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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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Originally Issued: May 25, 2010

Reply to: Jeff Clark
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Unapproved Minutes of the May 25, 2010 Mack Test Surveillance Panel Meeting San Antonio, TX

Note: Action Items are shown in green italic font.

The meeting was called to order at 8:30 am by Chairman Mark Cooper. The attendance is show in **Attachment 1**. Brad Carter was added to the panel mailing list, representing Intertek AR.

Meeting Minutes

Previous meeting and teleconference minutes were unanimously approved.

TMC Report

Shown in **Attachment 2.**

CPD Report

The CPD Report was given by Zack Bishop of TEI **(Attachment 3)**. There was some discussion on possibly using S-batch rings in the T-8, but no action was taken.

The TMC was asked to post pre-test liner finish for the T-12 reference data.

Oil pumps are no longer available. Mack/Volvo advises against rebuilding the pumps. The pumps tend to last a long while. ***Zack was asked to poll labs as to the number of engines and pumps they have on hand.***

Zack reviewed the parts supply list. ***TEI was asked to investigate securing a supply of oil filter housing from salvage yards. Labs are to provide Zack with a needs assessment. As part of the review of the list, Zack was asked to add engine blocks, crankshafts, and conrod bearings to the list for future quarterly reports.*** Zack's report was accepted unanimously.

T-12A Test for MRV Results

Jeff Clark presented the draft information letter to create the T-12A for obtaining MRV results **(Attachment 4)**. A motion (Matasic, Richards) passed (9-0-1) to accept as written. ***The next steps for the panel are to establish test targets and to develop a data presentation for the HD class panel.*** See "T-12A MRV Targets" section for further discussion.

T-11 LTMS v2

Jim Rutherford presented **(Attachment 5)** and took questions throughout the presentation. Much of the discussion was on LTMS v2, the current status of the test, and how best to proceed forward.

PC-9 Diesel Test Fuel

Barbie Green presented for Chevron Phillips **(Attachment 6)** and took questions throughout the presentation. Steve Kennedy also presented T-11 reference oil 820-2 results with European fuel compared to standard PC-9 test fuel **(Attachment 7)**. There was a noticeable difference in the results, with the Euro fuel results being milder. Steve also showed a characterization of the ULSD fuel.

T-11 Severity Issues

The panel discussed ways to add severity back to the test which is currently trending very mild. This was a very, very long, wide ranging discussion. Coming out of discussion, was a consensus to add 48 hours to the test to slow the soot rate and to move and adjust the soot windows accordingly. A motion was made (Shank, Kennedy) for ***labs to run development T-11 style tests as follows:***

Test length extended to 300 hours.
Oil sampling to continue on typical schedule of 12 hour intervals.
Soot Windows:
- ***108 hours: 2.48 – 2.97***
- ***228 hours: 5.13 – 5.94***
- ***276 hours: 6.19 – 7.13***

No timing changes allowed after 276 hours.
MRV measurement to be at 204 hours.
PC-10 ULSD Fuel

Upon completion of tests from labs, the data will be reviewed to examine if making these changes provide a path forward. This motion passed 9-0-0.

T-12A MRV Targets

Jim Rutherford presented work as requested from the earlier T-12A discussion on MRV reference oil targets for the T-12A **(Attachment 8)**. Results show a mean of 12800 cP and a standard deviation of 805. A motion to accept these as targets for the T-12 A (Matasic, Cooper) passed 9-0-0.

T-12 Liner Wear Severity

Jim Moritz raised concern about liner wear severity. Jim queried the panel as to whether the panel desired to run a round of coordinated references with both the new liners and the new rings (soon to be available) and also raised the question of reviewing the existing correction factor. The panel agreed to consider coordinated references when the rings become available.

T-12 LTMS v2

With time running short, this was not reviewed. However, it was decided that the panel would begin a series of conference calls that will culminate with a face-to-face meetings in August.

The meeting adjourned at 5:55 p.m.

Attachment 1

MACK SP Meeting
MAY 25

NAME	Co.	Ph.	Email
Jeff Clark	TMC		
Andy Ritchie	Infineum		
Doyle Roese	Infineum		
CHRIS CASTANIEN	LZ		
Jim Matasic	LZ		
GREG Shank	Volvo/MACK		
Zack Bishop	TEI		
KURT KNAPP	Chevron Phillips Chem	713-703-5169	KNAPPKA@CPCHEM.COM
J Richards	SWRI	210-522-3567	JOSH.RICHARDS@SWRI.ORG
Mark Cooper	Chevron Oronite		
Ryan D. Johnson	SwRI		
Tom WINGFIELD	Chevron Phillips Chem.	281.257.3732	WINGFTM@CPCHEM.COM
Barbie Green	Chevron Phillips Chem Co	806-275-5761	nugenbr@cpchem.com
JIM CARTER	HALTERMANN PRODUCTS	517-347-4947	JECARTER@JHALTERMANN.COM
JOEL MORENO	HALTERMANN Products	832-876-2243	JAMORENO@JHALTER.COM
JIM GUTZWILLER	INFINEUM	210-732-8123	JAMES.GUTZWILLER@INFINEUM.COM
Bob Campbell	AFTON		
Jim Rutherford	Chevron Oronite		
Steve Kennedy	Exxon Mobil		
Mike Alessi	Exxon Mobil		~~mike~~ michael.l.alessi@exxonmobil.com
BRAD CARTER	INTERTEK	TBD	TBD
JIM MORITZ	INTERTEK		

Attachment 2

Test Monitoring Center
http://astmtmc.cmu.edu

Test Monitoring Center Report to the Mack Test Surveillance Panel

May 2010

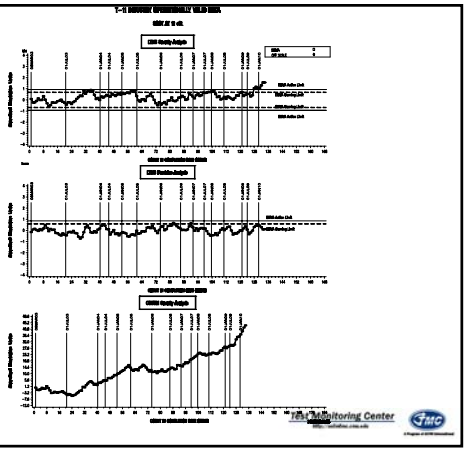
San Antonio, TX

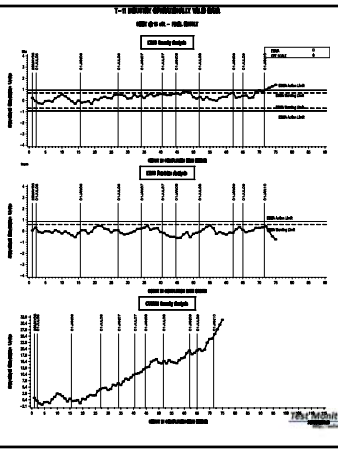
T-8 Reference Oil Testing Summary

- Test Activity
  - Very Low
    - Labs: 2 calibrated
    - Stands: 3 calibrated
    - All parameters within chart limits

T-11 Reference Oil Testing Summary

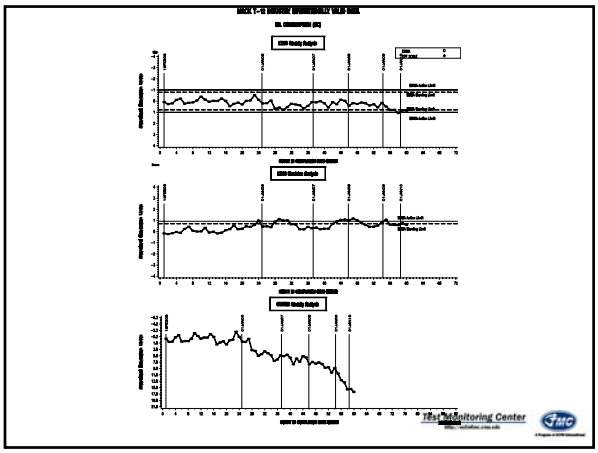
- Test Activity
  - Low
  - Labs: 1 calibrated
  - Stands: 1 calibrated
  - Soot at 12 & 15 cSt
    - Action Alarm, mild direction

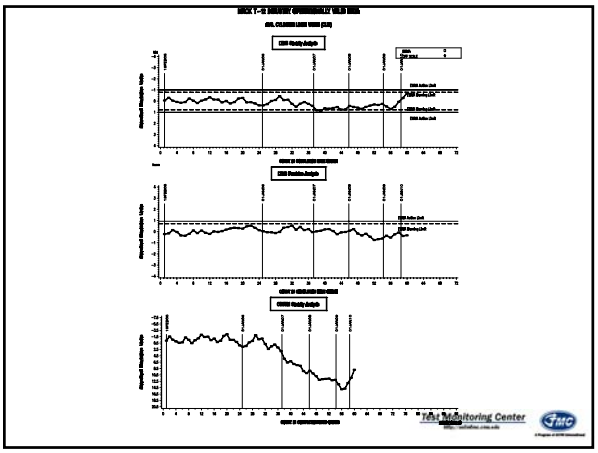




T-12 Reference Oil Testing Summary

- Test Activity
  - Low
  - Labs: 3 calibrated
  - Stands: 5 calibrated
  - Oil Consumption
    - Warning alarm, severe direction
  - Liner Wear
    - Possible mild trend





