



# Test Monitoring Center

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MEMORANDUM: 08-024  
DATE: April 17, 2008  
TO: Mark Cooper, Chairman, Mack Surveillance Panel  
FROM: Jeff Clark  
SUBJECT: T-11 Calibration Testing for the April 2008 ASTM Report Period

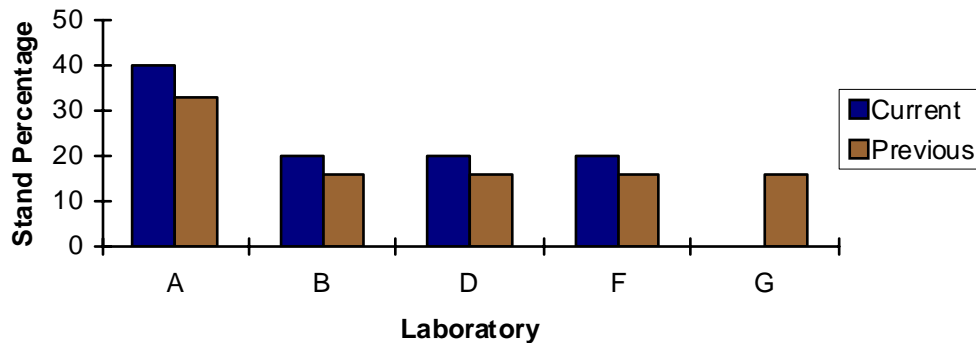
The following is a summary of T-11 reference oil tests completed during the April 2008 ASTM report period, which began on October 1, 2007 and ended on March 31, 2008.

### Lab / Stand Distribution:

	Reporting Data	Calibrated as of 3/31/08
Number of Laboratories	4	4
Number of Stands	5	5

The figure below shows the T-11 laboratory / stand distribution for tests completed the current and previous report periods:

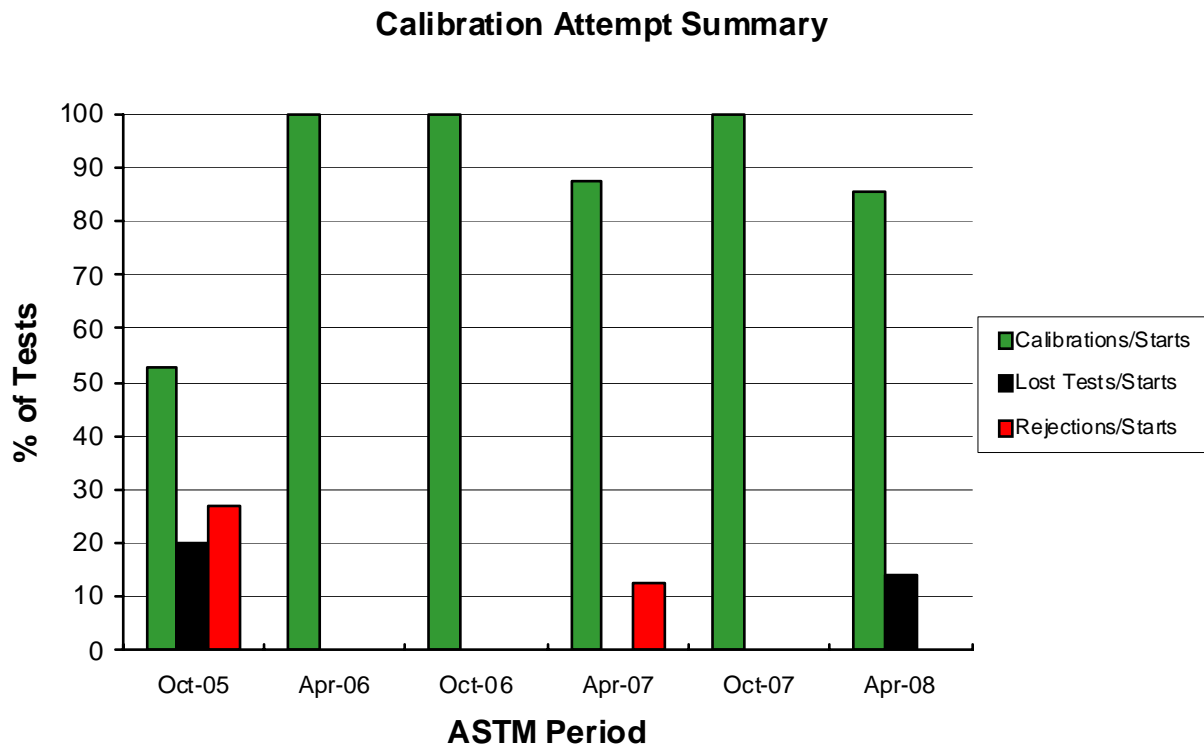
### Laboratory / Stand Distribution



The table below summarizes the status of the reference oil tests reported to the TMC this ASTM report period:

Test Status	TMC Validity Code	Number of Tests
Acceptable Calibration Test	AC	6
Failed Calibration Test (LTMS Criteria)	OC	0
Operationally Invalid Calibration Test	LC	1
Aborted Calibration Test	XC	0
Total		7

Calibrations per start, lost tests per start and rejections per start rates are summarized in the figure below:



A detailed list of reasons tests failed the acceptance criteria (OC validity) is shown in Table 1. Table 2 lists the operationally invalid tests (LC validity) and Table 3 lists the aborted tests (XC validity).

