standardized procedure)

- Camshaft and Lifters
 - Pre-measurement cleaning materials and procedures
- SwRI to measure lifters
 - V-block (lifter) SwRI had the specified v-block so they measured the lifters
- PE to measure cams
 - Snap gage (camshaft) PE had the specified snap gauge so they measured cams

No camshaft or lifter foot surface finish data traces

Procedural Review

Pre-test component preparation (standardized procedure)

- Engine block
 - Pre & post test cleaning
 - Honing
 - Pre-post honing cleaning procedures
 - Fluid & filter change intervals
 - Cylinder surface finish data comparison
 - Honer calibration - *An observation was made concerning the load measurement on the CV-616. Data shows that the observation is not a problem but it has been decided to develop a standardized method for calibration within the industry. SwRI and PE have installed calibrated watt meters on their honers and are currently monitoring the correlation between these meters and the factory bar graph display. The intent is to run both honers at the same wattage for all future testing.*

Procedural Review

Pre-test component preparation (standardized procedure)

- Engine block assembly
 - Reviewed all sub assembly components
 - Cleaning, measurement data, and assembly procedures
 - Camshaft & Lifters
 - Test oil pre-lube
 - » Standardized on lifter lubrication double dip and rotate procedure *This was not a standard procedure between the labs prior to this design of experiment (DOE)*
 - Installation and final valvetrain loading procedure
 - Cylinder head calibration
 - Reviewed head rig load cell calibration procedures
 - Cylinder head cleaning, lubrication, valve, seal, spring, and retainer installation
 - Final assembly calibration
 - Final installation procedures

Procedural Review

- Engine installation, startup, and operations
 - Reviewed procedures and standardized operations
 - Flush cart plumbing & operations
 - Restricted flow through front of intake during flush *This is a procedural change implemented with this DOE*
 - Fuel rail & injector purge
 - Purge fuel rail and injectors prior to installation on engine *This was not a standard method prior to this DOE*
 - Test oil charging standardization
 - Oil fill container *Calibrated beakers were used by both labs for initial oil charge*
 - Priming drill motor *The same (Dewalt) drill motor was used by both labs*
 - Reviewed all test operations and control parameters
 - Startup *Air starter oil misters were installed at SwRI, this was already in place at PE*
 - Speed & Load control
 - AFR control
 - Breather tube crankcase vent connections

Experiment Phase I Results

| Lab/Run# | Viscosity | Test Oil | % Vis. Inc. | Avg. Wear | WPD | PSV | Oil Cons. | Filter By-pass |
|----------|-----------|-------------------|-------------|-----------|------|------|-----------|----------------|
| PE/21 | 5W-20 | Cand.Ref Oil C- 2 | 166 | 45 | 3.40 | 8.38 | 3.88 | (24h)&73-81h |
| SR/25 | 5W-20 | Cand.Ref Oil B-1 | TVTM | 56.1 | 2.82 | 8.62 | N/A | |

Summary of results:

PE/21 - With engine swap and all other variables, PE/21 C-2 results on cam and lifter avg. wear (45μ) fell in line with previous results from SR/23 (43μ) & SR/24 (41μ). Viscosity increase, WPD, PSV, and oil consumption were all within the expected ranges on all three tests.

SRI/25 - The TVTM result is assumed to be due to high oil consumption which occurred early in the test. All test stand operations and engine build data were reviewed in detail. *No root cause for the high oil consumption has yet been determined.*

Experiment Phase II

Experiment Phase II outline

- All Phase I enhancements plus:
 - Run two additional tests
 - SwRI to hone both engines
 - PE & SwRI assemble their respective engines for test
 - Both labs to run Candidate Reference Oil B
 - Both labs to use epoxy impregnated front covers *The thought process was to eliminate the front covers as a possible source for glycol leaks and/or air entrainment with the new, potentially more porous, sand cast parts.*

Experiment Phase II Results

| Lab/Run# | Viscosity | Test Oil | % Vis. Inc. | Avg. Wear | WPD | PSV | Oil Cons. | Filter By-pass |
|----------|-----------|-------------------|-------------|-----------|------|------|-----------|----------------|
| PE/22 | 5W-20 | Cand.Ref Oil B- 2 | 148 | 38.4 | 4.37 | 9.20 | 4.64 | (45min)&26h |
| SR/25A | 5W-20 | Cand.Ref Oil B- 2 | 157 | 41.8 | 3.67 | 8.8 | 3.89 | |

PE/21 and PE/22 both experienced oil filter plugging. In each test, the first filter was replaced and the test continued according to procedural guidelines with no additional changes allowed.