A Program of ASTM International

Attachment 3

CPD Report
Mack Surveillance Panel
May 25, 2010

Mack T-11 / T-12 / T-8
Test Kit Hardware Update

List of Required Test Stand Hardware
Review and Comment

CPD Report
Mack Surveillance Panel
May 25, 2010

TEI INVENTORY of MACK T-11 PARTS

Part Description	Part Number	Part Availability	
T-11 Rebuild Kit		Current	Future
Cylinder Liner	509GC471	4+ year supply	4+ year supply
Piston Crown & Skirt	240GC2264M	2 month supply	4+ yr batch quantity on order
Top Ring (Blue Stripe with White Dot)	349GC3107 (Batch "S")	4+ year supply	4+ year supply
2nd Ring	349GC3108	4+ year supply	4+ year supply
Oil Ring	350GC343	4+ year supply	4+ year supply
Main Bearings	M1057GCT100	4+ year supply	4+ year supply
Connecting Rod Bearings	M1062GBT100	4+ year supply	4+ year supply

CPD Report
Mack Surveillance Panel
May 25, 2010

TEI INVENTORY of MACK T-12 PARTS

Part Description	Part Number	Part Availability	
T-12 Rebuild Kit		Current	Future
Cylinder Liner	509GC471	4+ year supply	4+ year supply
Piston Crown & Skirt	240GC2264M	2 month supply	4+ yr batch quantity on order
Top Ring (Blue Stripe)	349GC3107 (Batch "R")	2 month supply	4+ yr batch quantity on order
2nd Ring	349GC3108	2 month supply	4+ yr batch quantity on order
Oil Ring	350GC343	2 month supply	4+ yr batch quantity on order
Main Bearings	M1057GCT100	4+ year supply	4+ year supply
Connecting Rod Bearings	M1062GBT100	4+ year supply	4+ year supply

CPD Report
Mack Surveillance Panel
May 25, 2010

- TEI received 21 skids of liners from Federal Mogul. Our original order was for 19 skids. The additional 2 skids were part overrun pieces. TEI purchased these for the Industry rather than have them be discarded.
- Sampling of liners from each skid was conducted.
- Visual inspection and surface finish analysis of the liners sampled was better than projected. Only 12% were rejected (slightly below 12 micro-inch finish). The rejects will be preserved for possible future use.

CPD Report
Mack Surveillance Panel
May 25, 2010

TEI INVENTORY of MACK T-8 PARTS

Part Description	Part Number	Part Availability	
T-8 Rebuild Kit		Current	Future
Complete Assembly (Piston, Rings & Liner)	215SB217E (Kusalava Liner)	2 year supply	Next order ~ March 2012

CPD Report
Mack Surveillance Panel
May 25, 2010

Part Description	Part Number	Part Availability	
Miscellaneous Items		Current	Future
EGR Cooler (T-11)	19GBX52	21	Order as required - Supplier is available
EGR Cooler (T-12)	29GB519	0	Order as required - Supplier is available
High Temperature Hose	3101632M	131	Order as required - Supplier is available
Oil Pump Assembly (T-11 and T-12)	315GC465BM	6	No longer available - Rebuild existing pumps ?
Venturi (T-11 and T-12)	762GBX433SS	1	Order as required - Supplier is available
Exhaust Manifold Assembly "front" (T-11)	M10104GC5164MFR	1	Order as required - Supplier is available
Exhaust Manifold Assembly "rear" (T-11)	M10104GC5164MRR	0	Order as required - Supplier is available
Intake Manifori Assembly (T-11)	M10105GCX4332/5212	1	Order as required - Supplier is available
Turbo small (T-11)	631GC5145M3	21	Availability unknown - will the 21 suffice? Usage – 4/year
Turbo large (T-11)	3801847R	0	Order as required - Supplier is available
Turbo (T-12)	631GC5176CM7	0	Order as required - Supplier is available
Fuel Injector Line (T-11)	HL69-151	18	Order as required - Supplier is available
Fuel Injector Line (T-11)	HL69-152	17	Order as required - Supplier is available

CPD Report
Mack Surveillance Panel
May 25, 2010

Part Description	Part Number	Part Availability	
Miscellaneous Items		Current	Future
Modine Intercooler (T-11)	5424-03928031	1	Order as required - Supplier is available
Modine Intercooler (T-12)	5424-1A166566D	2	Order as required - Supplier is available
Oil Filter Housing (T-11 and T-12)	27GB525M	7	Obsolete part
Full Flow Oil Filter	485GB3226	8	Order as required - Supplier is available
Injection Pump "calibrated" (T-8)	313GC5212P16X	0	Order as required - Supplier is available
Machine Elbow (T-11 and T-12)	454GC5236	0	Order as required - Supplier is available
Camshaft Kit	57GC2209A	4	Order as required - Supplier is available
Lifter Assembly	72GC373A	12	Order as required - Supplier is available
Cylinder Head (T-11)	732GB3494M2	0	Order as required - Supplier is available
Cylinder Head (T-11 and T-12)	732GB3499	0	Order as required - Supplier is available
Cylinder Head (T-11 and T-12)	732GB3499M	1	Order as required - Supplier is available
Injection Nozzle (T-11)	736GB411M2	0	Order as required - Supplier is available
Electronic Actuator	9MS42	0	Order as required - Supplier is available
Short EGR Exhaust Probe (T-11)	TEGR0005	8	Order as required - Supplier is available
Oil Cooler End Caps (T-12)	TEI-T12OCEC	1	Order as required - Supplier is available
Turbo Gasket	TEIEX201064AM	84	Order as required - Supplier is available
Engine Block availability ? None stocked by TEI			

Attachment 4

(Revises D 7422-09a, as amended by Information Letter 10-01)

1.1.1 This test method also provides the procedure for running an abbreviated length test, which is commonly referred to as the T-12A. The procedures for the T-12 and T-12A are identical with the exception of the items specifically listed in Annex A9. Additionally, the procedure modifications listed in Annex A9 refer to the corresponding section of the T-12 procedure.

A9. T-12A ABBREVIATED LENGTH TEST REQUIREMENTS

A9.1 *Overview* —The purpose of the T-12A is to provide the low temperature viscosity result for used oil. The low temperature result in question is the MRV viscosity after 100 h at Phase I T-12 conditions. This result may be obtained two different ways. First, it may be obtained from an operationally valid standard T-12 test. Second, it may be obtained from a test stand setup that runs only the first 100 h of T-12 conditions. Unlike the standard T-12 test, this form of the T-12A does not require a new engine build with each test. Instead, it is a flush-and-run setup. With the exception of A9.4, A9.5.2, A9.5.3, and A9.6, no special instructions are necessary to obtain a T-12A result from a standard T-12. The special instructions necessary to obtain a T-12A result from a flush-and-run setup are contained in the remainder of this annex.

A9.2 *Preparation of Apparatus at Rebuild (refer to Section 8)*—Rebuild each T-12A flush-and-run engine after three calibration periods or 1500 h.

A9.2.1 *Injectors (refer to* 8.4.1*)*—Check the injector opening pressure at the start of each calibration. Reset the injector opening pressure if it is outside the specification of 24000 ± 2000 kPa.

A9.3 Procedure (refer to Section 9):

A9.3.1 *Pretest Oil Flush*—The pre-test flush is not performed on a new engine build. For new engine builds, run the break-in sequence according to A9.3.2. For existing engine builds, flush the engine and auxiliary oil system with test oil for 15 min. Drain the oil. Repeat the flush and drain sequence two more times. Use the same set of oil filters for all three flushes. At the completion of the third flush, drain the oil, change the oil filters, and charge the engine and auxiliary oil system with test oil. Proceed with the test according to A9.3.3.

A9.3.2 *Pretest Break-In (see* 9.1.2*)*—The pre-test break-in is not necessary for every test; it is only necessary for a new engine build. For a new engine build, run a 30-min break-in at Phase I conditions. To do this, follow the Phase I start-up sequence shown in Table A5.2, and once the start-up sequence is complete, hold the conditions for 30 min. Change all oil filters at the completion of the break-in.

A9.3.3 *Test Cycle (see* 9.4*)* —Conduct the test by operating for 100 h at Phase I conditions, which are shown in Table 1.

A9.3.4 *Post-Test Oil Flush*—At the completion of the test, drain the oil and change the oil filters. Hot flush the engine and auxiliary oil system with Bulldog Premium Oil for 15 min. Drain the oil. Repeat the flush and drain sequence two more times. Use the same set of oil filters for all three flushes.