Severity and Precision:

Figure 1 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Soot at 12 cSt Viscosity Increase (SOOT). SOOT is currently within control chart limits. For this period, SOOT is trending an average of 0.63  $\Delta/s$  mild, which is approximately 0.14 % TGA soot. For a history of SOOT industry alarms, refer to the industry alarm log shown in Table 4.

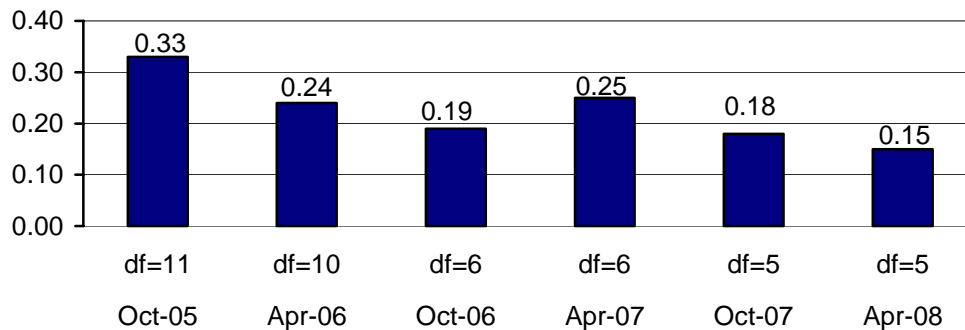
Figure 2 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for MRV Viscosity (MRV). MRV is currently in an industry warning alarm for severity, in the mild direction. For this period MRV is trending an average of 1.03  $\Delta/s$  mild, which is approximately 944 cP. For a history of MRV industry alarms, refer to the industry alarm log shown in Table 5.

Figure 3 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Soot at 4 cSt Viscosity Increase (SOOT4). SOOT4 is currently in an industry warning alarm for severity, in the mild direction. For this period, SOOT4 is trending an average of 0.79  $\Delta/s$  mild, which is approximately 0.22 % TGA soot. For a history of SOOT4 alarms, refer to the industry alarm log shown in Table 6.

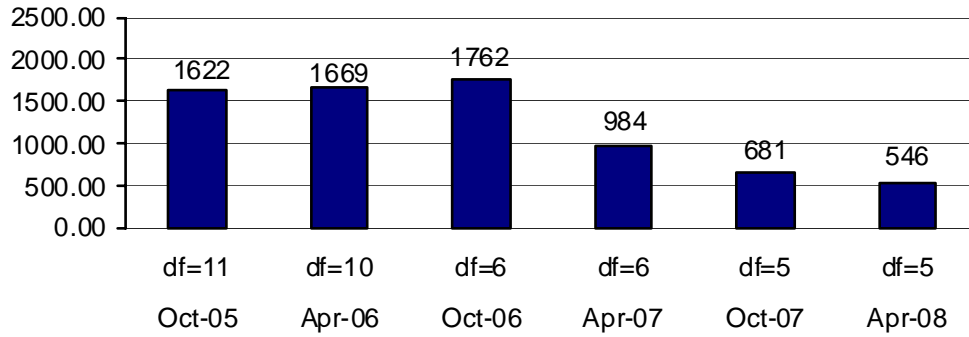
Figure 4 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Soot at 15 cSt Viscosity Increase (SOOT5). SOOT5 is currently in an industry warning alarm for severity, in the mild direction. For this period, SOOT5 is trending an average of 0.79  $\Delta/s$  mild, which is approximately 0.16% TGA soot. For a history of SOOT5 alarms, refer to the industry alarm log shown in Table 7.

Precision, as estimated by the pooled standard deviation, is shown in the following figures. For comparison purposes, the TMC will continue to report precision by ASTM period. For this period, precision for all parameters shows at least some improvement, while SOOT4 shows a sizeable improvement.