Summary of results:

Although we experienced oil filter plugging on PE/22, it is still a valid test and the results fall in line with SR/25A and SR/22.

SR/25 which generated the TVTM result is not being used for comparison in this case. Part of Phase II was to generate another run, i.e., SR/25A, for lab comparison.

Oil Filter Plugging Investigation

- FTIR Glycol checks prove negative contamination in last five tests at PE
- SwRI investigated glycol contamination in tests SR/22 & SR/25A using ASTM D-4219 (GC). SwRI did not show substantial amounts of glycol contamination. *Understanding that FTIR and Gas Chromatography have different sensitivity levels and may produce conflicting results, GM is investigating an alternative coolant additive to introduce a tracer element (Potassium) that will be identifiable through ICP analysis for future testing.*
- SEM analysis performed on wash from PE/22 45min. oil filter debris shows high Calcium and Sulfur deposits. *This finding was also confirmed through ICP on the used oil samples and the sludge deposits from the bottom of the oil pan at end of test. (SEM analysis on the new oil samples from each lab confirmed these elements in the new oil at varying concentrations.)*

Oil Filter Plugging Investigation Continued

OHT randomly selected 12 WIX oil filters and sent them to WIX for analysis. WIX concluded that there were no problems with the curing of the filter paper and/or the potting adhesive used in construction of the filters.

- OHT currently conducting bench testing at Wix

Test Conditions:

- Three oils 538, “B”, & “C” (TMC Blends)
- 100 hours duration
- Heated bath (150°C)

As a result of unexpected oil filter plugging in tests PE/21 & PE/22, the development team is looking at an alternative oil filter. Testing is ongoing at Wix to determine what effect 150 °C oil might have on the filter media.

Oil Filter Plugging Investigation

- Initial concerns over low sodium concentrations in the used oil did not prove sodium to be coming from the coolant additive.

ICP testing of PDN50 and NAT50 parts cleaning detergent shows high sodium which is believed to be the cause of low levels of sodium (~100ppm) in the used oil samples.

Final Development Runs

GM-2 0.075% Phos. Aryl Zinc

| Lab/Run# | Viscosity | Test Oil | % Vis. Inc. | Avg. Wear | WPD | PSV | Oil Cons. | Filter By-pass |
|----------|-----------|----------|-------------|-----------|------|------|-----------|----------------|
| PE/23 | 5W-20 | GM-2 | 146 | 80.0 | 3.29 | 8.59 | 3.57 | |
| SR/26 | 5W-20 | GM-2 | 168 | 69.9 | 2.84 | 7.6 | 3.64 | |

Summary of results:

SR/26 and PE/23 both generated uniform wear on all camshaft lobes and lifters. Both tests used PF-47 oil filters and neither test experienced filter plugging.

