



# Test Monitoring Center

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MEMORANDUM: 03-034  
DATE: April 10, 2003  
TO: Wim Van Dam, Chairman, Mack Surveillance Panel  
FROM: Jeff Clark  
SUBJECT: T-10 / T-10A Calibration Testing for the April 2003 ASTM Report Period

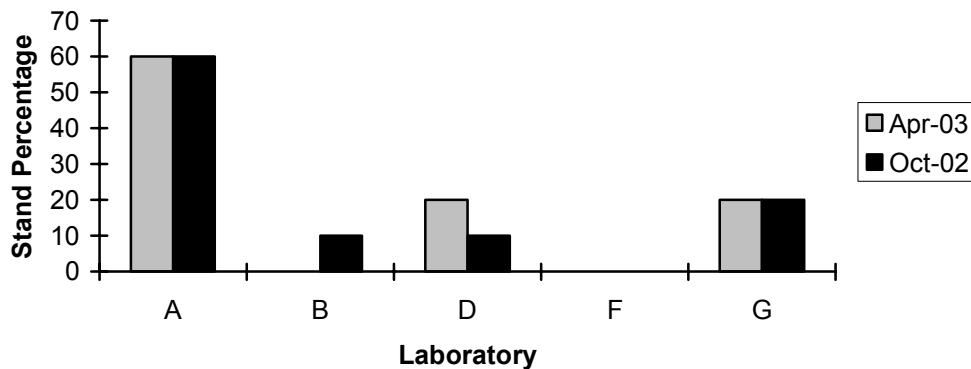
The following is a summary of T-10 reference oil tests completed during the April 2003 ASTM report period, which began on October 1, 2002 and ended on March 31, 2003.

### Lab / Stand Distribution:

	Reporting Data	Calibrated as of 3/31/03
Number of Laboratories	3	3
Number of Stands	5	5

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

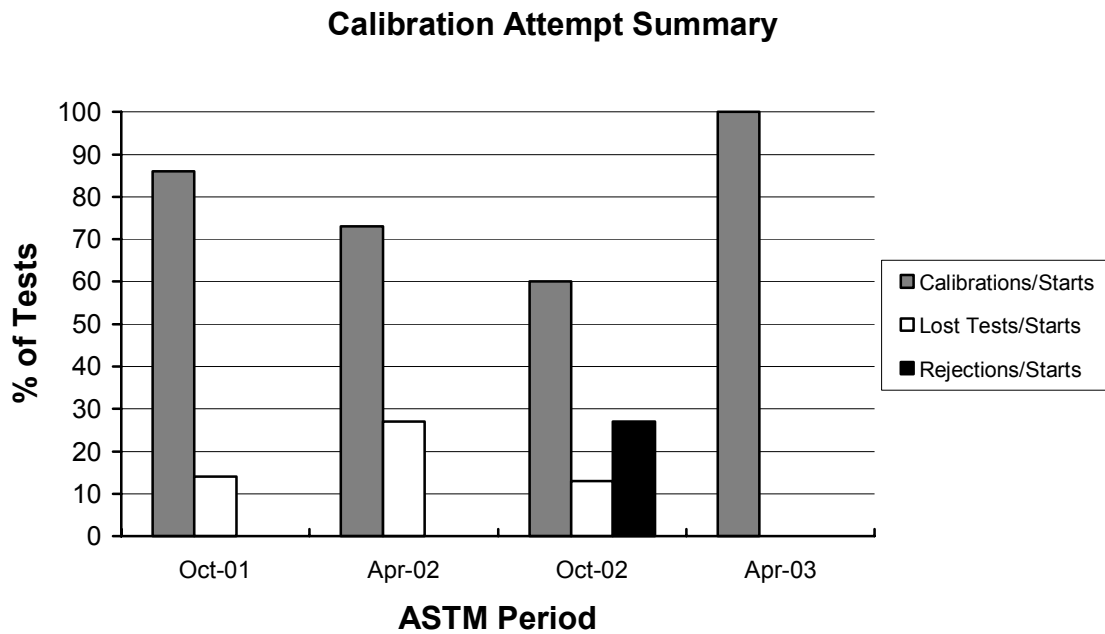
### Laboratory / Stand Distribution



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 T-10 Tests
Acceptable Calibration Test	AC	4
Failed Calibration Test (LTMS Criteria)	OC	0
Operationally Invalid Calibration Test	LC	0
Aborted Calibration Test	XC	0
Industry Donated Test, not for calibration	AG	1
Total		5

