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MEMORANDUM: 02-047

DATE: May 8, 2002

TO: Wim Van Dam, Chairman, Mack Surveillance Panel

FROM: Jeff Clark

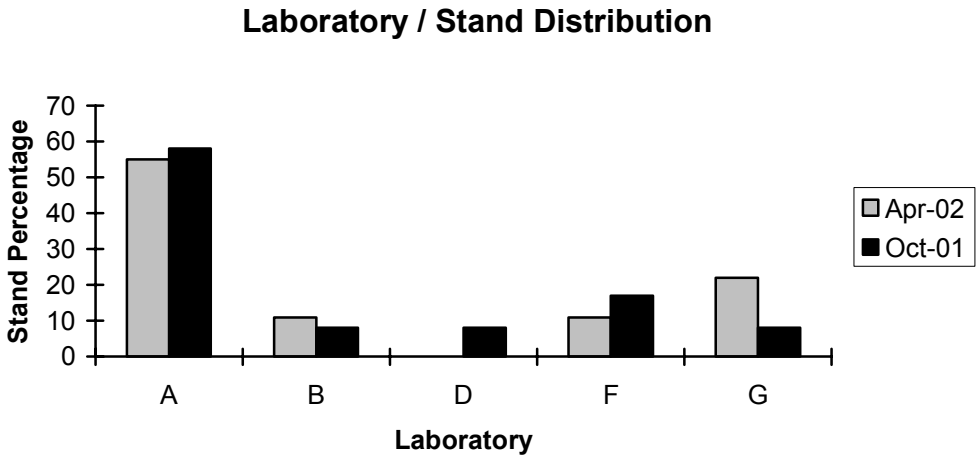
SUBJECT: T-10 Calibration Testing for the April 2002 ASTM Report Period

The following is a summary of T-10 reference oil tests completed during the April 2002 ASTM report period, which began on October 1, 2001 and ended on March 31, 2002.

Lab / Stand Distribution:

	Reporting Data	Calibrated as of 3/31/02
Number of Laboratories	4	4
Number of Stands	9	8

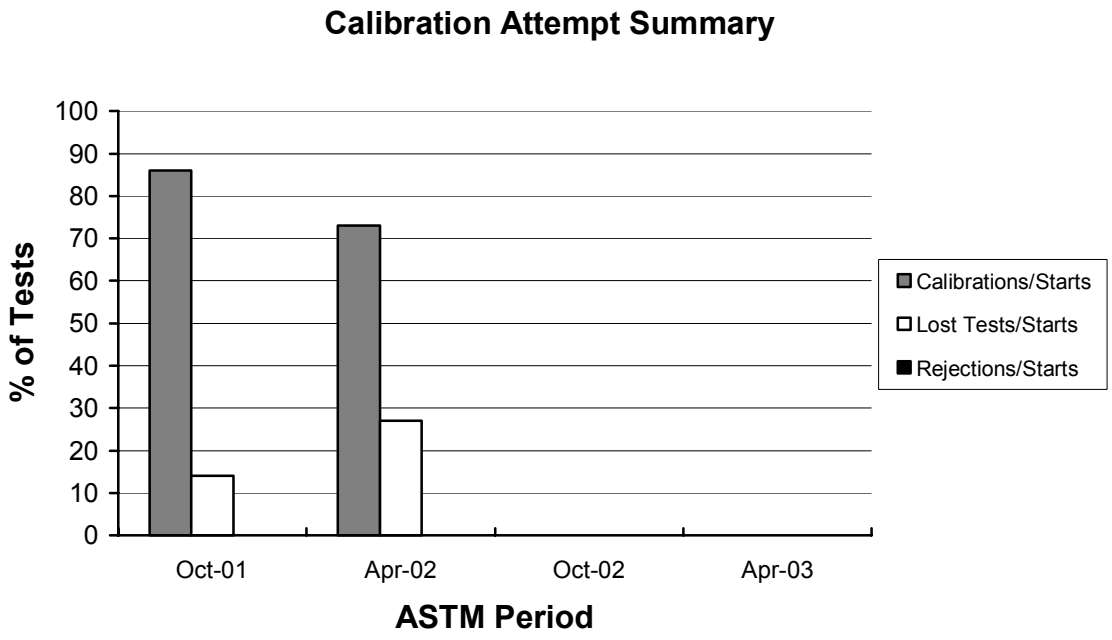
The figure below shows the T-10 laboratory / stand distribution for tests completed the current and previous report periods:



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 T-10 Tests
Acceptable Calibration Test	AC	8
Failed Calibration Test (LTMS Criteria)	OC	0
Operationally Invalid Calibration Test	LC	2
Aborted Calibration Test	XC	1
Total		11

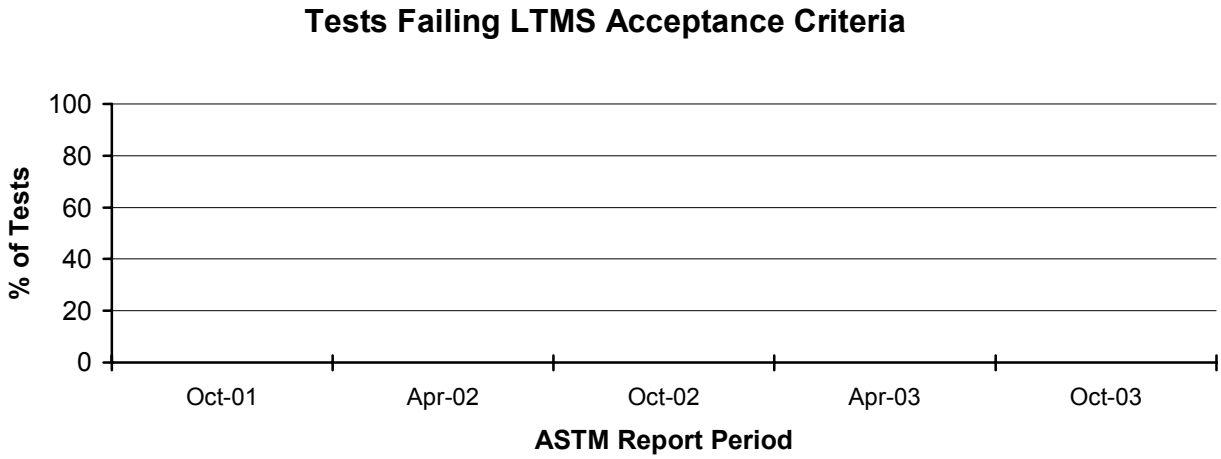
Calibrations per start, lost tests per start and rejections per start rates are summarized in the figure below:



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).

LTMS Acceptance Criteria / Stand Alarms:

The following figure shows the percentage of operationally valid tests that failed the LTMS acceptance criteria (TMC validity code = OC) for recent ASTM report periods:



There were no LTMS stand alarms for the current period. No LTMS deviations were issued this period. No LTMS deviations have been issued during the history of the T-10.

Severity and Precision:

Figure 1 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Delta Pb @ EOT (PB). PB is currently in control. For a history of PB industry alarms, refer to the industry alarm log shown in Table 4.

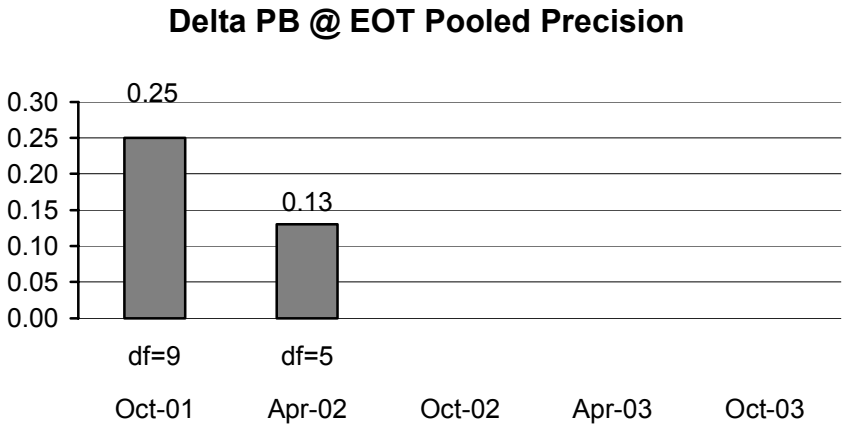
Figure 2 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Cylinder Liner Wear (CLW). For this period, CLW is trending an average 0.13 Δ/s severe. This is equivalent to 0.4 microns. CLW is currently in an industry warning alarm for precision. For a history of CLW industry alarms, refer to the industry alarm log shown in Table 5.

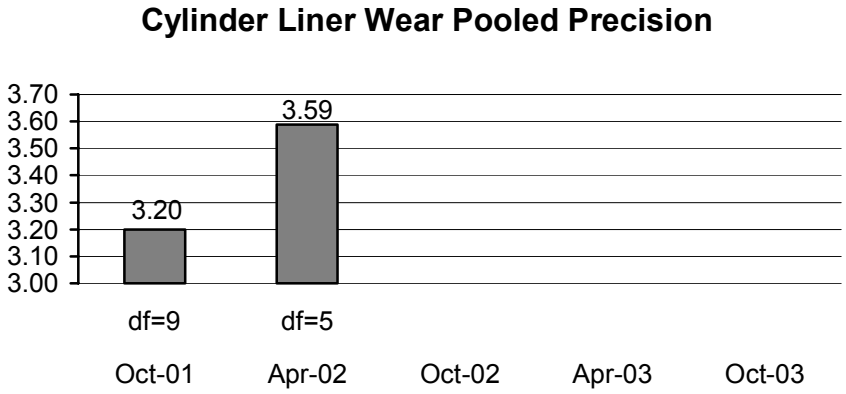
Figure 3 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Top Ring Weight Loss (TRWL). TRWL is currently in control. For this period, TRWL is trending an average of 0.35 Δ/s mild, or approximately 9 mg. For a history of TRWL industry alarms, refer to the industry alarm log shown in Table 6.

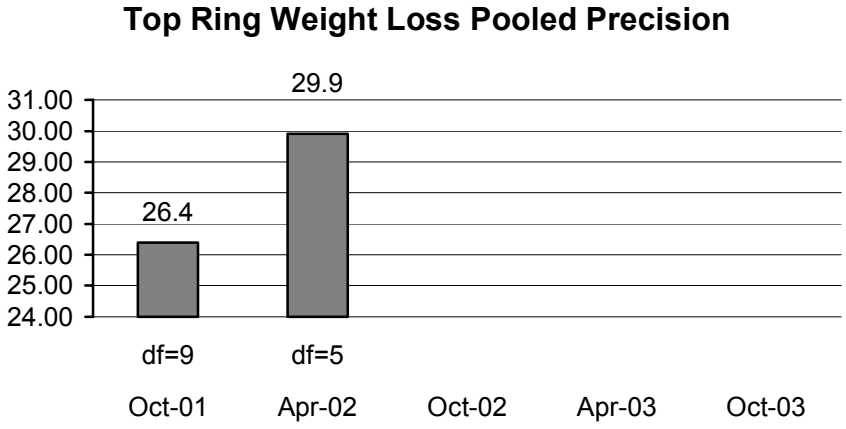
Figure 4 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Oil Consumption (OC). OC is currently in control. For a history of OC industry alarms, refer to the industry alarm log shown in Table 7.