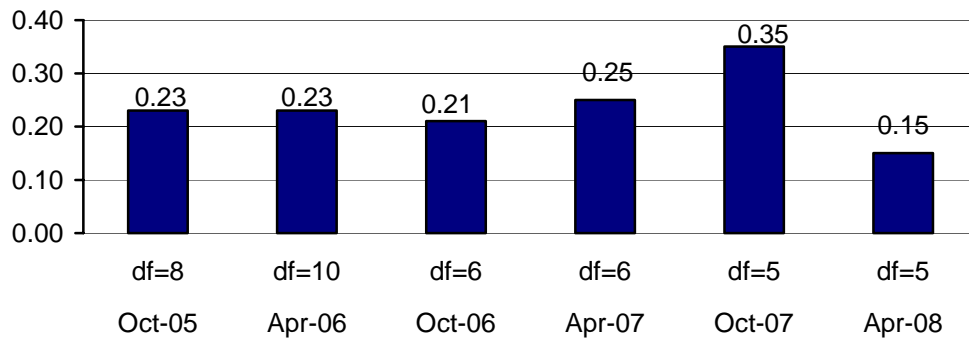
**SOOT Pooled Precision**



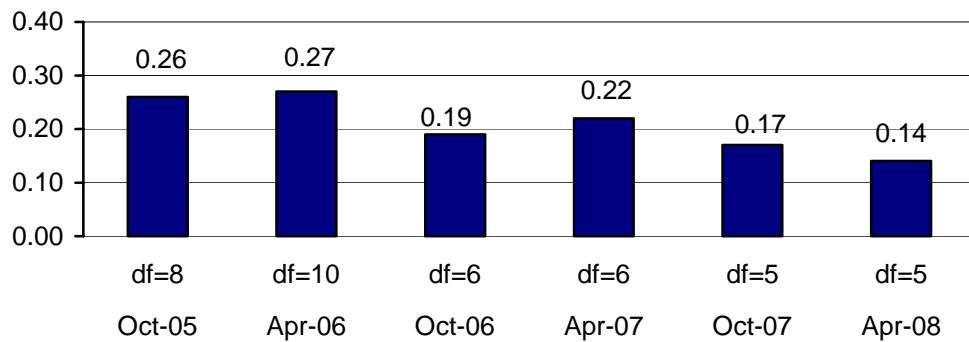
### MRV Viscosity Pooled Precision



### SOOT4 Pooled Precision



### SOOT5 Pooled Precision



Please note, that the degrees of freedom (df) equals  $\Sigma(n \text{ observations per oil} - 1)$ .

Reference Oils:

The current reference oil test targets are shown below:

Oil	N	Parameter	Mean (cSt)	s
820-3	11	SOOT	5.92	0.22
		MRV	14981	916
		SOOT4	3.95	0.30
		SOOT5	6.51	0.20

The table below shows supply levels of oil 820-3.

Oils	TMC Inventory (gallons)	Lab Inventory (# of samples)	Estimated Life (years)
820-3	1964	8	7.1

Hardware:

The change to the part number 349GC3107 top rings has resulted in correction factors for both SOOT (-0.35 %) and MRV (+956 cP).

Information Letters:

No T-11 Information Letters were issued this ASTM period.

TMC Laboratory Visits:

No TMC laboratory visits were conducted this ASTM period.

LTMS Deviations

No LTMS deviations were issued this period. No LTMS deviations have been issued during the history of the T-11.

Quality Index:

Two Quality Index deviations were issued this ASTM period; one for fuel flow, one for inlet air temperature. For the history of the T-11, three Quality Index deviations have been issued.

Additional Information:

The T-11 test procedure is ASTM D 7156.

Table 8 contains the T-11 Timeline which details changes to the test since its inception.

The T-11 database can be accessed on the TMC's homepage. If you have any questions on how to access this information, contact the TMC.

JAC/jac/mem08-024.jac.doc

Attachments

c: J.L. Zalar, TMC

F.M. Farber, TMC

Mack Surveillance Panel

<ftp://ftp.astmtmc.cmu.edu/docs/diesel/mack/semiannualreports/T-11/T11-04-2008.pdf>