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

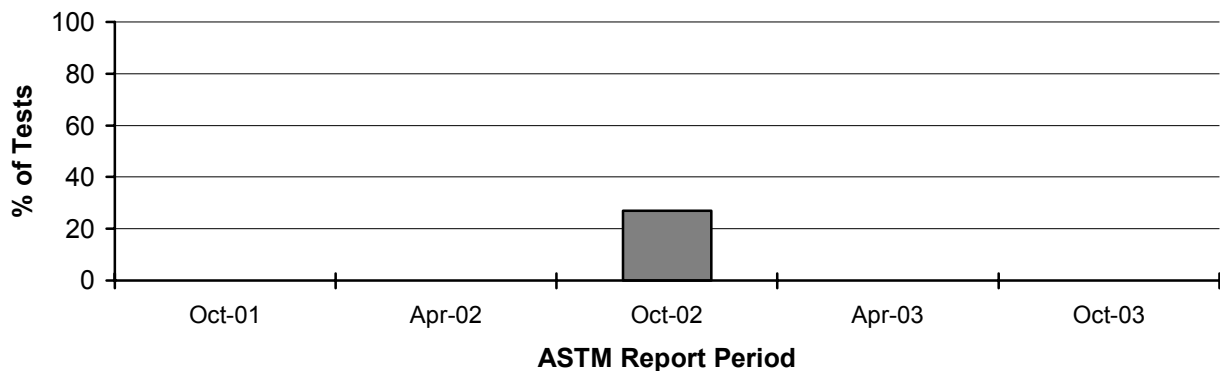


A detailed list of reasons tests failed the acceptance criteria (OC validity) is shown in Table 1. Table 2 lists the operationally invalid tests (LC validity) and Table 3 lists the aborted tests (XC validity).

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:

### Tests Failing LTMS Acceptance Criteria



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 this period, PB is trending an average of 0.54  $\Delta/s$  mild. This is equivalent to 0.13 natural log units or approximately 4 ppm at the CI-4 Merit Rating Target value of 30 ppm. 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). CLW is currently in control. For this period, CLW is trending an average of 0.34  $\Delta/s$  severe. This is equivalent to 1.4 microns. For a history of CLW industry alarms, refer to the industry alarm log shown in Table 5.

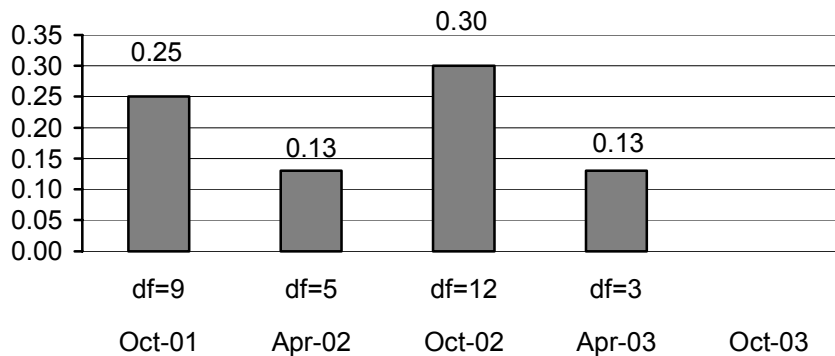
Figure 3 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Top Ring Weight Loss (TRWL). TRWL is currently in control. For this period, TRWL is trending an average of 0.19  $\Delta/s$  severe, or approximately 3 mg. For a history of TRWL industry alarms, refer to 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 this period, OC is trending an average of 0.45  $\Delta/s$  severe. This is equivalent to 3.2 g/hr. For a history of OC industry alarms, refer to the industry alarm log shown in Table 7.