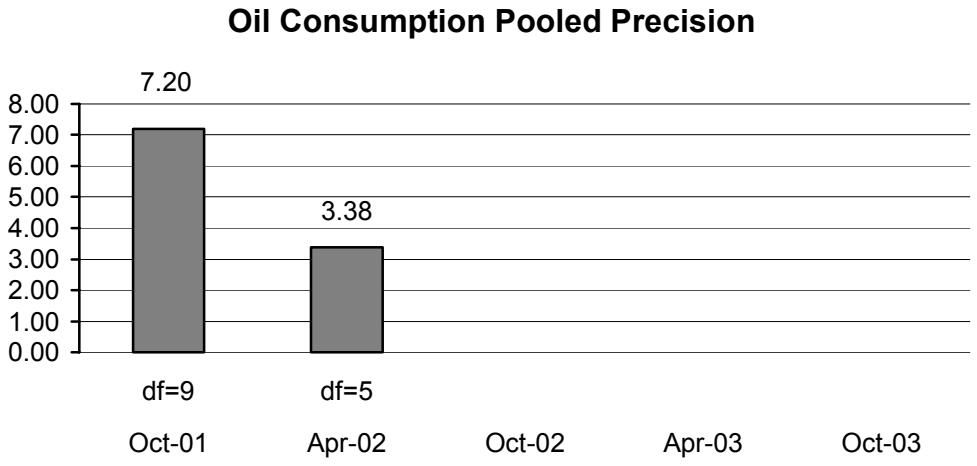
Figure 5 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Delta Pb 250-300 Hours (PB2). PB2 is currently in control. For a history of PB2 industry alarms, refer to the industry alarm log shown in Table 8.

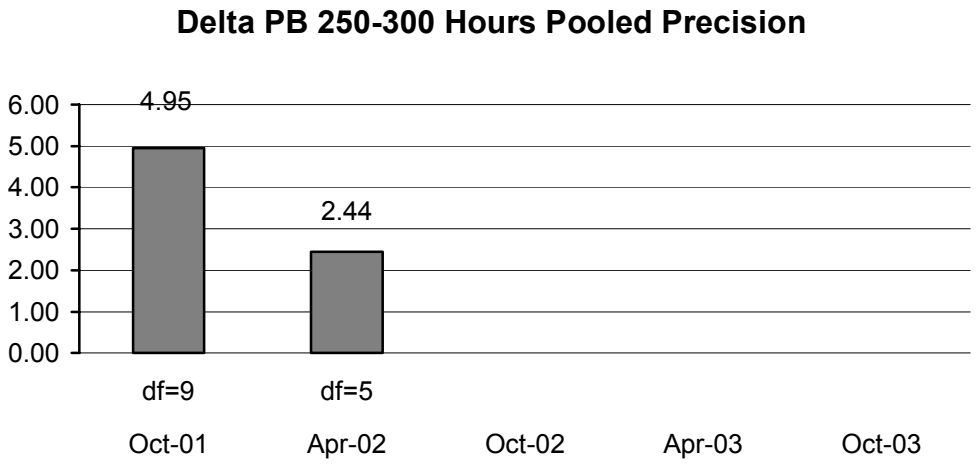
Precision, as estimated by the pooled standard deviation, is shown in the following figures. For comparison purposes, the TMC will continue to report precision by ASTM period.


Delta PB @ EOT Pooled Precision
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.25
0.13
df=9
df=5
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03


Cylinder Liner Wear Pooled Precision
3.70
3.60
3.50
3.40
3.30
3.20
3.10
3.00
3.59
3.20
df=9
df=5
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03


Top Ring Weight Loss Pooled Precision
31.00
30.00
29.00
28.00
27.00
26.00
25.00
24.00
29.9
26.4
df=9
df=5
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03





Oil consumption and both lead parameters show significant improvement in precision while both cylinder liner wear and top ring weight loss show a slight degradation. Please note, that the degrees of freedom (df) equals Σ(n observations per oil - 1).

Reference Oils:

The current reference oil test targets are shown below:

Oils	Parameter	N*	Mean (cSt)	S
820-2	PB	13	3.1298	0.2847
	CLW	13	32.5	3.4
	TRWL	13	134	26
	OC	13	49.6	10.9
	PB2	13	8.2	5.2

*Thirteen tests on PC-9A.

TMC oil 820-2 has been introduced and the current targets are based on oil 820 (PC-9A). To date, 8 tests have been completed on 820-2.

Abbreviated Length Test T-10A:

The TMC monitors the T-10A for the determination of laboratory severity adjustments for MRV viscosity. Figure 6 (attached) shows the current industry EWMA severity, EWMA precision, and CUSUM charts for MRV viscosity. MRV viscosity is currently in an industry action for severity, in the mild direction. Investigation has revealed that this trend is independent of laboratory and stand. It is also independent of the type of test used to generate the result (flush-n-run vs. rebuild). The trend is believed to actually be a shift in severity caused by the introduction of oil 820-2. Accordingly, the surveillance panel needs to discuss updating targets for this oil. For a history of MRV viscosity industry alarms, refer to the industry alarm log shown in Table 9.

Information Letters:

No information letters were issued this ASTM period.

TMC Laboratory Visits:

No TMC laboratory visits were conducted this ASTM period.

Quality Index:

Quality Index has not yet been implemented for the T-10. The TMC will be conducting an industry capability study, after which a QI proposal will be brought to the panel for consideration.

Additional Information:

Table 10 contains the T-10 / T-10A Timeline which details changes to the test since its inception.