A9.4 *Oil Inspection (see 10.3)*—Analyze the 100 h oil sample for MRV viscosity according D 6896. As part of the MRV measurement procedure, be sure to prepare the sample in accordance with A4.3 (Annex A4) of Test Method D 5967.

A9.5 *Laboratory and Engine Test Stand Calibration/Non-Reference Oil Requirements (Section 11)*:

A9.5.1 *Test Stand/Engine Calibration (refer to* 11.5*)*—The calibration period for a flush-and-run T-12A is five operationally valid non-reference oil tests or ten months since the completion of the last successful calibration test.

A9.5.1.1 A T-12A flush-and-run stand may be installed in a stand that originally calibrated as a standard T-12 without impacting the standard T-12 calibration status. However, the flush-and-run setup will only be calibrated for the first non-reference oil test. To re-establish calibration, a reference oil test shall be run following the first test on the flush-and-run engine.

A9.5.1.2 A newly rebuilt engine requires a reference oil test to establish test stand calibration. Additionally, a T-12A cannot be run on an engine build that has seen Phase II test conditions (break-in conditions are excluded for a T-12A obtained as part of a standard T-12).

A8.5.2 *Test Result (see* 11.6*)* —The specified test result is MRV viscosity at 100 h. Report the results on the appropriate forms.

A8.5.3 *Non-Reference Oil Test Result Severity Adjustments (see* 11.8*)*—This test method incorporates the use of an SA for non-reference oil test results. A control chart technique, described in the LTMS, has been selected for identifying when a bias becomes significant for MRV viscosity at 100 h. When calibration test results identify a significant bias, an SA is determined according to LTMS. Report the SA on Form 4 in the space for SA. Add this SA value to non-reference oil test results, and enter the SA adjusted result in the appropriate space. The SA remains in effect until a new SA is determined from subsequent calibration test results, or the test results indicate the bias is no longer significant. Calculate and apply SA on a laboratory basis. Be aware that the SA applied to non-reference results is the laboratory SA that is in place at the completion of the 100th hour of the test (that is, for T-12A results that are obtained through a standard length T-12, do not use the SA at EOT of the T-12, instead use the SA that is in place at 100 h).

A9.6 *Precision and Bias (refer to Section 13)*:

A9.6.1 *Precision*—The test precision for MRV Viscosity at 100 h, as of April 19, 2010, is shown in Table A9.1.

A9.6.2 *Bias*—Bias is determined by applying the LTMS control chart technique (see A8.5.3) and when a significant bias is determined, a severity adjustment is permitted for non-reference oil test results.

TABLE A9.1 Test Precision

Test Result	Intermediate Precision (*i.p.*)	Reproducibility (*R*)
MRV viscosity at 100 h (cP)	1550	1550

Attachment 5

Mack T-11 LTMS Version 2 Exploration

Mack Surveillance Panel

May 25, 2010

Reference oil data summary

- Includes 161 reference tests in TMC dataset
- Includes 134 chartable reference tests
- Six test laboratories
  - A – 42 chartable tests
  - B – 29 chartable tests
  - *D – 16 chartable* tests
  - *F – 14 chartable* tests
  - *G – 27 chartable* tests
  - *G1 – 6 chartable* tests
- Latest reference oil result is April 25, 2010

Current LTMS

- Critical Parameter: *Soot at 12 cSt viscosity increase – Conduct additional reference test if stand severity EWMA is exceeded and "if the direction of the test stand severity is deemed different from that of the test laboratory". Conduct additional reference test if stand severity Shewhart limit is exceeded. Apply severity adjustment as for noncritical parameters.*
- Noncritical Parameters: *Soot at 4 cSt viscosity increase, soot at 15 cSt viscosity increase, MRV at 180 hours – Apply severity adjustment if lab severity EWMA limit is exceeded.*

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

		EWMA Chart				Shewhart Chart	
		LAMBDA		K		K	
Chart Level	Limit Type	Precision	Severity	Precision	Severity	Precision	Severity
Stand	Reduced	--	--	--	--	--	1.43
	Action	0.3	0.3	1.74	2.05	1.74	1.75
Lab	Warning	0.2	--	1.74	--	--	--
	Action	0.2	0.2	2.58	1.96	1.74	1.75
Industry	Warning	0.2	0.2	1.74	2.05	--	--
	Action	0.2	0.2	2.58	2.81	--	--

LTMS Version 2

e_i and Z_i Parameter: *Soot at 12 cSt viscosity increase*
Z_i only Parameters: *Soot at 4 cSt viscosity increase, soot at 15 cSt viscosity increase, MRV at 180 hours*

Prediction Error: $e_i = Y_i - Z_{i-1}$

Limit Type	Limit
Level 3	2.066
Level 2	1.734
Level 1	1.351

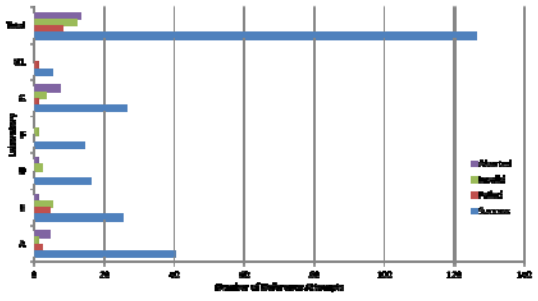
Lab EWMA : $Z_i = \lambda(Y_i) + (1 - \lambda)Z_{i-1}$

Limit Type	Lambda	Limit
Level 2 Lower	0.2	TBD by SP
Level 2 Upper	0.2	TBD by SP
Level 1	0.2	0

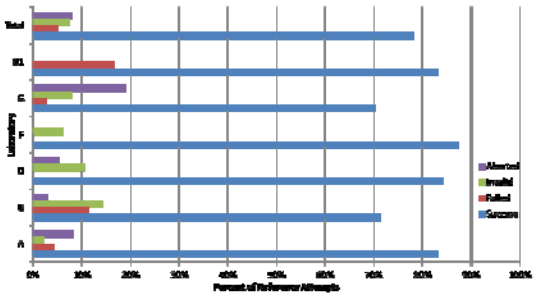
Industry EWMA : $Z_i = \lambda(Y_i) + (1 - \lambda)Z_{i-1}$

Limit Type	λ	Limit
Level 2 Lower	0.2	TBD by SP Input
Level 2 Upper	0.2	TBD by SP Input
Level 1	0.2	0.65

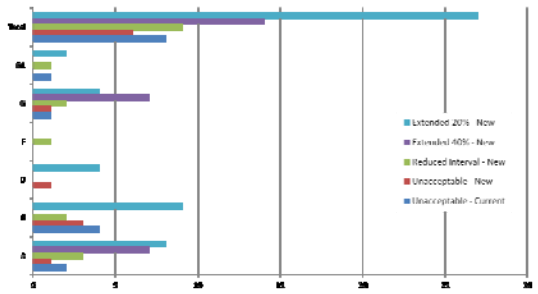
Review of alarms and actions Fate of T-11 Calibration Attempts in Current System



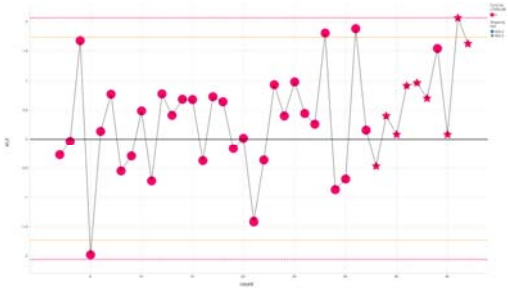
Review of alarms and actions Fate of T-11 Calibration Attempts in Current System



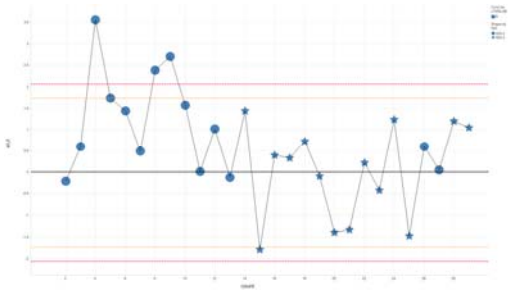
Review of alarms and actions
Fate of T-11 Calibration Attempts
Current System versus New System



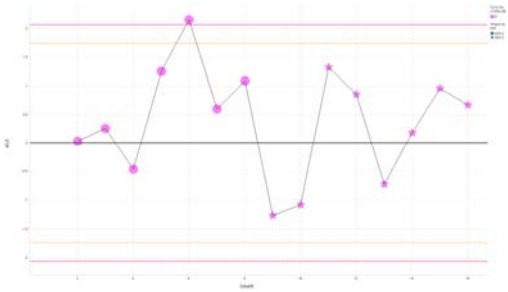
Prediction error by lab for Soot at 12 cSt
e_i for Laboratory A