Distribution: Email

**Table 1**  
**Summary of Reasons for Failed Tests**

	No. of Tests
No failed tests	

**Table 2**  
**Summary of Reasons for Invalid Tests**

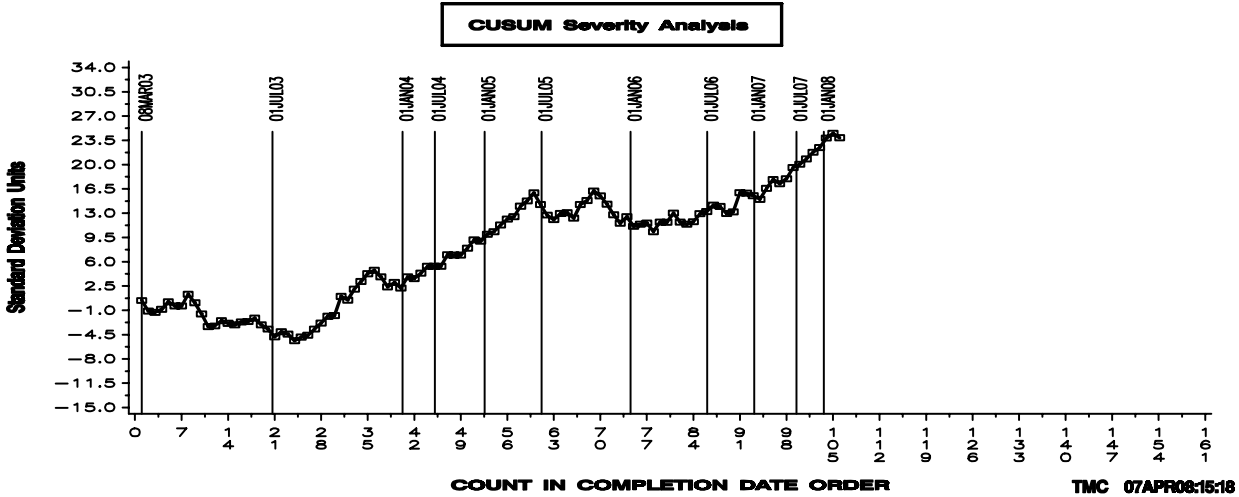
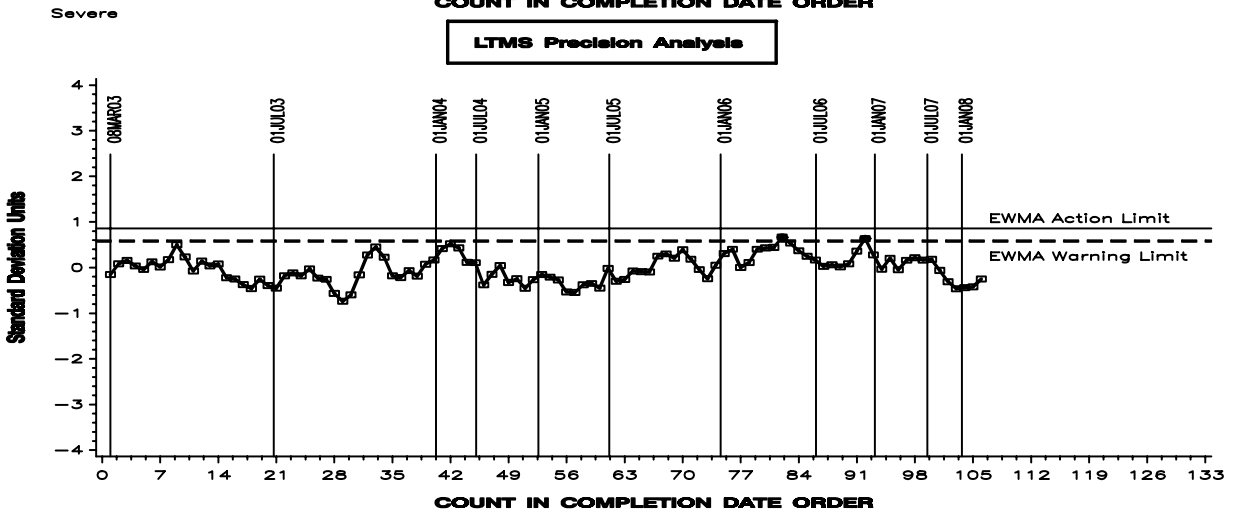
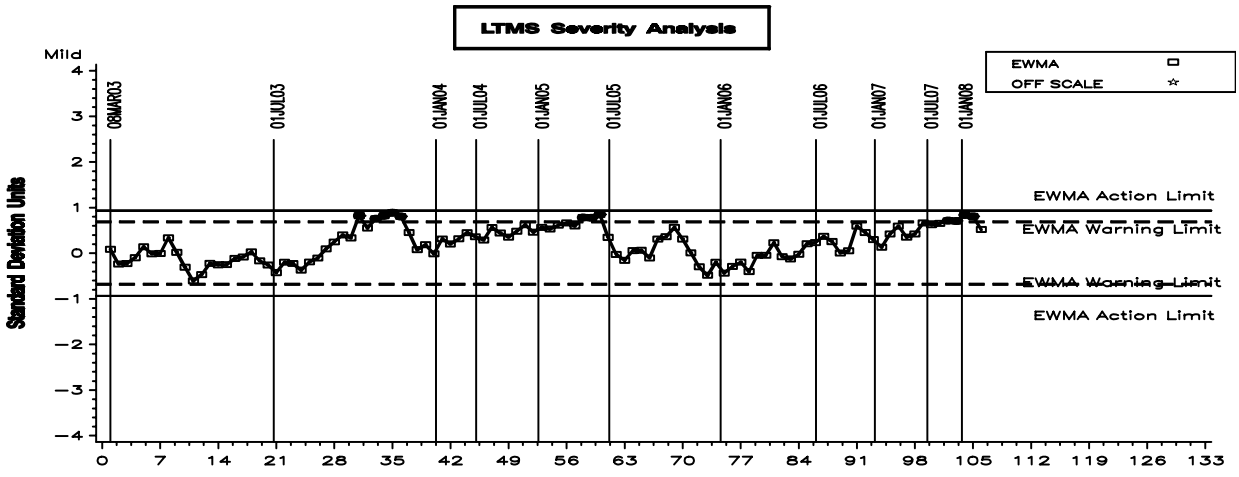
	No. of Tests
EGR Cooler Leak	1

**Table 3**  
**Summary of Reasons for Aborted Tests**

	No. of Tests
No aborted tests	-

**FIGURE 1**  
**T-11 INDUSTRY OPERATIONALLY VALID DATA**

**SOOT AT 12 cSt**





**TABLE 4**  
**SOOT AT 12 cSt INDUSTRY ALARM LOG**

**August 11, 2003 to November 3, 2003 (Severity, Mild direction)**

Five of six tests trigger an industry warning alarm. No cause was apparent and the alarm cleared without any action being taken by the surveillance panel.