The T-10 and T-10A databases can be accessed on the TMC's homepage. If you have any questions on how to access this information, contact the TMC.

JAC/jac/mem02-047.jac.doc

Attachments

c: J.L. Zalar, TMC
F.M. Farber, TMC
Mack Surveillance Panel
ftp://ftp.astmtmc.cmu.edu/docs/diesel/mack/semiannualreports/T10-04-2002.pdf

Distribution: Email

Table 1
Summary of Reasons for Rejected Tests

	No. of Tests
No rejected tests	-

Table 2
Summary of Reasons for Invalid Tests

	No. of Tests
Ran test with wrong camshaft	2

Table 3
Summary of Reasons for Aborted Tests

	No. of Tests
Missed 75-hour soot window	1

FIGURE 1

T–10 INDUSTRY OPERATIONALLY VALID DATA

DELTA PB @ EOT

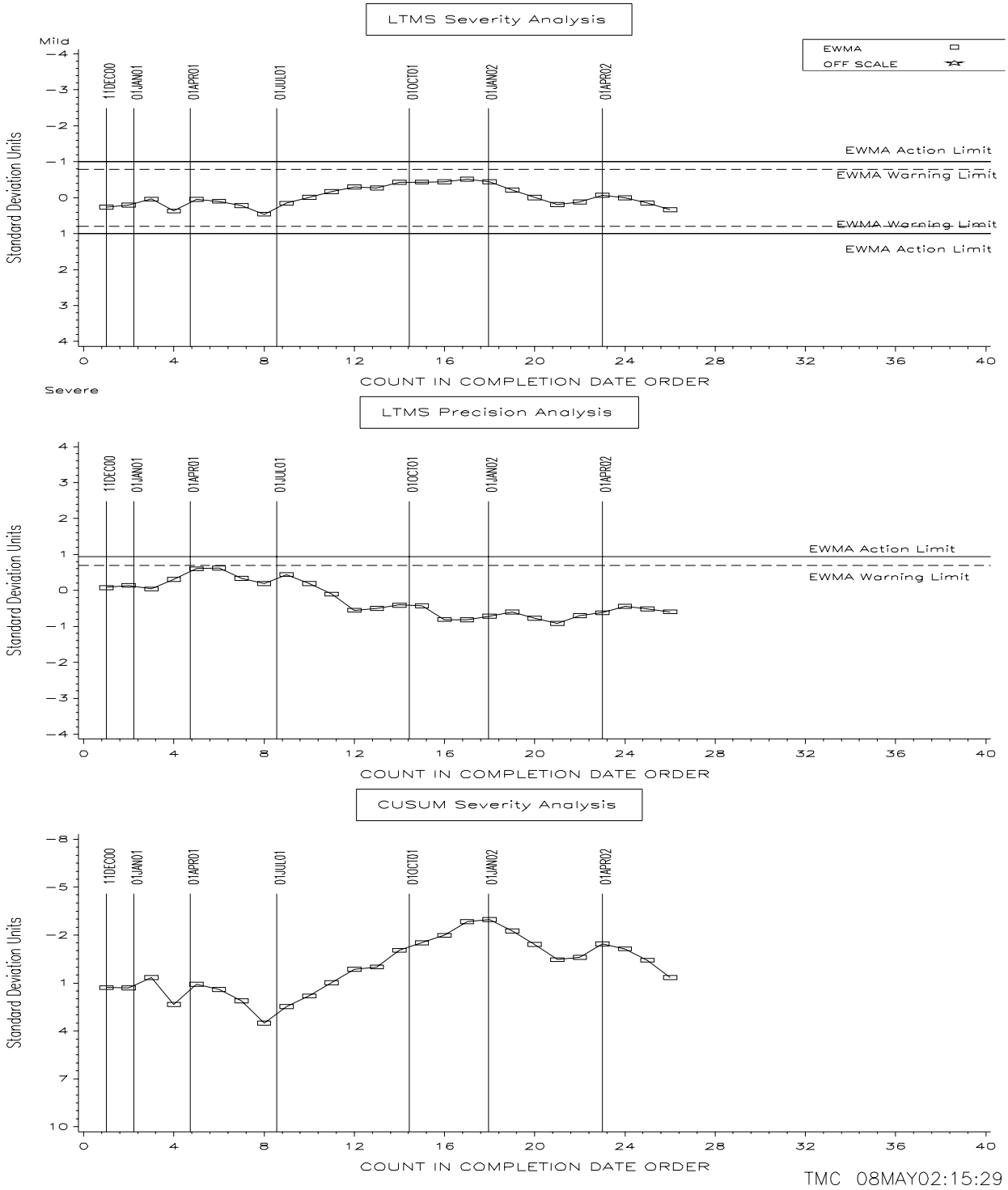


TABLE 4
DELTA PB @ EOT INDUSTRY ALARM LOG

No alarms have occurred.