Sequence III G Test Summary

All Phosphate NF-200 Cams

| Lab/Run# | Viscosity | Test Oil | % Vis. Inc. | Avg. Wear | WPD | PSV | Oil Cons. | Filter By-pass | MRV @ -30 |
|----------|-----------|-------------------|-------------|-----------|------|------|-----------|----------------|-----------|
| OHT/PE | 5W-30 | TMC Ref. 433-1 | 191 | 37.7 | 2.94 | 8.46 | 4.09 | | >400000 |
| SR/19 | 5W-30 | TMC Ref. 433-1 | TVTM | 98.9 | 3.13 | 8.51 | 4.31 | | N/A |
| PE/20 | 5W-30 | TMC Ref. 433-1 | 153 | 37.8 | 3.14 | 8.64 | 4.13 | | >400000 |
| OHT/SR | 5W-20 | GF-3 TMC Ref. 538 | 91.6 | 17.9 | 2.90 | 8.73 | 3.80 | | 18100 |
| SR/20 | 5W-20 | GF-3 TMC Ref. 538 | 92.7 | 19.3 | 2.89 | 8.25 | 3.12 | | 17500 |
| PE/16 | 5W-20 | GF-3 TMC Ref. 538 | 118.9 | 16.8 | 3.30 | 9.04 | 4.61 | | 22800 |
| PE/17 | 5W-20 | GF-3 TMC Ref. 538 | 101.2 | 15.8 | 2.64 | 8.10 | 3.29 | | 20300 |
| PE/18 | 5W-30 | 0.03 Phos. | 114 | 36.7 | 3.24 | 8.48 | 3.66 | | 57400 |
| SR/21 | 5W-20 | Cand. Ref Oil A-1 | 106 | 44.6 | 3.74 | 8.46 | 3.50 | | 28100 |
| PE/19 | 5W-30 | Cand.Ref Oil B-1 | 91 | 21.0 | 4.21 | 8.70 | 3.67 | | 26300 |
| SR/22 | 5W-30 | Cand.Ref Oil B-1 | 155 | 42.2 | 4.06 | 8.66 | N/A | (60h)&96h | 108600 |
| SR/23 | 5W-20 | Cand.Ref Oil C-1 | 159 | 43.2 | 2.97 | 7.88 | 3.73 | | 70700 |
| PE/21 | 5W-20 | Cand.Ref Oil C- 2 | 166 | 45 | 3.40 | 8.38 | 3.88 | (24h)&73-81h | 81700 |
| SR/24 | 5W-20 | Cand.Ref Oil C-1 | 133 | 41.2 | 3 | 8.31 | 3.54 | | 49600 |
| SR/25 | 5W-30 | Cand.Ref Oil B-1 | TVTM | 56.1 | 2.82 | 8.62 | N/A | | N/A |
| PE/22 | 5W-30 | Cand.Ref Oil B- 2 | 148 | 38.4 | 4.37 | 9.20 | 4.64 | (45min)&26h | 61400 |
| SR/25A | 5W-30 | Cand.Ref Oil B- 2 | 157 | 41.8 | 3.67 | 8.8 | 3.89 | | 92700 |
| SR/26 | 5W-20 | GM-2 | 168 | 69.9 | 2.84 | 7.6 | 3.64 | | 41100 |
| PE/23 | 5W-20 | GM-2 | 146 | 80.0 | 3.29 | 8.59 | 3.57 | | 38600 |
| PE/XX | 5W-20 | Cand.Ref Oil C | 228 | 32.8 | 3.19 | 8.96 | 4.30 | | 266300 |

Conclusion

The development team believes it has addressed the perceived wear severity difference between the two San Antonio test labs.

- Wear on tests PE/22 & SR/25A are comparable

| Lab/Run# | Viscosity | Test Oil | % Vis. Inc. | Avg. Wear | WPD | PSV | Oil Cons. | Filter By-pass |
|----------|-----------|-------------------|-------------|-----------|------|------|-----------|----------------|
| PE/22 | 5W-20 | Cand.Ref Oil B- 2 | 148 | 38.4 | 4.37 | 9.20 | 4.64 | (45min)&26h |
| SR/25A | 5W-20 | Cand.Ref Oil B- 2 | 157 | 41.8 | 3.67 | 8.8 | 3.89 | |

- Wear on tests PE/23 & SR/26 are comparable

| Lab/Run# | Viscosity | Test Oil | % Vis. Inc. | Avg. Wear | WPD | PSV | Oil Cons. | Filter By-pass |
|----------|-----------|----------|-------------|-----------|------|------|-----------|----------------|
| PE/23 | 5W-20 | GM-2 | 146 | 79.5 | 3.29 | 8.59 | 3.57 | |
| SR/26 | 5W-20 | GM-2 | 168 | 69.9 | 2.84 | 7.6 | 3.64 | |

- Labs are working to standardize honer operations for the entire test industry, i.e., calibrated watt meter readings will be used to establish correlation between watt vs current driven bar graph displays.
- Suspected cause for rating offsets have been identified and will be resolved
 - Precision matrix will be dual rated
- Sporadic filter plugging will continue to be monitored, investigated, and resolved

It's time to run the precision matrix !