**April 19, 2005 to June 27, 2005 (Severity, Mild direction)**

This trend appeared to be the continuation of a long-term mild trend. The surveillance panel investigation found an increase in oil consumption had occurred in the same time frame. A series of tests were run using new top ring hardware (T-12 top rings) and the oil consumption problem was abated. However, a shift in SOOT results occurred with the implementation of the new hardware. Industry-wide correction factors were adopted for tests run with T-12 top rings. The alarm cleared on June 27, 2005. The surveillance panel will continue to evaluate the correction factor as more data becomes available.

**May 1, 2006 to May 5, 2006 (Precision)**

A one-test excursion occurs. No indication of a true industry alarm.

**December 20, 2006 to December 24, 2006 (Precision)**

A one-test excursion occurs. No indication of a true industry alarm.

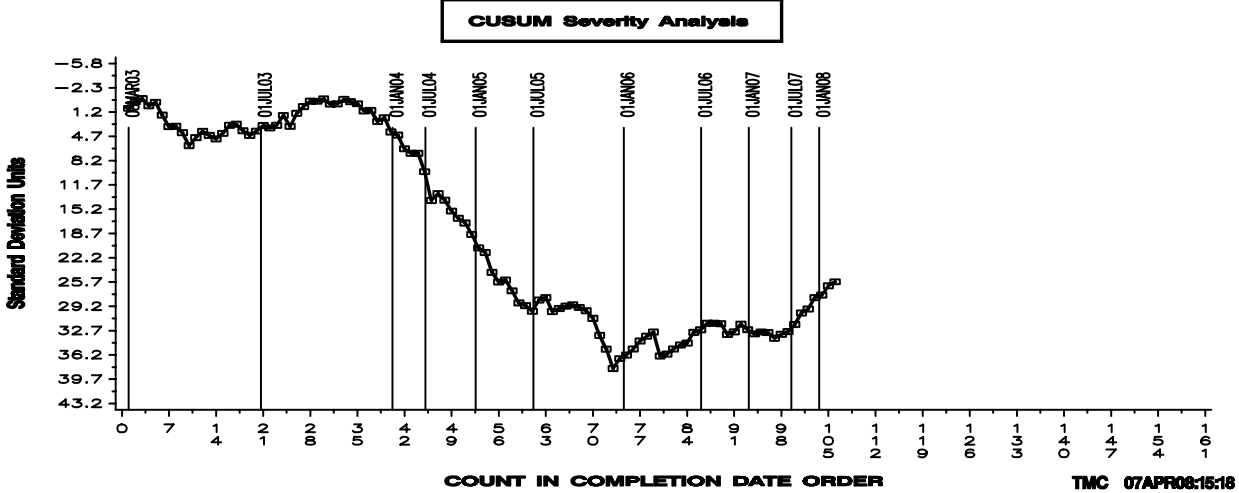
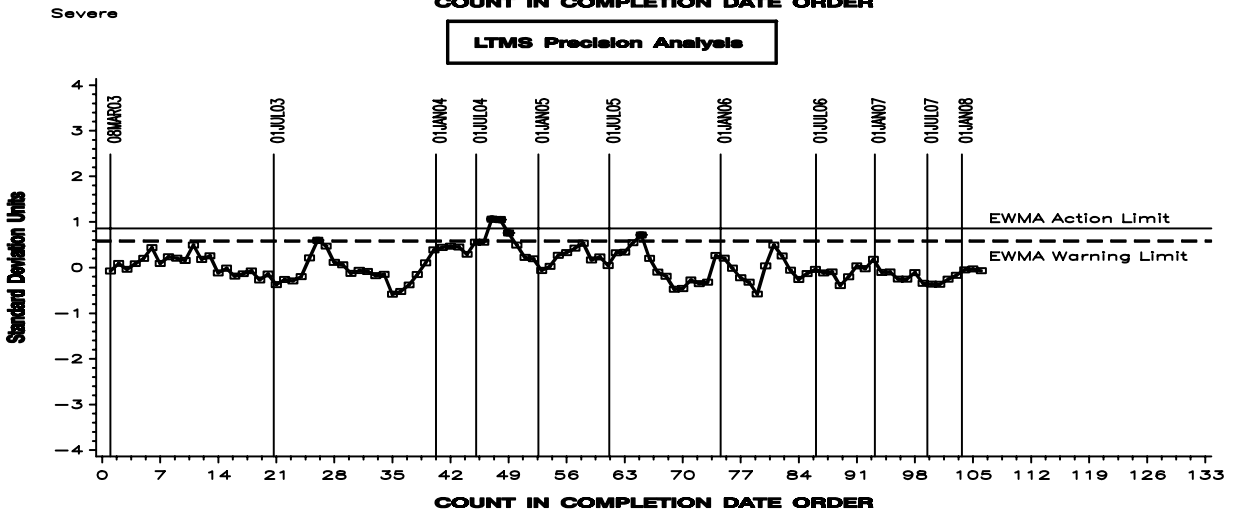
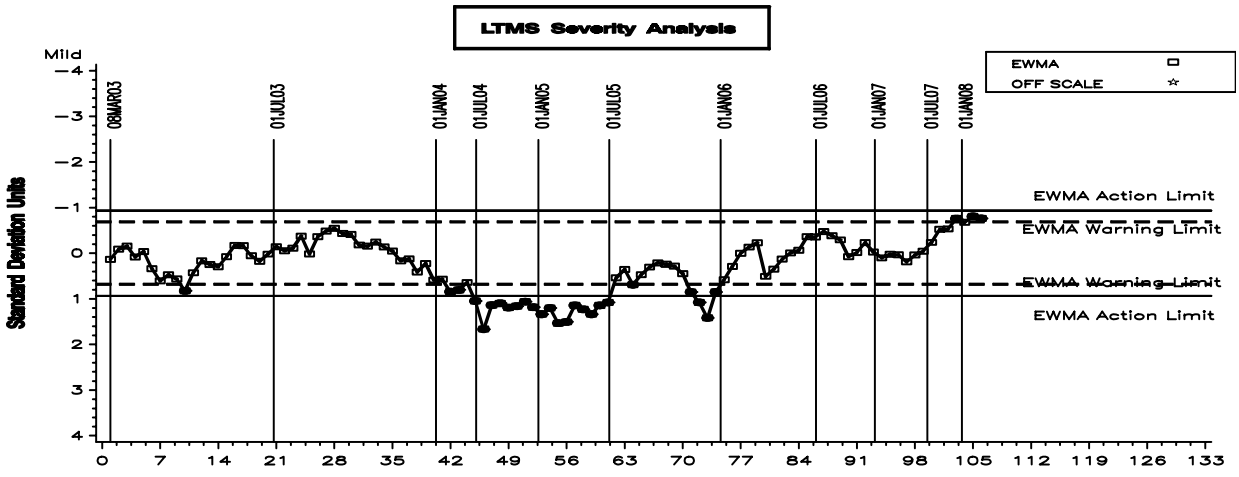
**December 4, 2007 to February 16, 2008 (Severity, Mild direction)**