Updated 5/8/02

FIGURE 2

T–10 INDUSTRY OPERATIONALLY VALID DATA

CYLINDER LINER WEAR

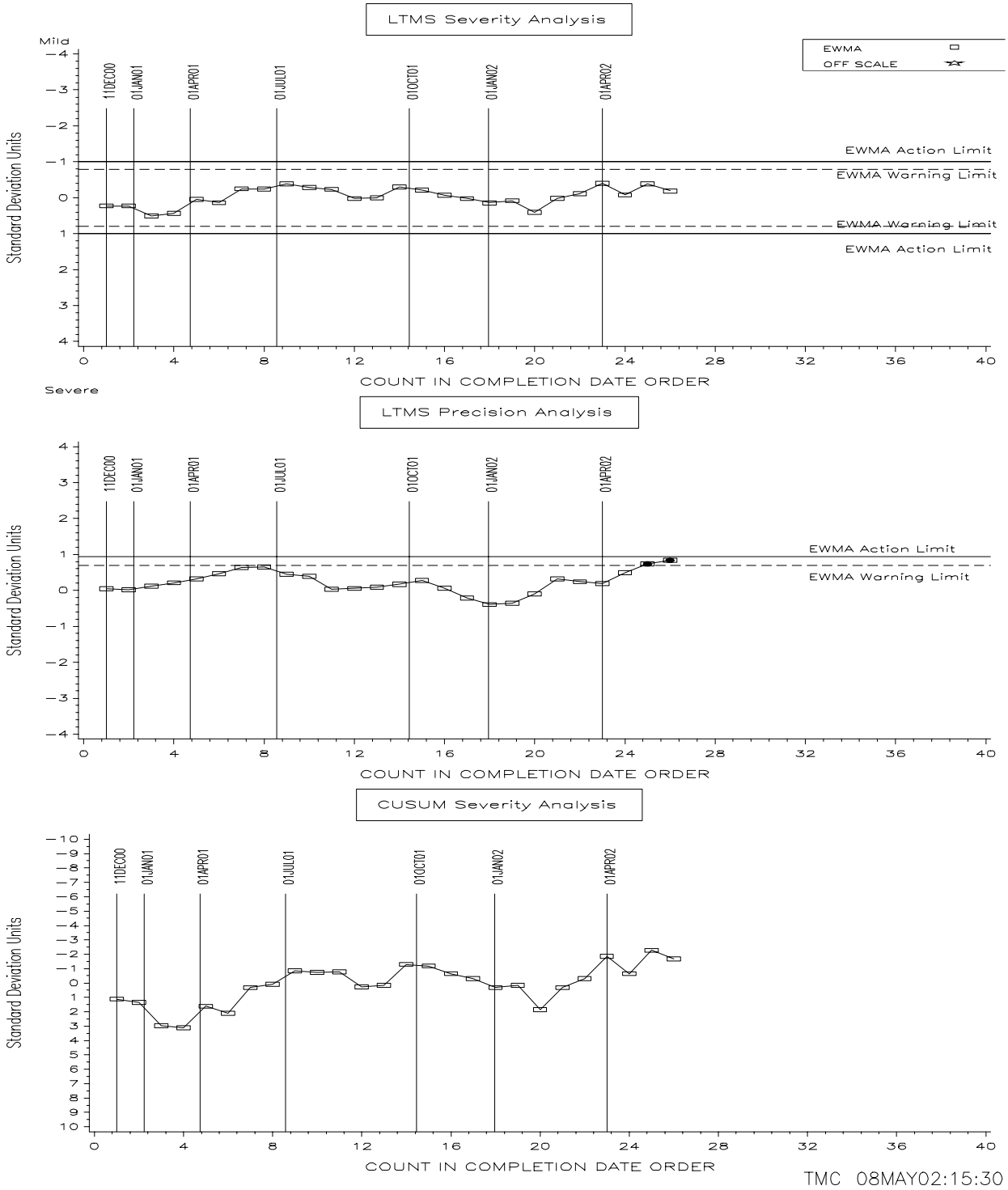


TABLE 5
CYLINDER LINER WEAR INDUSTRY ALARM LOG

April 22, 2002 to date. (Precision)

Two-tests have sound an industry warning alarm for precision. No indication yet if this is a true industry alarm.