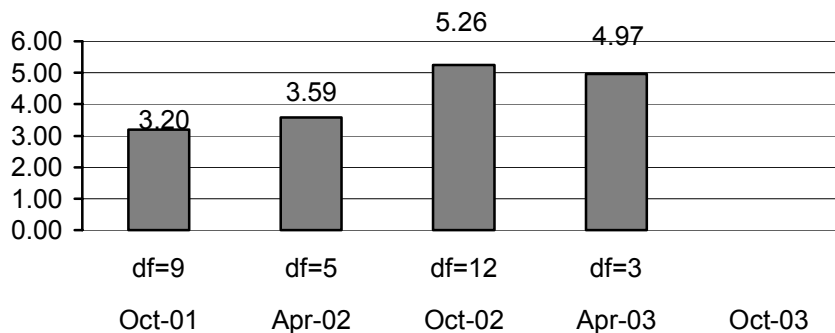
Figure 5 (attached) shows the current industry EWMA severity, EWMA precision, and cusum charts for Delta Pb 250-300 Hours (PB2). PB2 is currently in control. For this period, PB2 is trending an average of 0.21  $\Delta/s$  mild. This is approximately 1 ppm. For a history of PB2 industry alarms, refer 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.

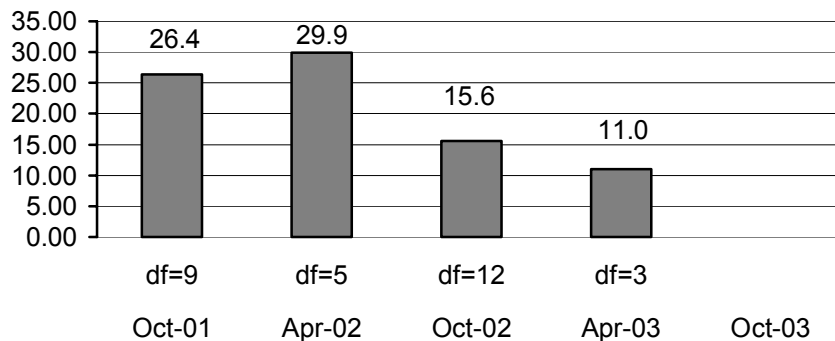
### Delta PB @ EOT Pooled Precision



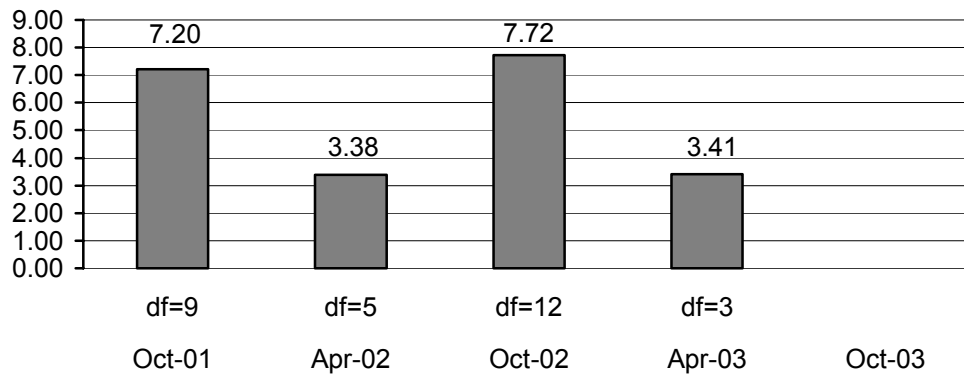
### Cylinder Liner Wear Pooled Precision