Four tests trigger an industry warning alarm. No cause was apparent and the alarm cleared without any action being taken by the surveillance panel.

Updated 4/17/08

# FIGURE 2 T-11 INDUSTRY OPERATIONALLY VALID DATA

## MRV VISCOSITY



**TABLE 5**  
**MRV VISCOSITY INDUSTRY ALARM LOG**

**April 26, 2003 to April 29, 2003 (Severity, Severe direction)**

A one-test excursion occurs. No industry related problem.

**July 19, 2003 to July 21, 2003 (Precision)**

A one-test excursion occurs. No industry related problem.

**March 12, 2004 to August 22, 2005 (Severity, Severe direction; Precision)**

This trend appeared to be the continuation of a long-term severe trend. The surveillance panel investigation found an increase in oil consumption had occurred in the same time frame. A series of tests were run using new top ring hardware (T-12 top rings) and the oil consumption problem was abated. However, a mild shift in MRV results occurred with the implementation of the new hardware. An industry-wide correction factor was adopted for tests run with T-12 top rings. The alarm cleared on August 22, 2005. The surveillance panel will continue to evaluate the correction factor as more data becomes available.

**November 6, 2005 to January 10, 2006 (Severity, Severe direction)**

A string of five consecutive severe tests trips an action alarm. The alarm clears when a subsequent string of six consecutive mild tests occurs. While it should be noted that the MRV correction factor (T-12 top ring hardware) was updated during this period, it does not directly correspond to the change from the severe to the mild trend. Also, the difference between the two CFs (561 cP) is not completely responsible for changing test results from severe to mild.