Updated 5/8/02

FIGURE 3

T–10 INDUSTRY OPERATIONALLY VALID DATA

TOP RING WEIGHT LOSS

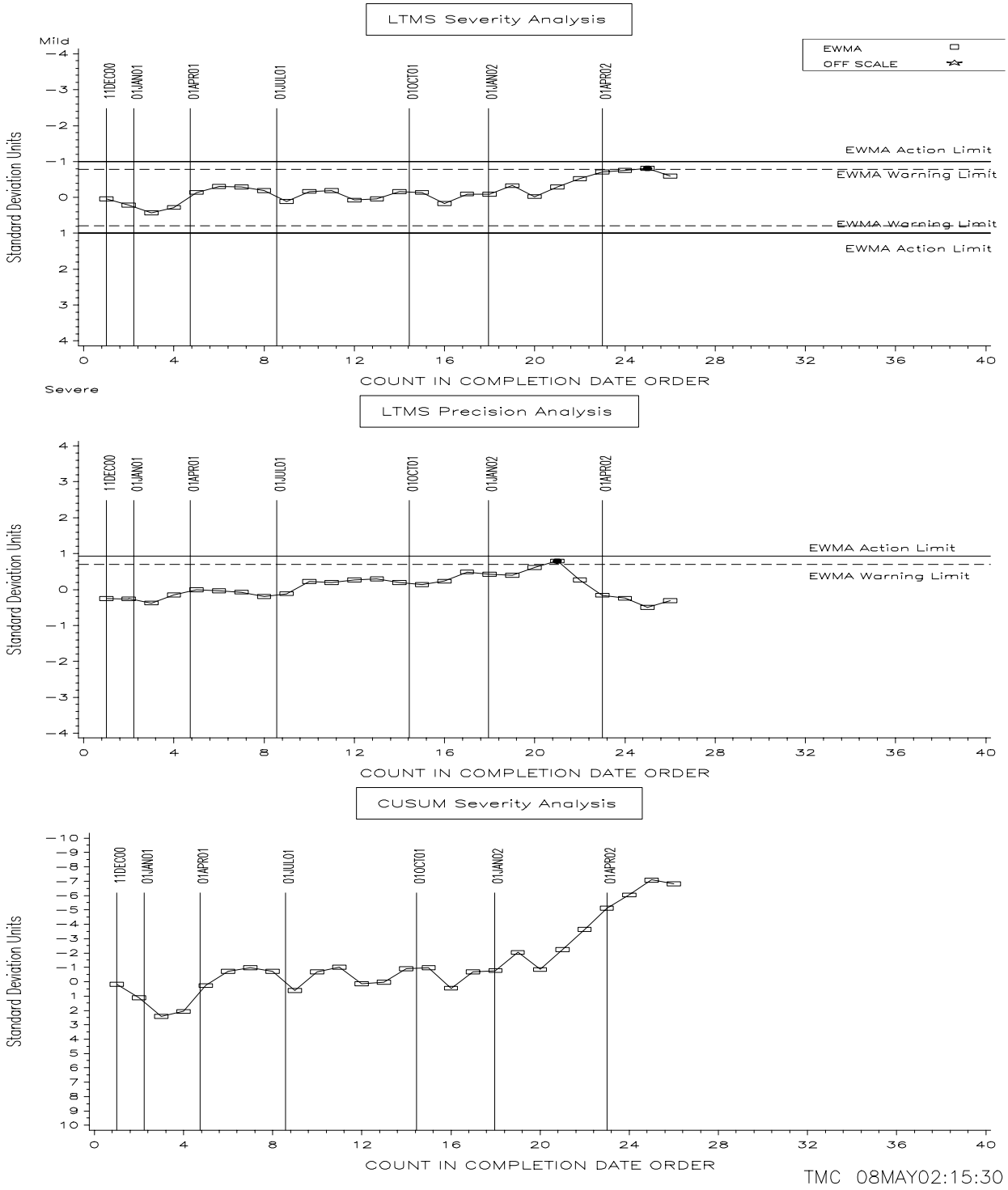


TABLE 6
TOP RING WEIGHT LOSS INDUSTRY ALARM LOG

March 22, 2002 to March 28, 2002 (Precision)

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

April 22, 2002 to April 27, 2002 (Severity, mild direction)

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

Updated 5/8/02

FIGURE 4

T–10 INDUSTRY OPERATIONALLY VALID DATA

OIL CONSUMPTION

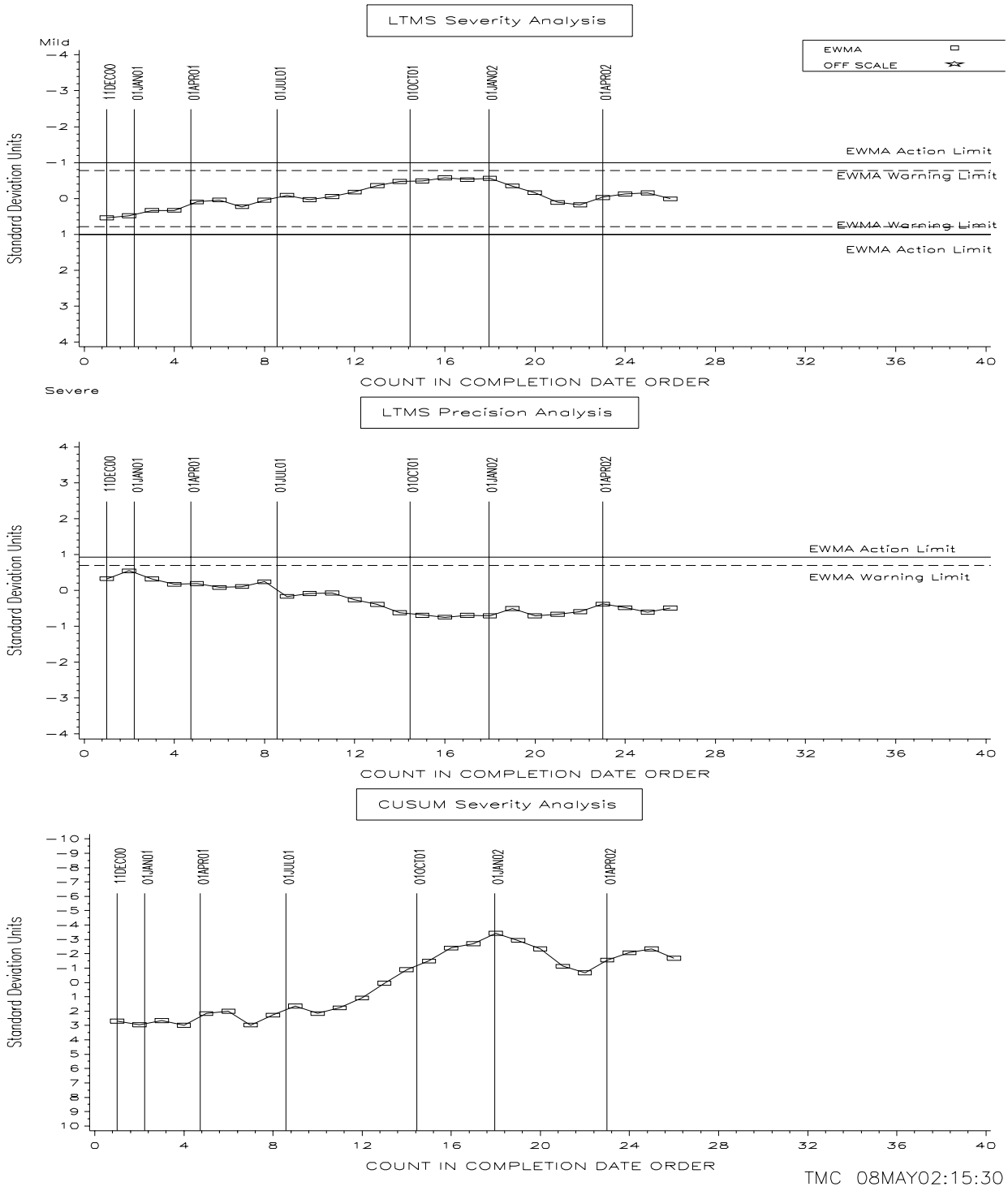


TABLE 7
OIL CONSUMPTION INDUSTRY ALARM LOG

No alarms have occurred.