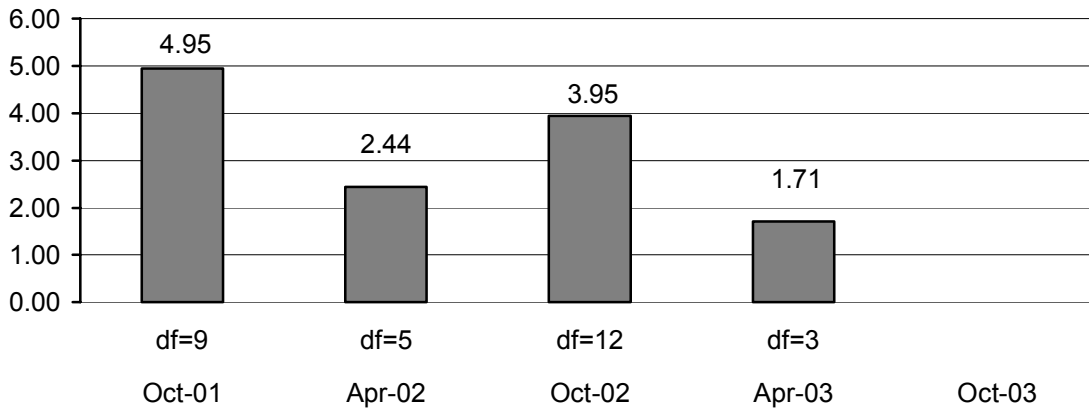
### Top Ring Weight Loss Pooled Precision



### Oil Consumption Pooled Precision



### Delta PB 250-300 Hours Pooled Precision



All parameters show improvement in precision compared with the previous period. CLW is within historical levels and the other four parameters are at or near historical lows in variability. The reduced numbers of degrees of freedom for this period make it difficult to offer meaningful commentary regarding these precision estimates. 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 in the following table.

**T-10 Reference Oil Test Targets**

Oil	N	Parameter	Mean (cSt)	S
820-2	20	PB	3.2106	0.2339
		CLW	32.0	4.2
		TRWL	109	18
		OC	52.9	7.2
		PB2	9.0	3.5

Once 30 tests on oil 820-2 have been completed, the TMC will provide a target update for surveillance panel consideration.

Abbreviated Length Test T-10A:

The TMC monitors the T-10A for the determination of laboratory severity adjustments for MRV viscosity. For this period, five T-10A calibration tests were run. Four of these were in conjunction with T-10 references. Figure 6 (attached) shows the current industry EWMA severity, EWMA precision, and CUSUM charts for MRV viscosity. MRV viscosity is currently in a severity warning alarm in the severe direction. For this period, MRV is trending an average of 0.91  $\Delta$ /s severe. This is equivalent to 452 cP. For a history of MRV viscosity industry alarms, refer to the industry alarm log shown in Table 9.

Information Letters:

T-10 Information Letter 03-1, Sequence No. 3 was issued February 14, 2003. Topics included oil pump part number, thrust washers, and conrod bearing part numbers.

TMC Laboratory Visits:

Four TMC laboratory visits were conducted this ASTM period. A total of 20 deficiencies were noted, and those deficiencies are summarized in the table below.

Deficiency	Number of Labs
Brass fittings used in auxiliary oil system	1
Wrong intake air filter element and housing	1
Temperature calibration tolerance exceeds 0.5°C specification	1
EGR Pre-Venturi temperature thermocouple upstream of pressure tap	1
Instrumentation calibration range does not bracket operating range	3
Pressure calibration tolerance excessively large	1
Ring cleaning procedure not being followed – no walnut shell blasting	1
Engine coolant system not using Pencool 3000	1
Incorrect Severity Adjustment applied	2
Precision alarm notification and documentation requirements not followed	2
Improper exhaust temperature thermocouple insertion depth	1
Coolant-In thermocouple improperly located	1
Intake manifold pressure and temperature sensors reversed	1
6" thermocouple used in oil sump temperature (4" specified)	1
Blowby line does not maintain downward slope away from engine	1
Oil sump level sight glasses being used***	1

\*\*\* The procedure does not address the use of sight glasses. The surveillance panel needs to determine if this practice is acceptable.