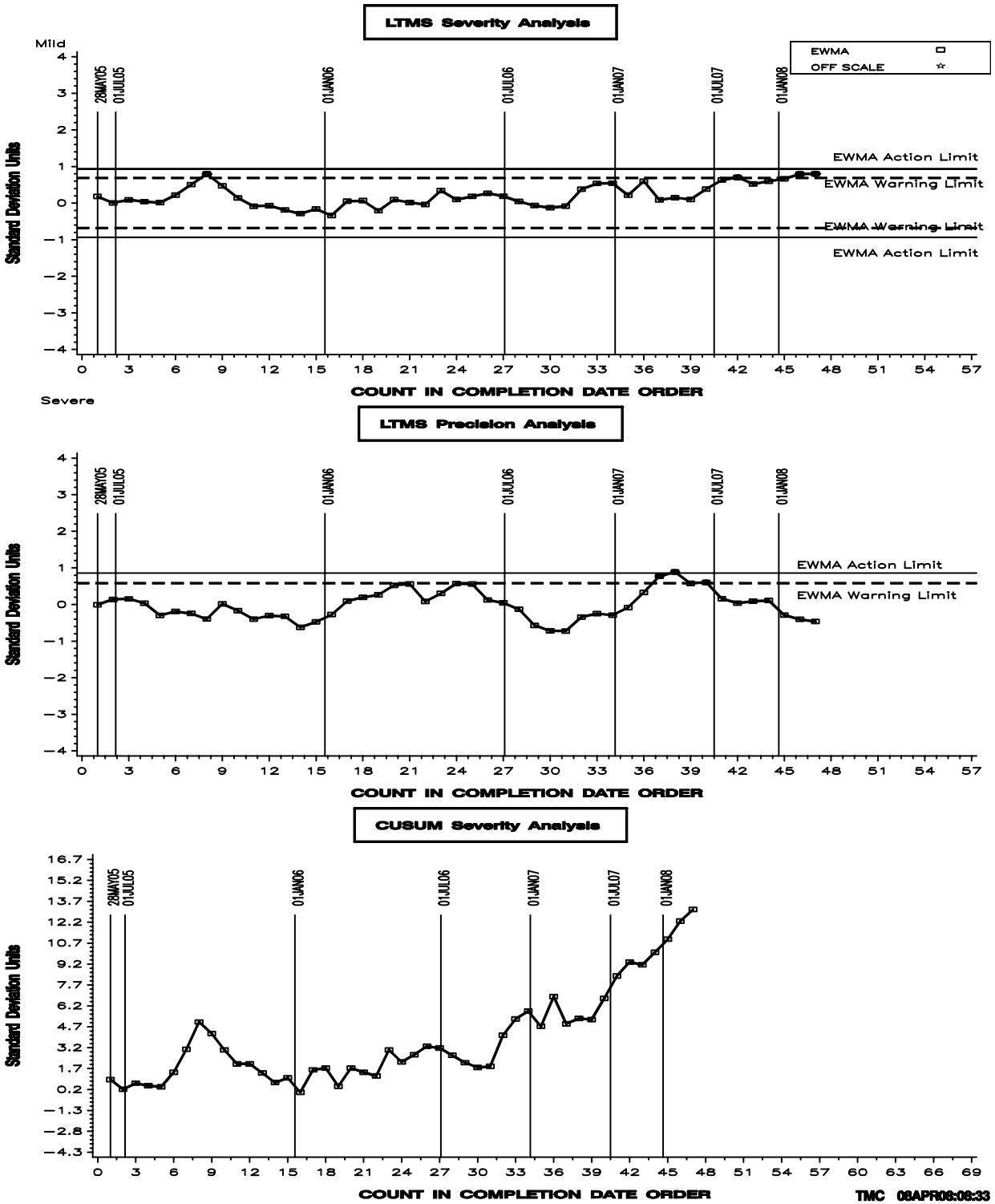
**December 27, 2007 to Date (Severity, Mild direction)**

Three of four tests trigger an industry warning alarm. No indication yet of cause.

Updated 4/17/08

# FIGURE 3 T-11 INDUSTRY OPERATIONALLY VALID DATA

## SOOT @ 4 cSt - FINAL RESULT



**TABLE 6**  
**SOOT AT 4 cSt INDUSTRY ALARM LOG**

**September 10, 2005 to September 30, 2005 (Severity, Mild direction)**

A one-test excursion occurs. No industry related problem.

**May 27, 2007 to July 10, 2007 (Precision)**

A four-test excursion occurs. No evidence of an industry related problem.

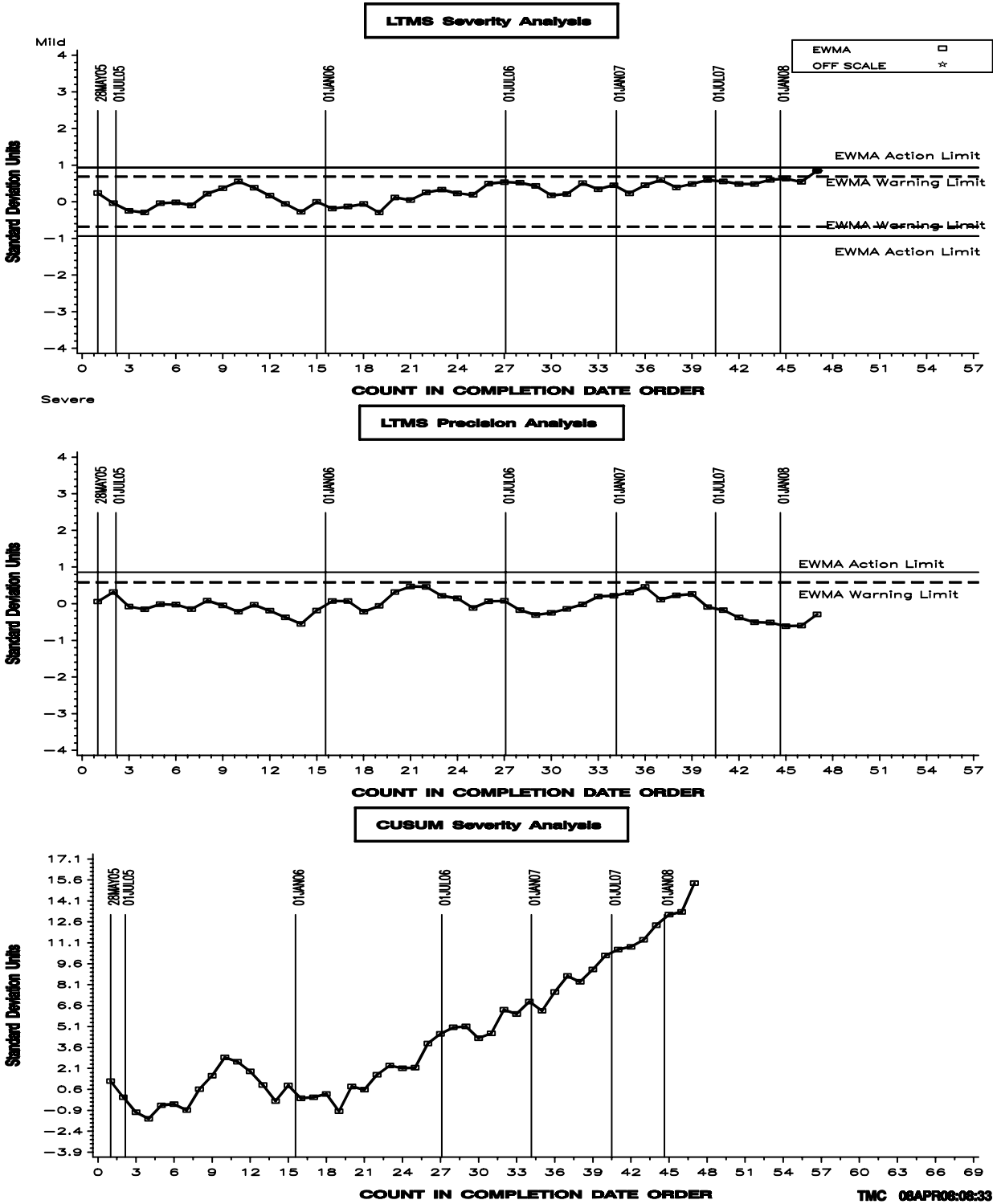
**November 5, 2007 to Date (Severity, Mild direction)**