Updated 5/8/02

FIGURE 5

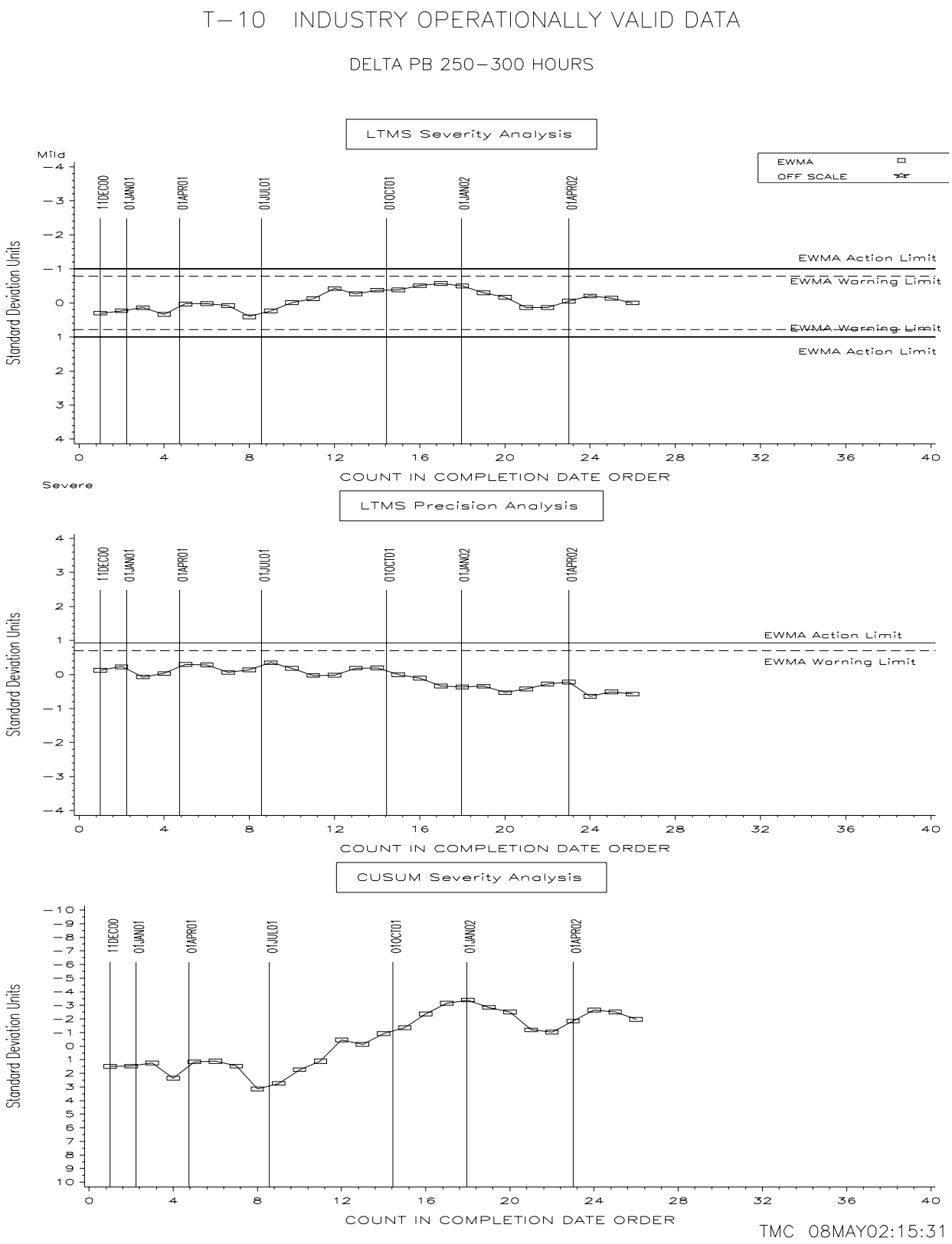

T–10 INDUSTRY OPERATIONALLY VALID DATA
DELTA PB 250–300 HOURS
LTMS Severity Analysis
Mild
Severe
Standard Deviation Units
EWMA
OFF SCALE
11DEC00
01JAN01
01APR01
01JUL01
01OCT01
01JAN02
01APR02
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
EWMA Action Limit
EWMA Warning Limit
COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
COUNT IN COMPLETION DATE ORDER
TMC 08MAY02:15:31

TABLE 8
DELTA PB 250-300 HOURS INDUSTRY ALARM LOG

No alarms have occurred.