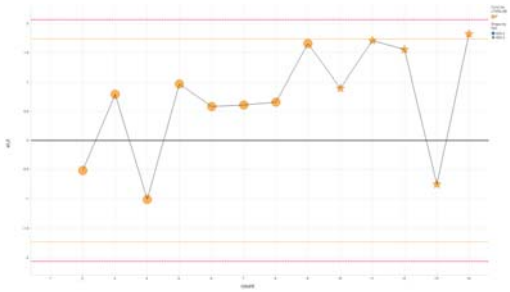
Prediction error by lab for Soot at 12 cSt
e_i for Laboratory B



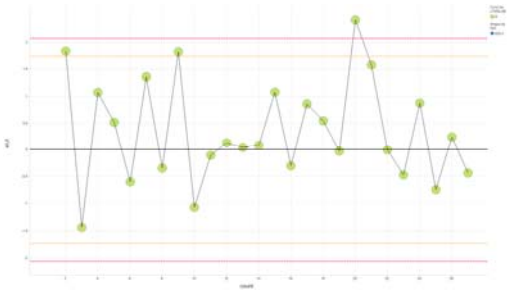
Prediction error by lab for Soot at 12 cSt
e_i for Laboratory D



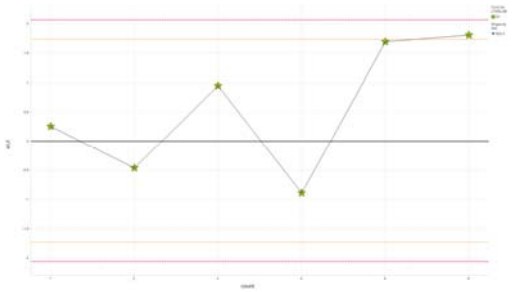
Prediction error by lab for Soot at 12 cSt
e_i for Laboratory F



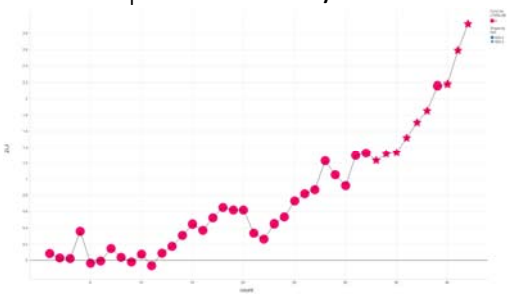
Prediction error by lab for Soot at 12 cSt
e_i for Laboratory G



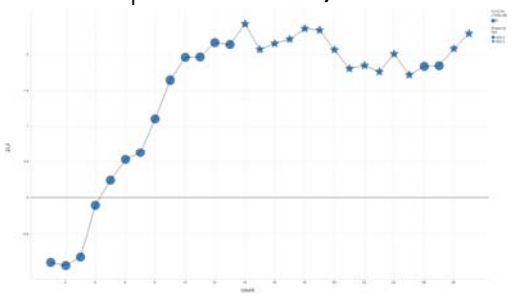
Prediction error by lab for Soot at 12 cSt
e_i for Laboratory G1



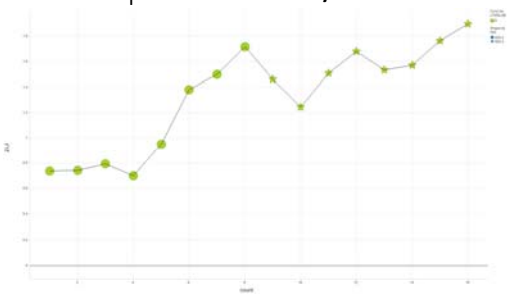
EWMA by lab for Soot at 12 cSt
Z_i for Laboratory A



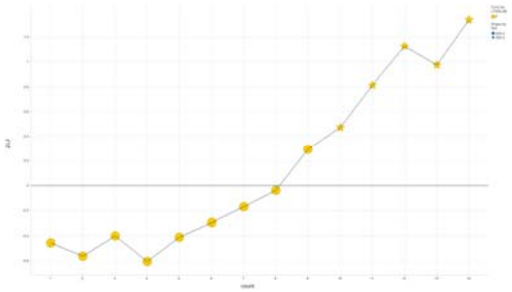
EWMA by lab for Soot at 12 cSt
Z_i for Laboratory B



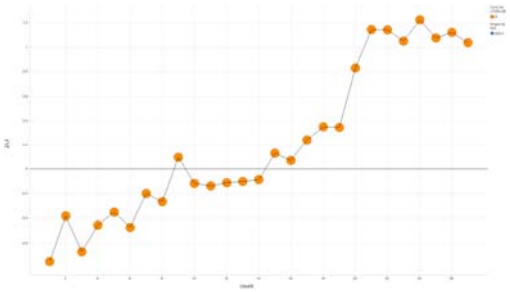
EWMA by lab for Soot at 12 cSt
Z_i for Laboratory D



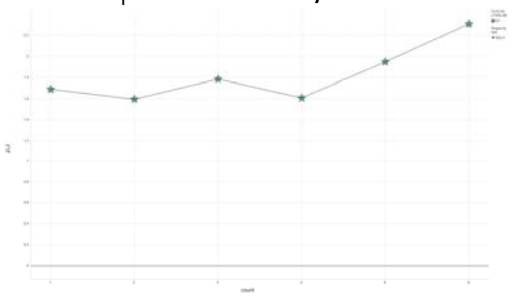
EWMA by lab for Soot at 12 cSt
Z_i for Laboratory F



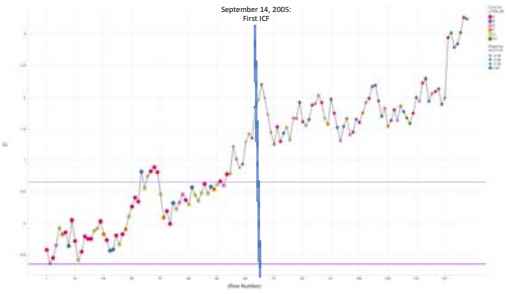
EWMA by lab for Soot at 12 cSt
Z_i for Laboratory G



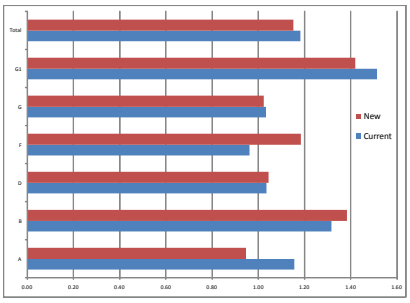
EWMA by lab for Soot at 12 cSt
Z_i for Laboratory G1



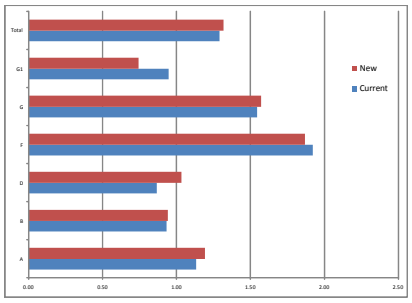
Industry EWMA for Soot at 12 cSt



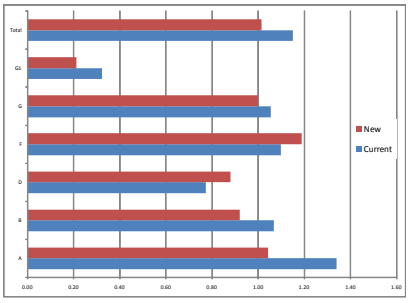
Prediction error – Soot @ 12 cSt



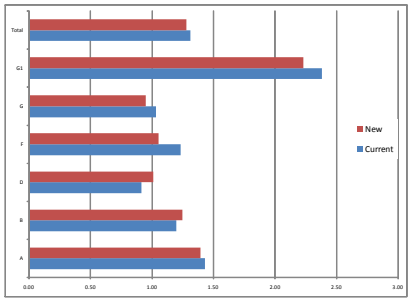
Prediction error – MRV



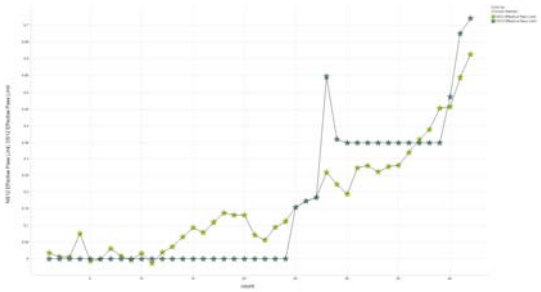
Prediction error – Soot @ 4 cSt



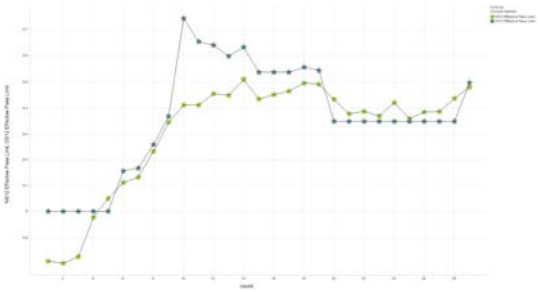
Prediction error – Soot @ 15 cSt



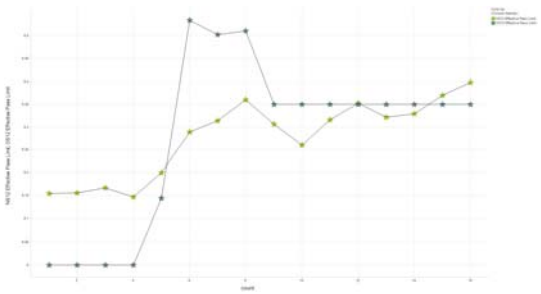
Effective pass limit Soot at 12 cSt
New System versus Current – Laboratory A