Batch Concept Task Force Report

Presented to the Sequence III Surveillance Panel

Charlie Leverett

April 16, 2003

BCTF Recommendations

- All parts are to be distributed and used on a first-in first-out (FIFO) basis.
 - Camshafts to be distributed as intermixed random batches
- Suppliers of critical test components are required to maintain a minimum six month industry inventory.
 - Includes un-machined castings, i.e., blocks, cylinder heads, camshafts.
- Laboratories should not exceed a sixty day internal inventory of critical parts based on calibrated stand usage.
 - Lower inventory levels are encouraged to ensure a more timely inventory turnover.

BCTF Recommendations

- All critical parts are to be identified by serial number and/or batch code identification.
 - Additional receipt date coding should be used at the laboratory level to assure FIFO compliance
- All parts are to be used as received unless specific modifications are specified in the test procedure.
- All rejected parts are to be brought to the attention of the critical part supplier and the test sponsor.
 - The part supplier or the test sponsor will report all rejections to the Surveillance Panel, O&H Sub panel, and the TMC test engineer semi-annually or earlier depending on the urgency.

BCTF Critical Part Recommendations

Sequence III G Critical Test Component List

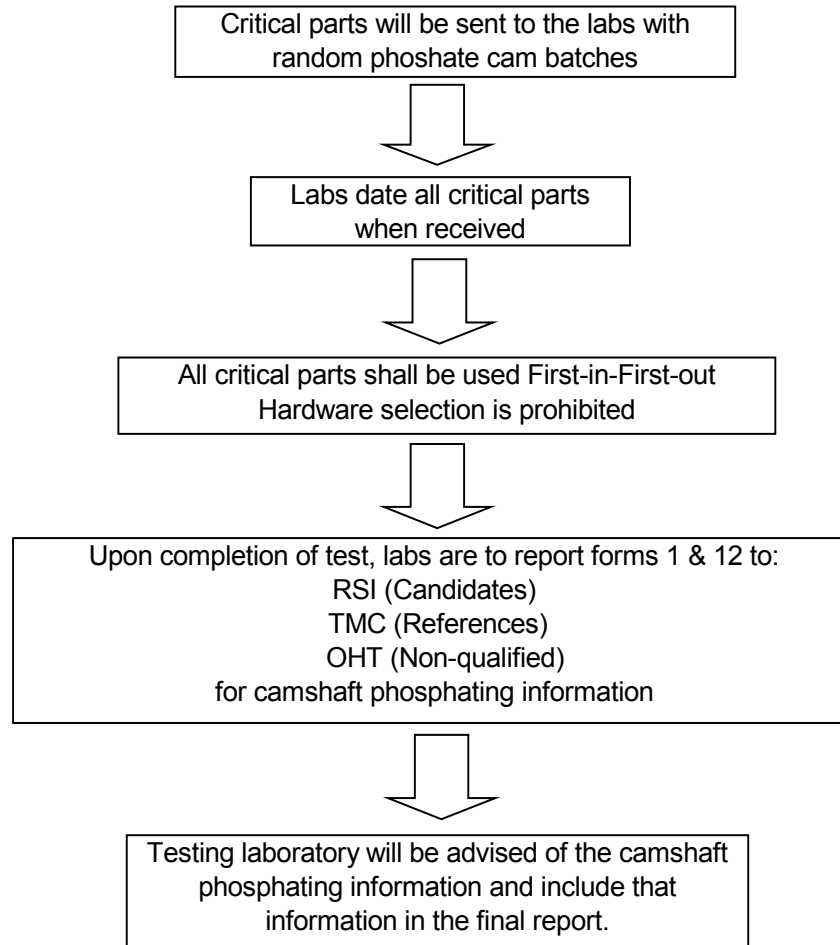
| <u>Part Description</u> | <u>Identification</u> | <u>Supplier</u> |
|-------------------------|-----------------------|-----------------|
| Camshaft* | Serial Number | CPD |
| Crankshaft | Batch Code | SPS |
| Cylinder Head | Serial Number | SPS |
| Engine Bearings | Batch Code | CPD |
| Engine Block | Serial Number | SPS |
| Ex. Valve Seal | Batch Code | CPD |
| In. Valve Seal | Batch Code | CPD |
| Lifters | Serial Number | CPD |
| Oil Cooler | Batch Code | CPD |
| Oil Filter | Batch Code | CPD |
| Pistons | Batch Code | CPD |
| Rings | Batch Code | CPD |
| Rocker Arm | Batch Code | CPD |
| Valve Spring | Batch Code | CPD |

* Camshafts shall be serialized and include additional processing information received after End of Test.