Updated 5/8/02

FIGURE 6

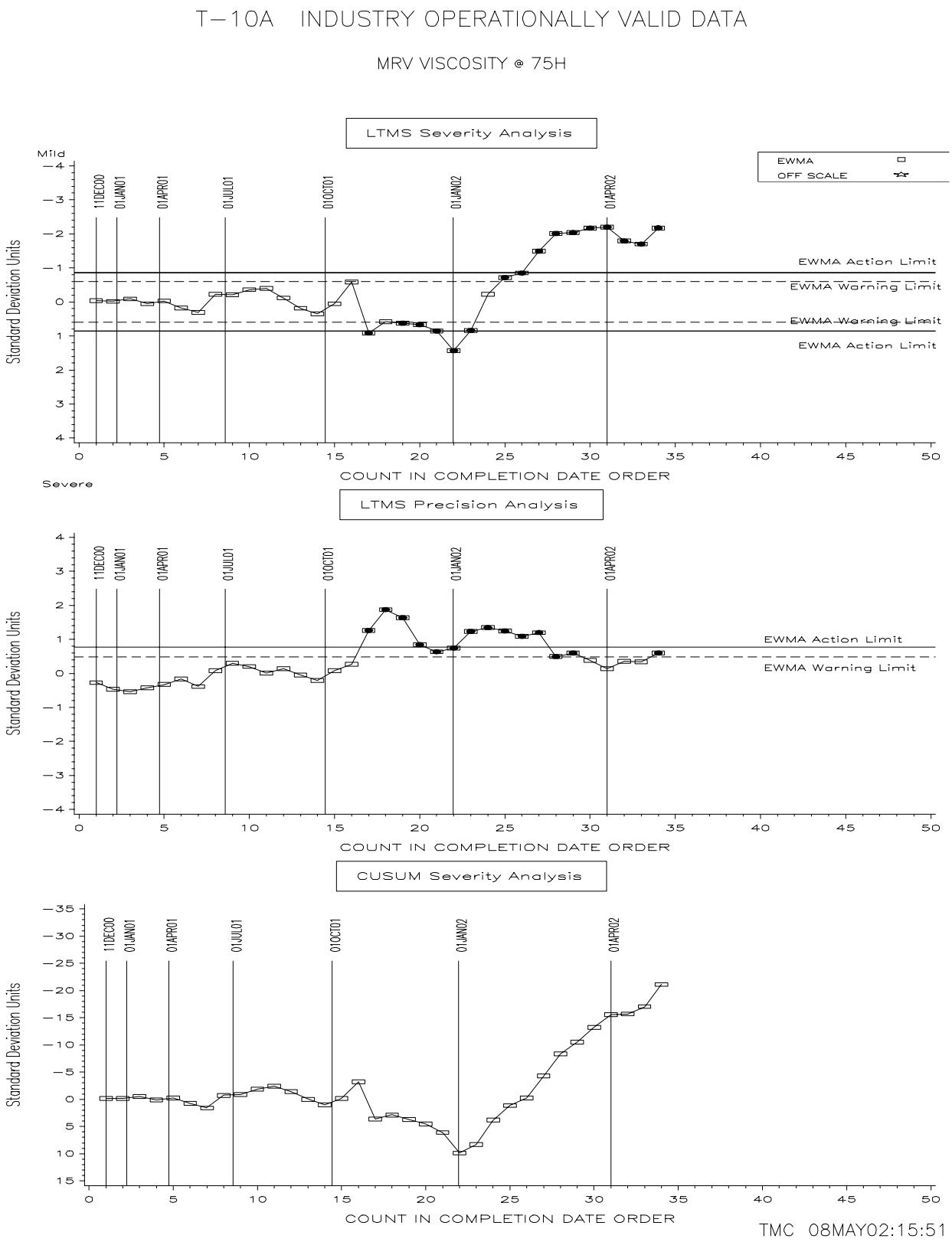

T—10A INDUSTRY OPERATIONALLY VALID DATA
MRV VISCOSITY @ 75H
LTMS Severity Analysis
Mild
Severe
Standard Deviation Units
EWMA
OFF SCALE
11DEC00
01JAN01
01APR01
01JUL01
01OCT01
01JAN02
01APR02
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
EWMA Action Limit
EWMA Warning Limit
COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
COUNT IN COMPLETION DATE ORDER
TMC 08MAY02:15:51

TABLE 9

MRV VISCOSITY INDUSTRY ALARM LOG

November 13, 2001 to January 29, 2002 (Severity, severe direction; Precision action)

A series of seven tests sounds industry warning and action alarms. Thought to be caused by a single result that was extremely severe (6.9 standard deviations). No industry related problem.

February 27, 2002 to date (Severity, mild direction; Precision warning)

A shift in results to the mild direction is observed, coincident with the introduction of oil 820-2. Surveillance panel to discuss target implementation to address mild trend.

Updated 5/8/02

TABLE 10
T-10/ T-10A TIMELINE

Date	IL No.	Topic
20000524		PROCEDURE PRELIMINARY DRAFT ISSUED
20000831		PROCEDURE DRAFT NO. 1 ISSUED
20001127		BEGINNING OF PC-9 MATRIX
20010703		COMPLETION OF PC-9 MATRIX
20010710		LABS EXPERIMENT WITH CONTROLLING EGR BASED ON CO2 INTAKE
20010809		EGR CONTROL SET WITH CO2 INTAKE; EXHAUST O2 USED FOR REPORT ONLY
20010816		INTAKE MANIFOLD TEMPERATURE SPEC FOR PHASE 1 CHANGED TO 70 DEGREES C
20010820		LTMS IMPLEMENTED
20010906		PROCEDURE DRAFT NO. 2 ISSUED
20011024		ABBREVIATED TEST T-10A APPROVED
20011029		PROCEDURE DRAFT NO. 3 ISSUED
20011105		OIL 820-1 INTRODUCED FOR TESTING
20011126		PROCEDURE DRAFT NO. 4 ISSUED
20011127		PROCEDURE DRAFT NO. 5 ISSUED
20020122		OIL 820-2 INTRODUCED FOR TESTING
20020305	02-1	ENGINE CALIBRATION REQUIREMENTS DROPPED; CALIBRATION DETERMINED BY STAND ONLY
20020305	02-1	MRV VISCOSITY TO BE MEASURED BY MODIFIED METHOD ONLY; SAMPLE HANDLING PER T-8 PROCEDURE
20020419	02-1	PROCEDURE DRAFT NO. 6 ISSUED