Quality Index:

Quality Index has not yet been implemented for the T-10. The T-10 O&H group has reviewed industry capability for the T-10 control parameters. Based on this review, the TMC has submitted a Quality Index proposal to the surveillance panel for consideration. To date, the surveillance panel has not taken action on this proposal.

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/mem03-034.jac.doc

Attachments

c: J.L. Zalar, TMC  
F.M. Farber, TMC  
Mack Surveillance Panel  
<ftp://ftp.astmtmc.cmu.edu/docs/diesel/mack/semiannualreports/T10-04-2003.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
No invalid tests	-

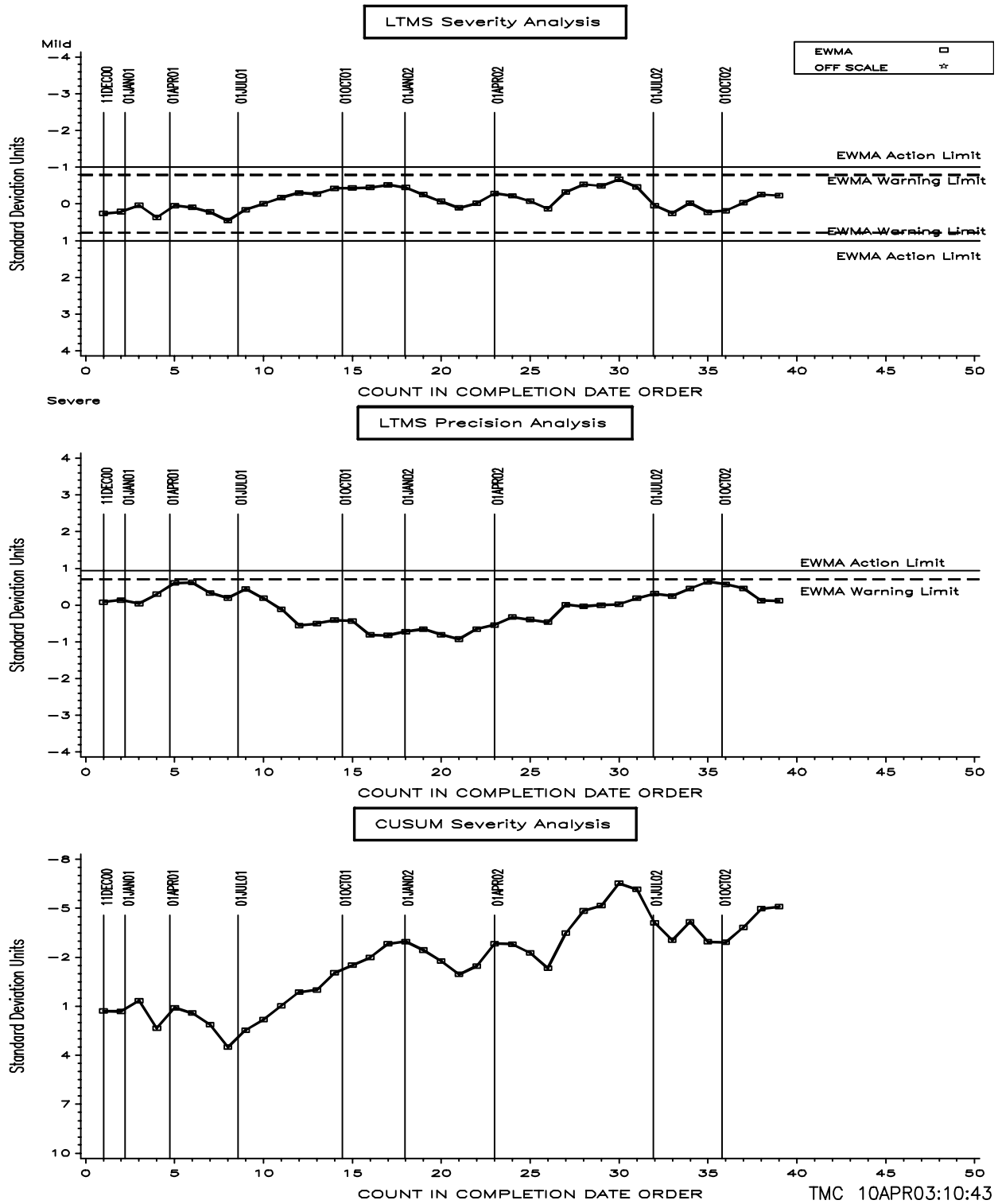
**Table 3**  
**Summary of Reasons for Aborted Tests**