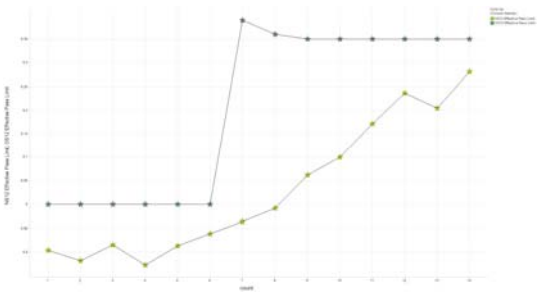
Effective pass limit Soot at 12 cSt
New System versus Current – Laboratory B



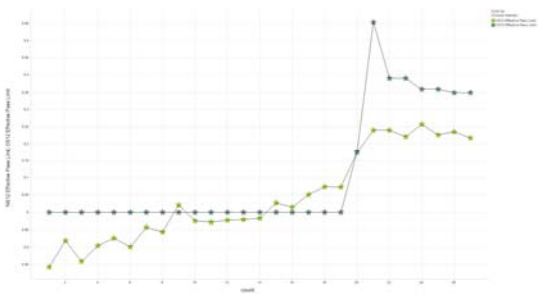
Effective pass limit Soot at 12 cSt
New System versus Current – Laboratory D



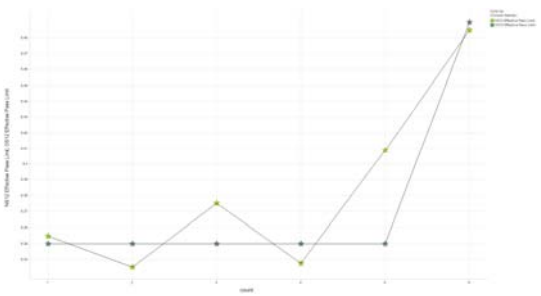
Effective pass limit Soot at 12 cSt
New System versus Current – Laboratory F



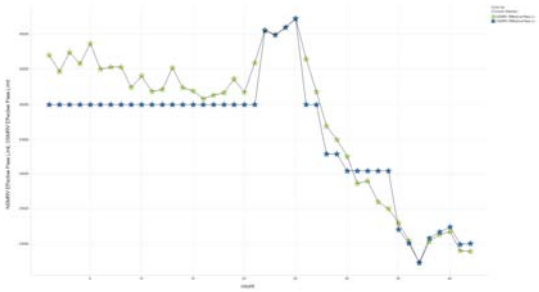
Effective pass limit Soot at 12 cSt
New System versus Current – Laboratory G



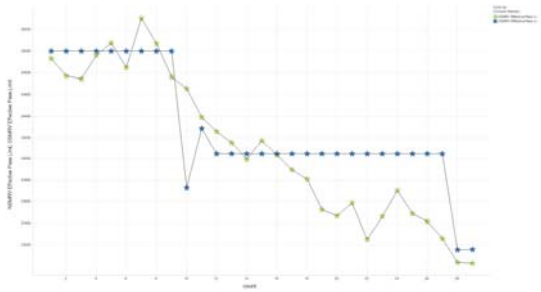
Effective pass limit Soot at 12 cSt
New System versus Current – Laboratory G1



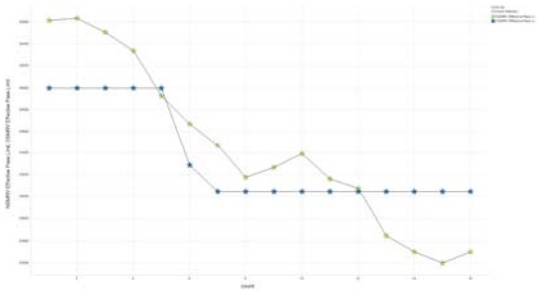
Effective pass limit MRV
New System versus Current – Laboratory A



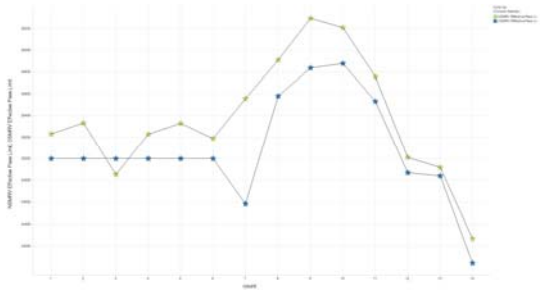
Effective pass limit MRV
New System versus Current – Laboratory B



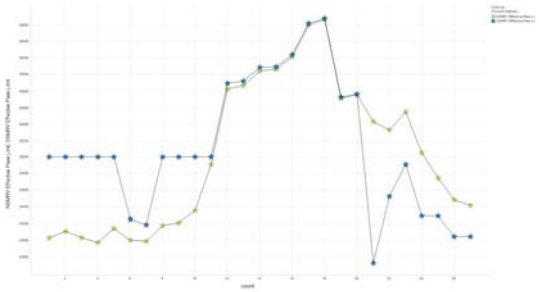
Effective pass limit MRV
New System versus Current – Laboratory D



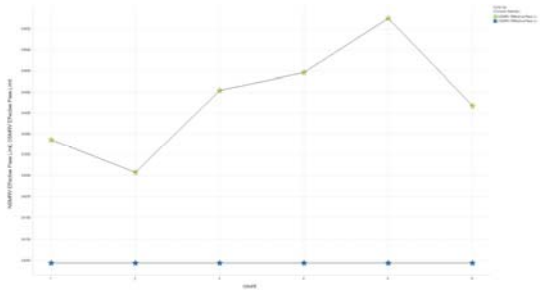
Effective pass limit MRV
New System versus Current – Laboratory F



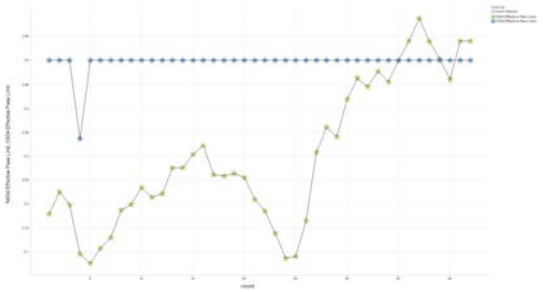
Effective pass limit MRV
New System versus Current – Laboratory G



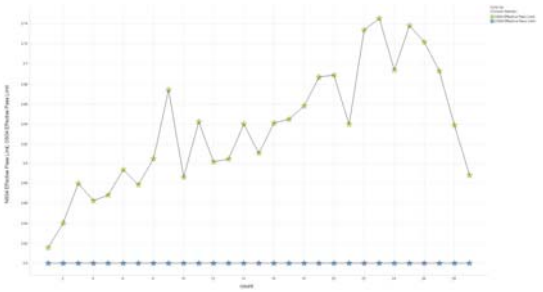
Effective pass limit MRV
New System versus Current – Laboratory G1



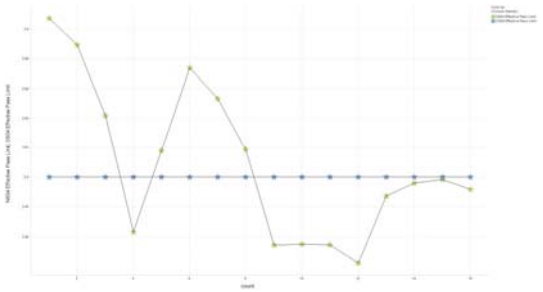
Effective pass limit Soot @ 4 cSt
New System versus Current – Laboratory A



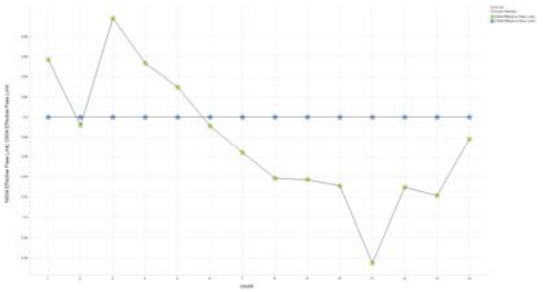
Effective pass limit Soot @ 4 cSt
New System versus Current – Laboratory B