Three tests in a series of six trigger an industry warning alarm. No indication yet of cause.

Updated 4/17/08

# FIGURE 4 T-11 INDUSTRY OPERATIONALLY VALID DATA

## SOOT @ 15 cSt - FINAL RESULT



**TABLE 7**  
**SOOT AT 15 cSt INDUSTRY ALARM LOG**

**February 16, 2008 to Date (Severity, Mild direction).**

A one-test excursion has occurred. No indication yet if this is a true industry alarm.

Updated 4/17/08

**TABLE 8***T11 Timeline*

15:10 Monday, April 7, 2008 1

Obs	effective_date	info_letter_number	event
1	20030221		Draft 1 of test procedure issued
2	20030303		Oil sump configuration specified
3	20030313		Draft 2 of test procedure issued
4	20030422		Oil sample location specified as the pre-oil filter pressure port
5	20030709		Draft 3 of test procedure issued
6	20030714		Calibration period set to six months or six tests (1512 test hours)
7	20030717		Draft 4 of test procedure issued
8	20030821		Oil consumption limit of 65 g/hr maximum, using 25-h to EOT regression slope
9	20030821		LTMS implemented
10	20030905		Third soot window moved from EOT to 228 hours
11	20030918		Draft 5 of test procedure issued
12	20030923		Report Forms and Data Dictionary Version 20030819
13	20031205		Report Forms and Data Dictionary Version 20031029
14	20040415		Intake Manifold Pressure specification set to 140 kPa minimum.
15	20040504		Draft 6 of test procedure issued
16	20041215		USE OF DYED FUEL ACCEPTED
17	20050511		GB3133 VALVE GUIDES INTRODUCED
18	20050528		349GC3107 TOP RINGS INTRODUCED (T-12 RINGS)
19	20050603		Test procedure available as ASTM D 7156
20	20050803	05-1	349GC3107 TOP RINGS APPROVED FOR ALL TESTS
21	20050909	05-1	Rotational Viscosity measurements dropped from test method.
22	20050914	05-1	Correction factors adopted for SOOT (-0.39) and MRV (+1274) for all tests run with 349GC3107 top rings
23	20051206	05-1	Correction factors updated for SOOT (-0.36) and MRV (+713) for all tests run with 349GC3107 top rings
24	20060123	06-1	Protocol for running T-11A abbreviated test added to test method.
25	20060123	06-1	Soot at 4 cSt Viscosity Increase and Soot at 15 cSt Viscosity Increase added to test method.
26	20060324	06-2	Correction factors updated for SOOT (-0.35) and MRV (+956) for all tests run with 349GC3107 top rings
27	20060703	06-3	D7109 added as a Test Method to measure DIN Shear Viscosity
28	20061202		TMC oil 820-3 introduced.
29	20061213	06-4	Section 4.3 corrected to indicate that engine build frequency is at laboratory discretion.
30	20061213	06-4	Requirement for post break-in valve lash check removed.
31	20061213	06-4	Maximum MRV results are set at 400,000 cP. This value is to be use for results that are TVTM.
32	20070201	07-1	Fuel sulfur measurement method changed to D 5453, with D 2622 and D 4294 as acceptable substitutes.
33	20070201	07-1	Valve guide reaming procedure updated.
34	20070201	07-1	New lab and new stand time limits corrected.



*T11 Timeline*

15:10 Monday, April 7, 2008 2

Obs	effective_date	info_letter_number	event
35	20070201	07-1	Clarification that linear interpolation is used to calculate Soot Contents.
36	20070907		Eleven test targets implemented for oil 820-3