	No. of Tests
No aborted tests	-



**FIGURE 1**  
T-10 INDUSTRY OPERATIONALLY VALID DATA

DELTA PB • EOT



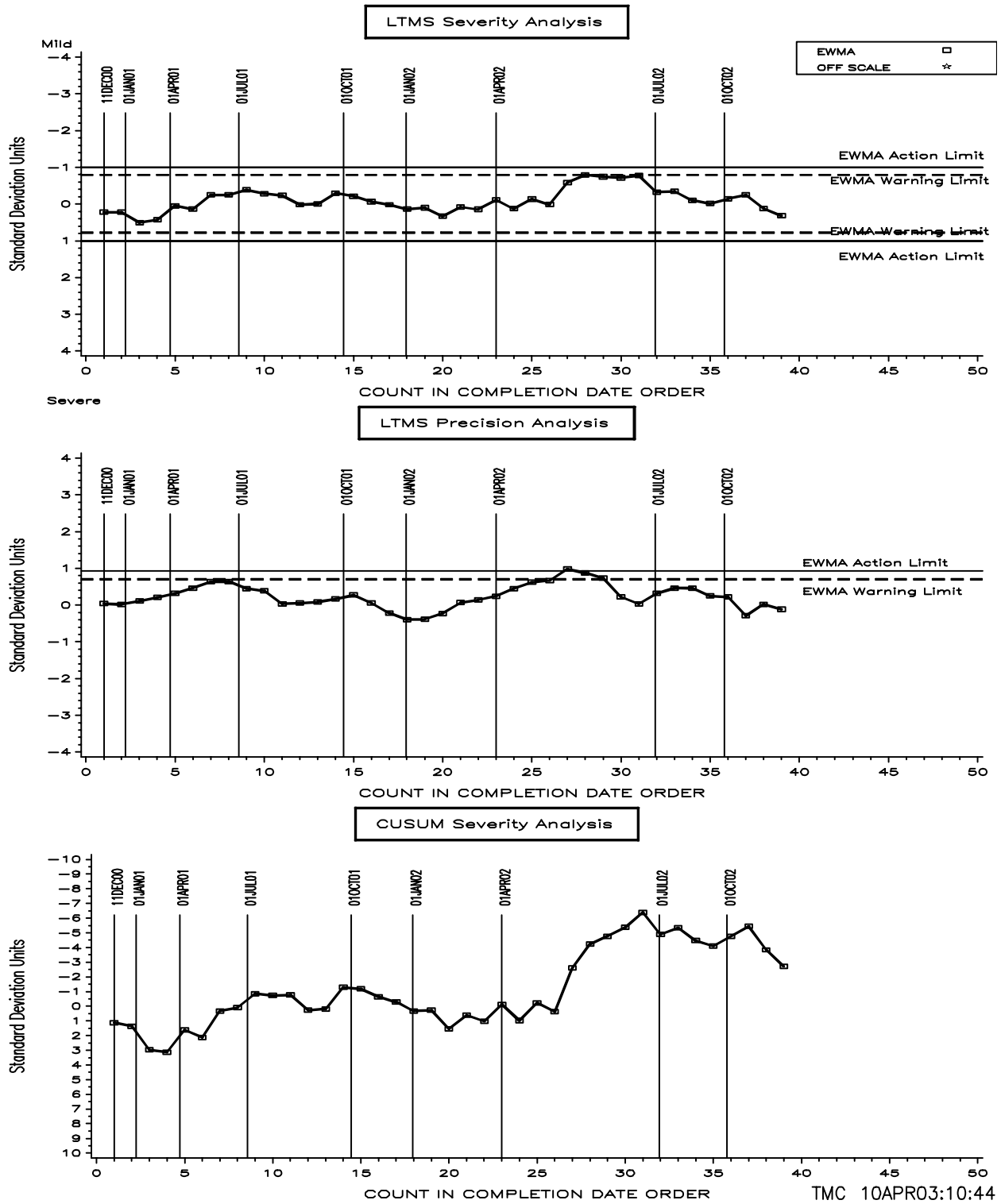
**TABLE 4**  
**DELTA PB @ EOT INDUSTRY ALARM LOG**