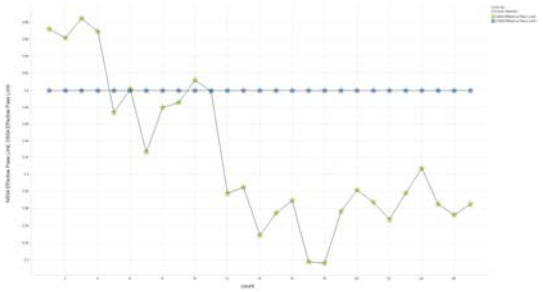
Effective pass limit Soot @ 4 cSt
New System versus Current – Laboratory D



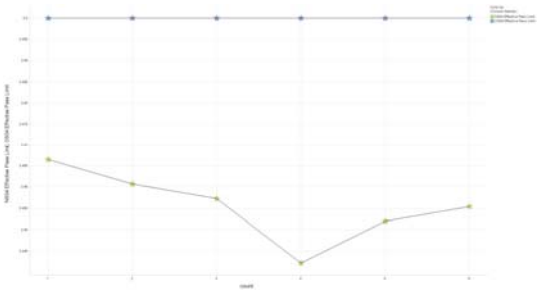
Effective pass limit Soot @ 4 cSt
New System versus Current – Laboratory F



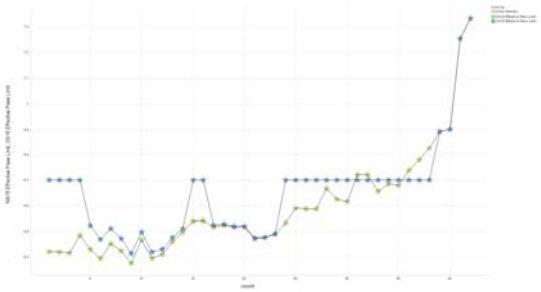
Effective pass limit Soot @ 4 cSt
New System versus Current – Laboratory G



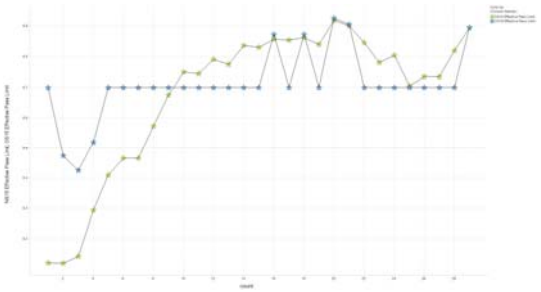
Effective pass limit Soot @ 4 cSt
New System versus Current – Laboratory G1



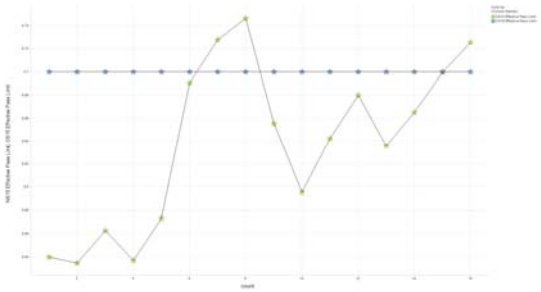
Effective pass limit Soot @ 15 cSt
New System versus Current – Laboratory A



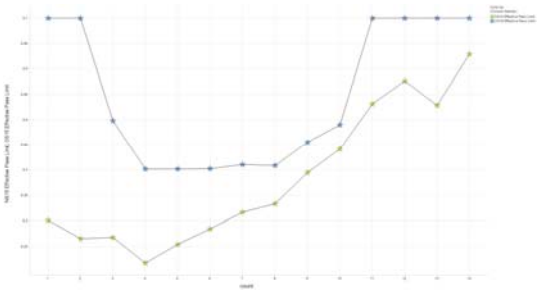
Effective pass limit Soot @ 15 cSt
New System versus Current – Laboratory B



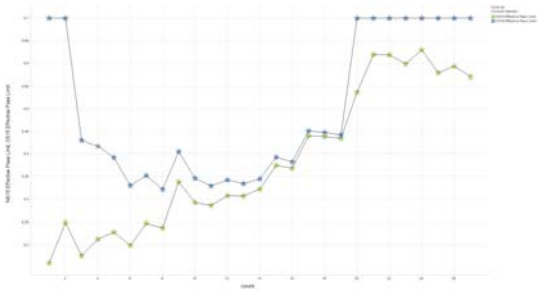
Effective pass limit Soot @ 15 cSt
New System versus Current – Laboratory D



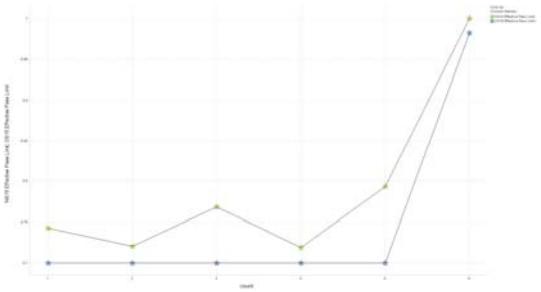
Effective pass limit Soot @ 15 cSt
New System versus Current – Laboratory F



Effective pass limit Soot @ 15 cSt
New System versus Current – Laboratory G



Effective pass limit Soot @ 15 cSt
New System versus Current – Laboratory G1



Attachment 6

Chevron Phillips Chemical Co. LP

Diesel PC-9 Batch Data

Mack Surveillance Panel

May 25, 2010

San Antonio, TX

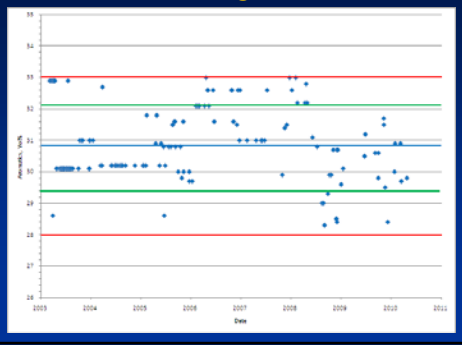
1

Fuel Testing Methods

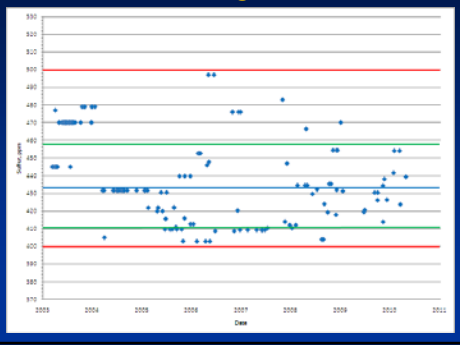
- Aromatics – ASTM D1319
- Sulfur – ASTM D5453
- Distillation – ASTM D86
- Specific Gravity – ASTM D4052
- Viscosity – ASTM D445

2

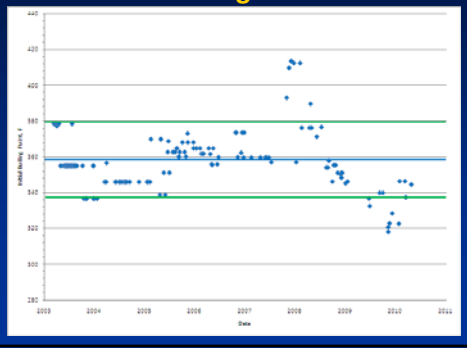
Fuel Aromatic Content versus Testing Date



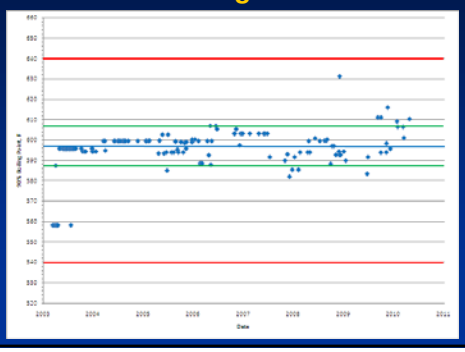
Fuel Sulfur Content versus Testing Date



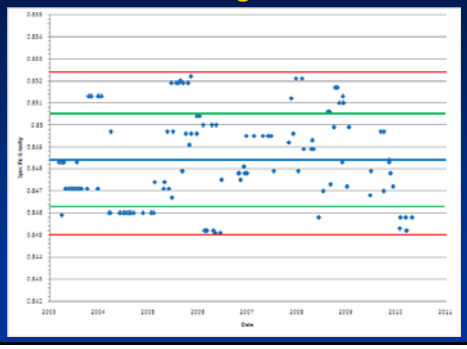
Fuel Initial Boiling Point versus Testing Date



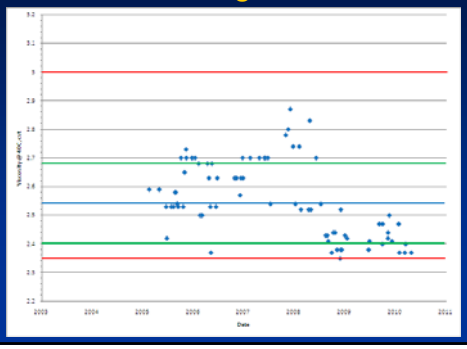
Fuel 90% Boiling Point versus Testing Date