BCTF Critical Part, (Camshaft), Information Release Flow Chart

Attachment 5

Recommendation



FINAL IIIG MATRIX

Sequence III Surveillance Panel Meeting
Frank Fernandez
April 16, 2003

**FINAL IIIG MATRIX
(April 16, 2003)**

FUNDING

- 12 TESTS FOR LAB CALIBRATION
- 12 TESTS PAID BY FUNDING GROUP
 - 2 Tests sponsored by ILSAC (~\$70,000)
 - 5 Tests sponsored by API (~\$175,000)
 - 5 Tests sponsored by ACC (~\$175,000)

**FINAL IIIG MATRIX
(April 16, 2003)**

APPROVED DESIGN

- 24 TESTS
- 3 OILS (TMC 434, TMC 435, TMC 538)
- 2 CAMS
- 2 LABS (SwRI AND PE)
- 3 STANDS PER LAB
- 4 WEEKS TO COMPLETE

**FINAL IIIG MATRIX
(April 16, 2003)**

STATUS OF MOA

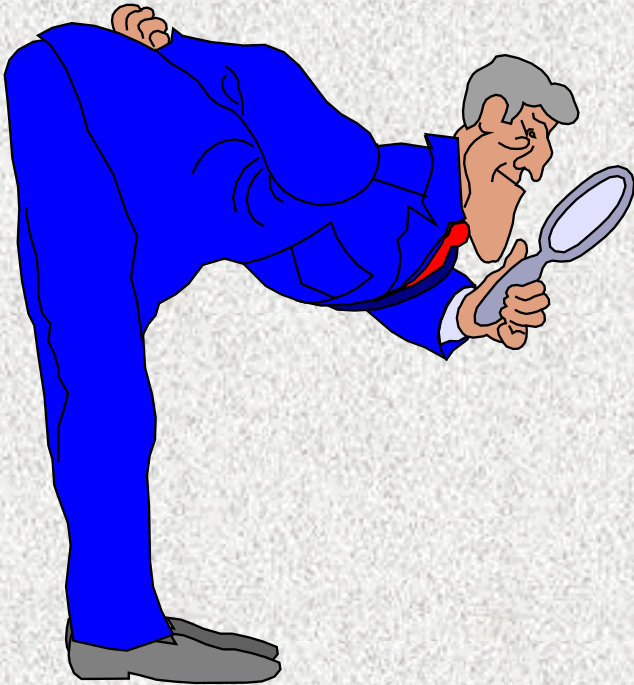
- > MOA for 18-test matrix has been signed by all parties.
- > Funding for 6 additional tests will be handled as an addendum to MOA.
 - > Signing expected shortly.

MRV

Storage Time & Temp Effects

for the

IIIG Matrix



Purpose

Determine what effects, if any, the storage time and storage temperature has on the MRV IIIG results

Issue raised at the February 2003 IIIG Surveillance Panel meeting

(Some of the IIIG MRV pre-matrix data was run significantly later than the IIIG EOT date)

Test Plan for the IIIG Matrix

Attachment 7



- All samples will be stored at $75 \pm 10^{\circ}\text{F}$
 - This eliminates one variable
- The CCS will be started 4 hours \pm 30 mins of each IIIG EOT matrix test performed.
- The MRV will be started at 4 hours \pm 30 mins of receiving the CCS results.
- In addition, each lab will run an extra MRV (not the CCS) for each IIIG matrix test, but with a sample storage time of 168 hours (1 week) from EOT.
- Note: Before the samples are run for CCS or MRV, the samples shall be “up ended” 5 times.