No alarms have occurred.

Updated 4/10/03

**FIGURE 2**  
T-10 INDUSTRY OPERATIONALLY VALID DATA

CYLINDER LINER WEAR



**TABLE 5**  
**CYLINDER LINER WEAR INDUSTRY ALARM LOG**

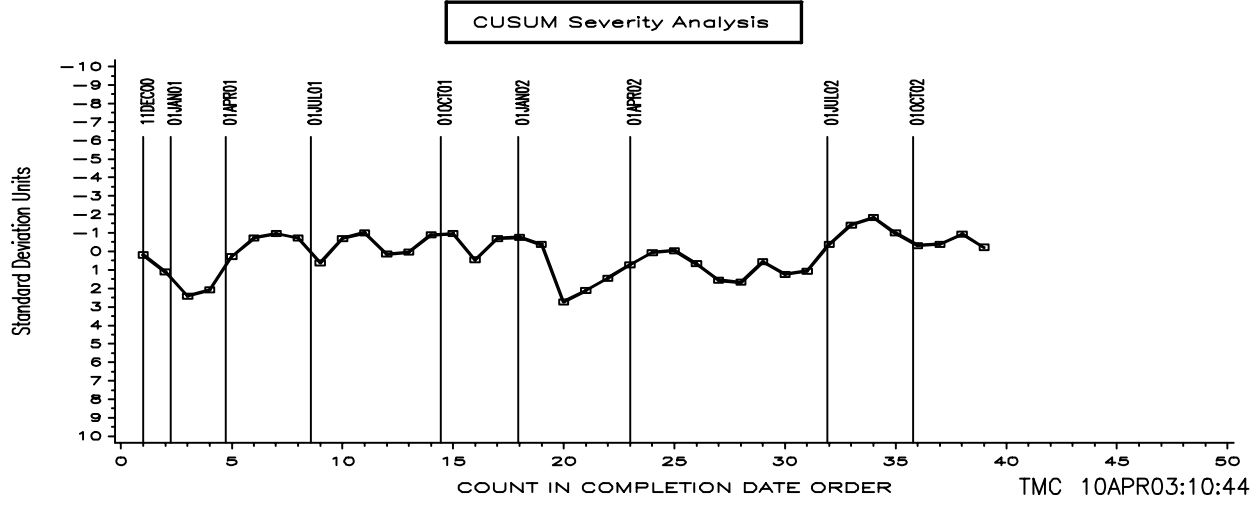
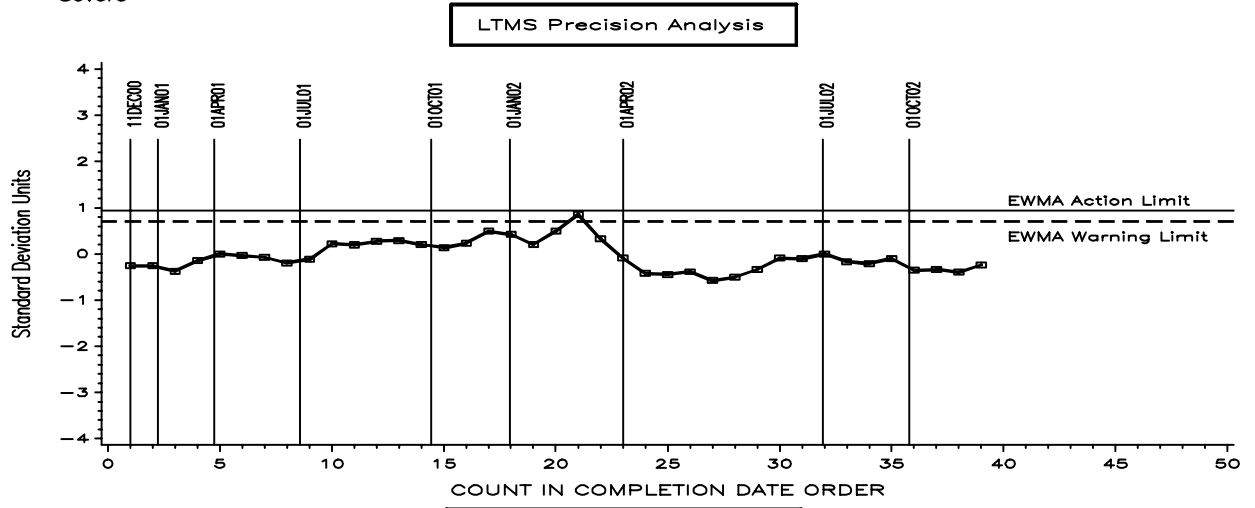