Fuel Specific Gravity versus Testing Date



Fuel Viscosity Versus Testing Date

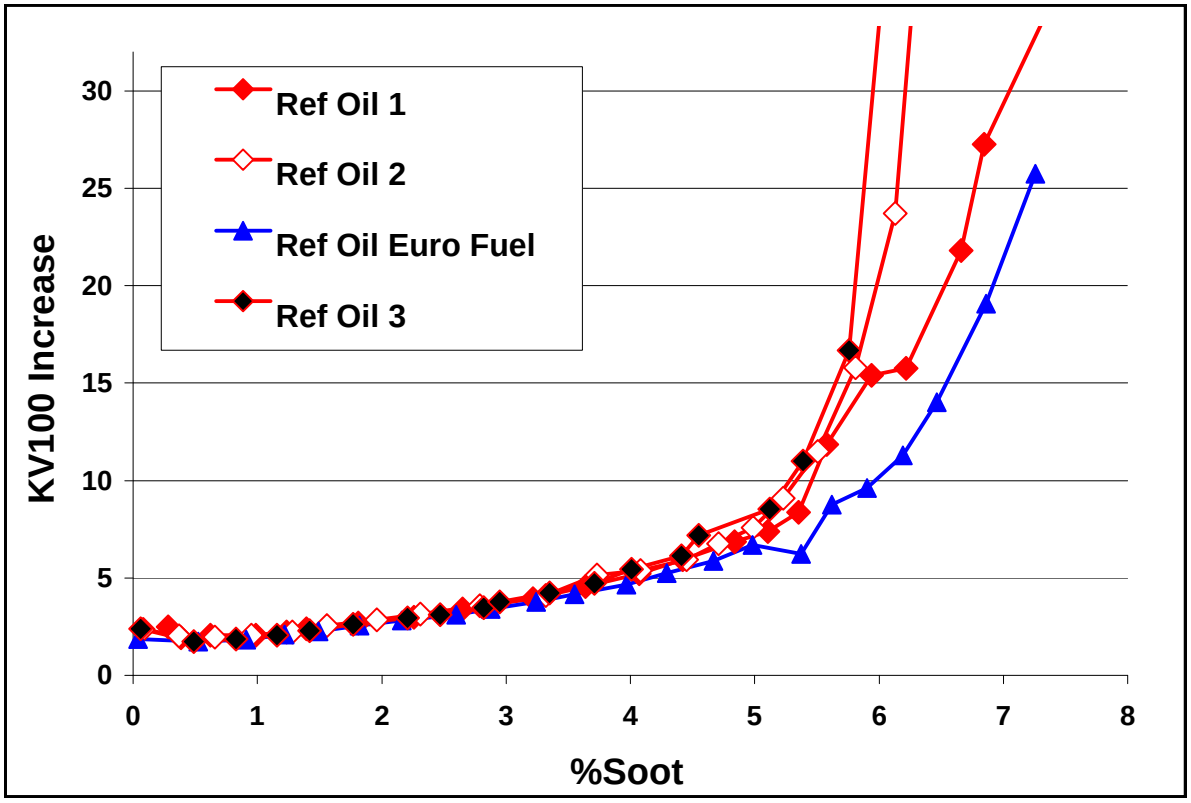


Questions?

Attachment 7

Mack T-11 Test with European Ultra Low Sulfur Diesel Fuel

Test Number	813-2	813-9	813-20	813-23
Oil Code	820-2	820-2	820-2	820-2
TMC Code	CMIR 44111	CMIR 44112	CMIR 48707	CMIR 49678
EOT	20030407	20030618	20031020	20031220
SOT Engine Hours	252	1512	3024	0
Description	Ref Oil 1	Ref Oil 2	Ref Oil (Euro Fuel)	Ref Oil 3
Soot at 12 cSt (90)	5.65	5.58	6.31	5.48
Soot at 15 cSt (90)	6.16	5.78	6.58	5.68
KV Inc @6.0% Soot (90)	14.79	20.27	9.57	33.87
KV Inc @6.7% Soot (90)	22.82	50.00	16.54	63.44
MRV (180)	17000	15700	15200	16700
Soot (180)	5.33	5.21	5.35	5.10
Oil Consumption, g/hr	41.5	46.4	51.9	47.3
EOT Used Oil Inspections				
%Soot	7.36	7.13	7.24	6.99
TBN	2.6	2.3	1.4	3.3
TAN	5.6	4.2	4.4	5.3
IR	161.0	250.4	-64.6	52.8
Iron	130	65	44	160
Lead	6	4	1	5



DOW Haltermann PRODUCTS

CERTIFICATE OF ANALYSIS

Diesel Test Fuel VD-10-03-04

Batch-No 4 (SL28513A47) **Date of Analysis: 30.05.05**

Parameter	Methode	Unit	Min.	Max.	Analysis
Cetane Number	ISO 5165		52,0	54,0	53,8
Cetane Index	EN ISO 4264		50,0		56,5
Density at 15 °C	EN ISO 12185	kg/m³	833,0	837,0	834,8
Distillation	ISO 3405				
I.B.P.		°C	Report		235,7
10 % v/v		°C	Report		251,2
50 % v/v		°C	245,0	280,0	266,9
90 % v/v		°C	Report		317,1
95 % v/v		°C	340,0	350,0	347,0
250 °C		% v/v	Report		6,6
350 °C		% v/v	Report		95,4
F.B.P.		°C		370,0	361,0
Flash Point	ISO 2719	°C	55		99
Cloud Point	ISO 3015	°C		-5	-26
CFPP	EN 116	°C		-15	-28
Viscosity 40 °C	ISO 3104	mm²/s	2,500	3,500	3,306
Sulfur Content	ASTM D 3231	mg/kg		10	2,3
Copper Corrosion	ISO 2160			1	1 a
Carbon Residue (10% DR)	EN ISO 10370	% m/m		0,20	<0,01
Ash Content	ISO 6245	% m/m		0,010	0,002
Water Content	ISO 12937	mg/kg		200	16
Oxidation Stability	ISO 12205	mg/100mL		2,5	0,2
Aromatic Hydrocarbons	IP 391				
Poly-Aromatics (2+3)		% m/m		2,0	0,6
Neutralisation Number (strong acid)	ASTM D 974	mg KOH/g		0,2	Zero
HFRR -WSD 1,4	ISO 12156-1	µm		400	146

Haltermann Products, Werk Hamburg,
Zweigniederlassung der DOW Olefinverbund GmbH
- Labor -
Robert Geisler

GMID
210914

UNRESTRICTED - May be shared with anyone

This Certificate of Analysis applies to: Date of Printing 25.07.05

Order No.: 51032168

Date: 25.07.2005 Signature:

Attachment 8

Chevron

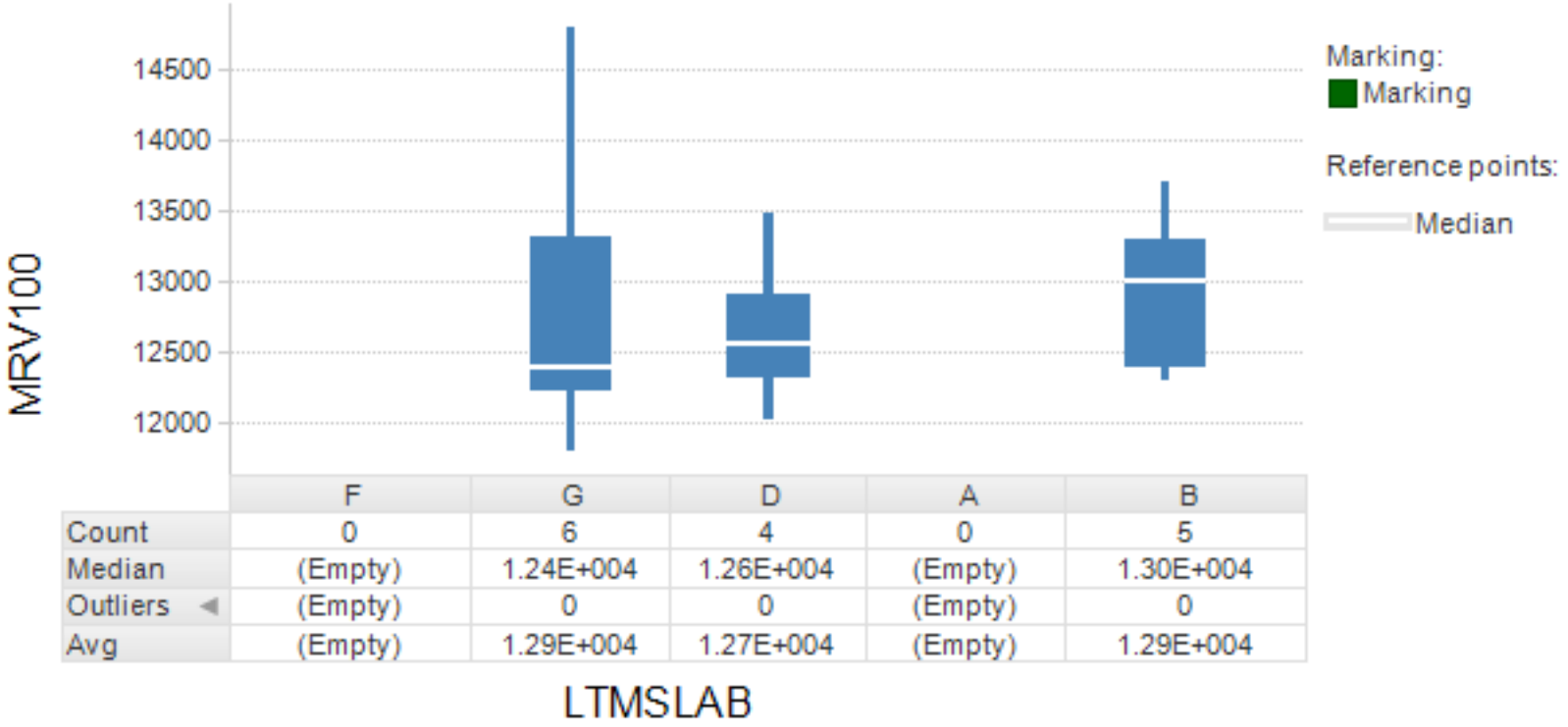
Oronite

Making the things that go, go better.™

T-10A	820-1	820-2	PC-9A	Total
A	2	23	11	36
B	0	4	1	5
D	0	4	1	5
F	0	3	2	5
G	0	19	5	24
Total	2	53	20	75

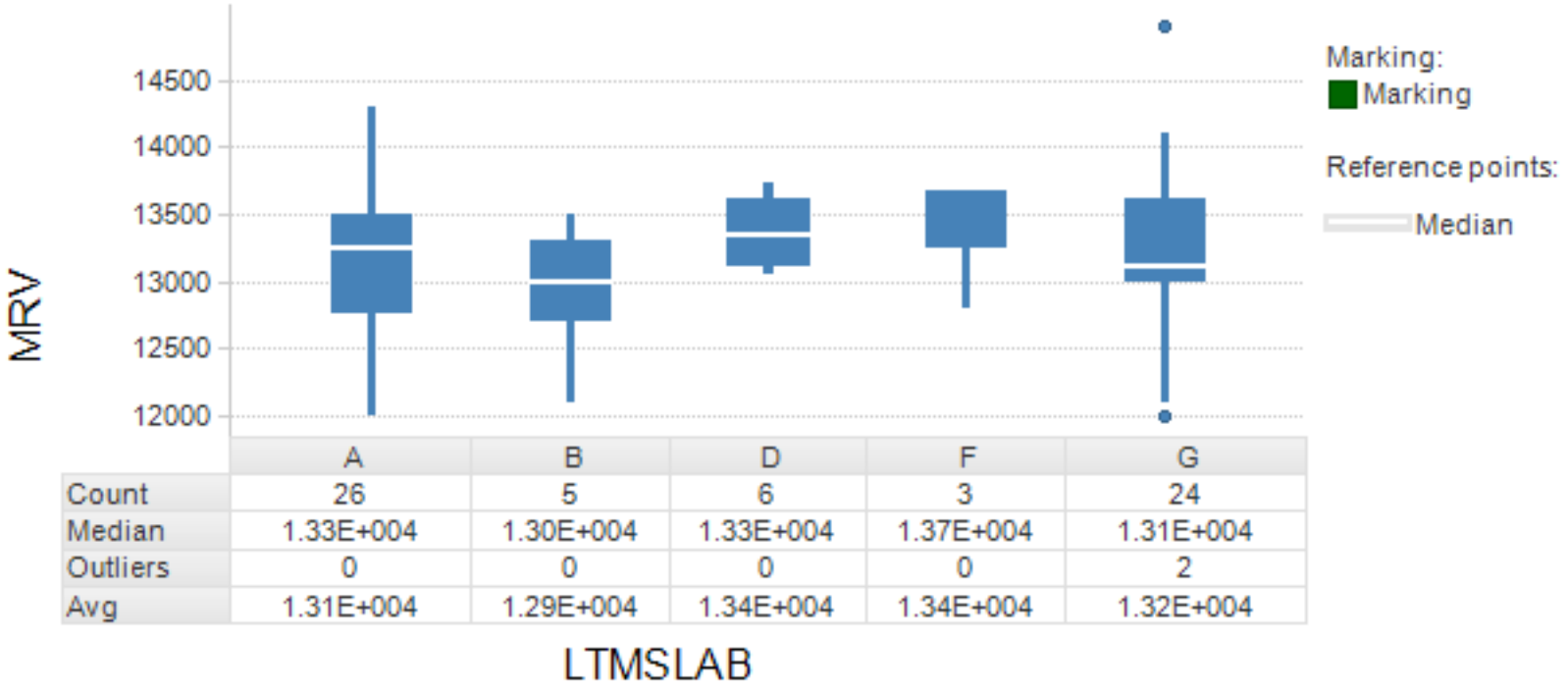
T-12A	820-2	821-1	PC10B	PC10C	PC10E	PC10F	Total
A	4	6	3	1	6	1	21
B	5	2	1	0	7	0	15
D	5	2	1	0	3	0	11
F	4	1	0	0	3	0	8
G	7	4	3	0	3	0	17
I	0	0	0	0	0	0	0
Total	25	15	8	1	22	1	72

Box Plot



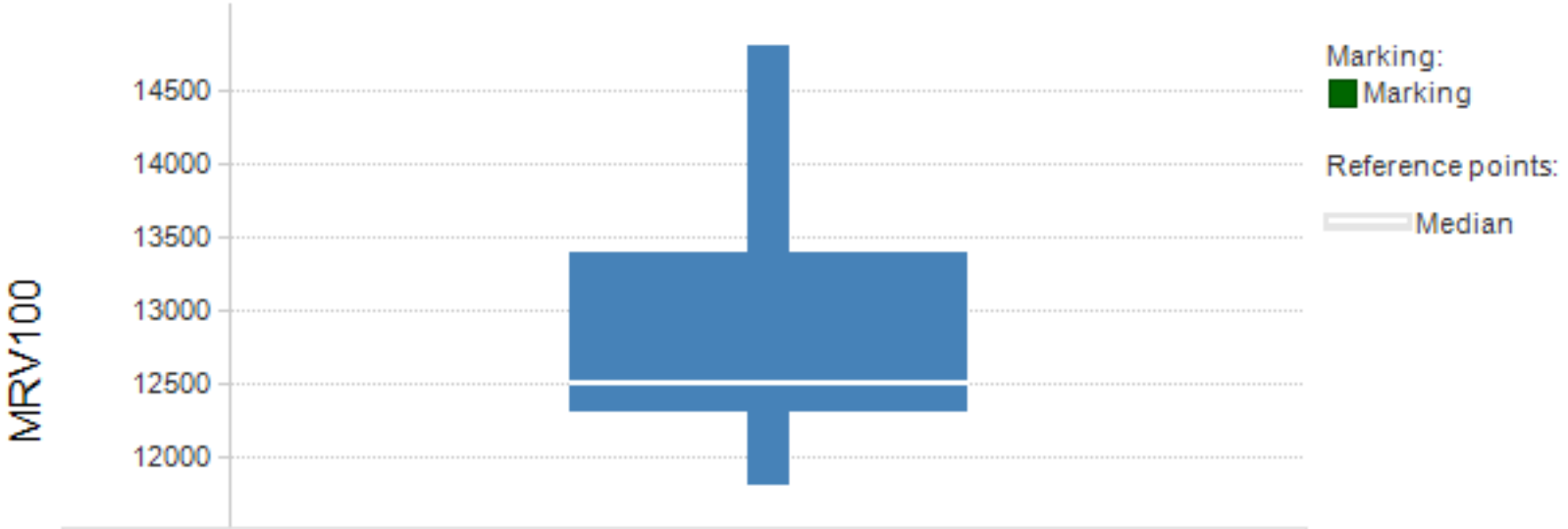
	F	G	D	A	B
Count	0	6	4	0	5
Median	(Empty)	1.24E+004	1.26E+004	(Empty)	1.30E+004
Outliers	(Empty)	0	0	(Empty)	0
Avg	(Empty)	1.29E+004	1.27E+004	(Empty)	1.29E+004

Box Plot



	A	B	D	F	G
Count	26	5	6	3	24
Median	1.33E+004	1.30E+004	1.33E+004	1.37E+004	1.31E+004
Outliers	0	0	0	0	2
Avg	1.31E+004	1.29E+004	1.34E+004	1.34E+004	1.32E+004

Box Plot



Count	15
Median	1.25E+004
Outliers	0
Avg	1.28E+004
StdDev	8.05E+002