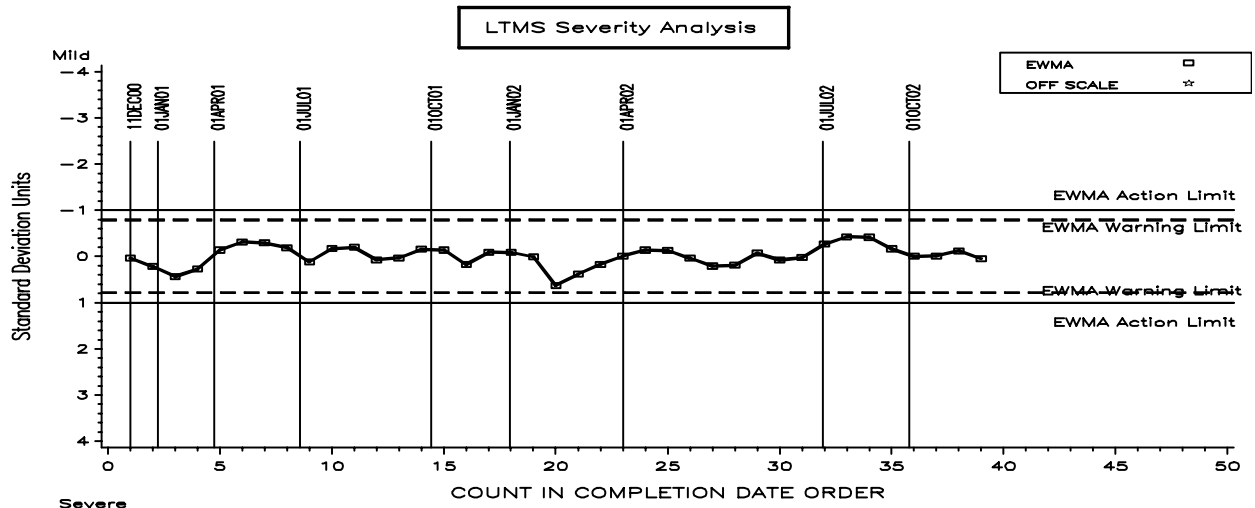
**May 1, 2002 to June 2, 2002 (Precision)**

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

Updated 4/10/03

**FIGURE 3**  
T-10 INDUSTRY OPERATIONALLY VALID DATA

TOP RING WEIGHT LOSS



**TABLE 6**  
**TOP RING WEIGHT LOSS INDUSTRY ALARM LOG**

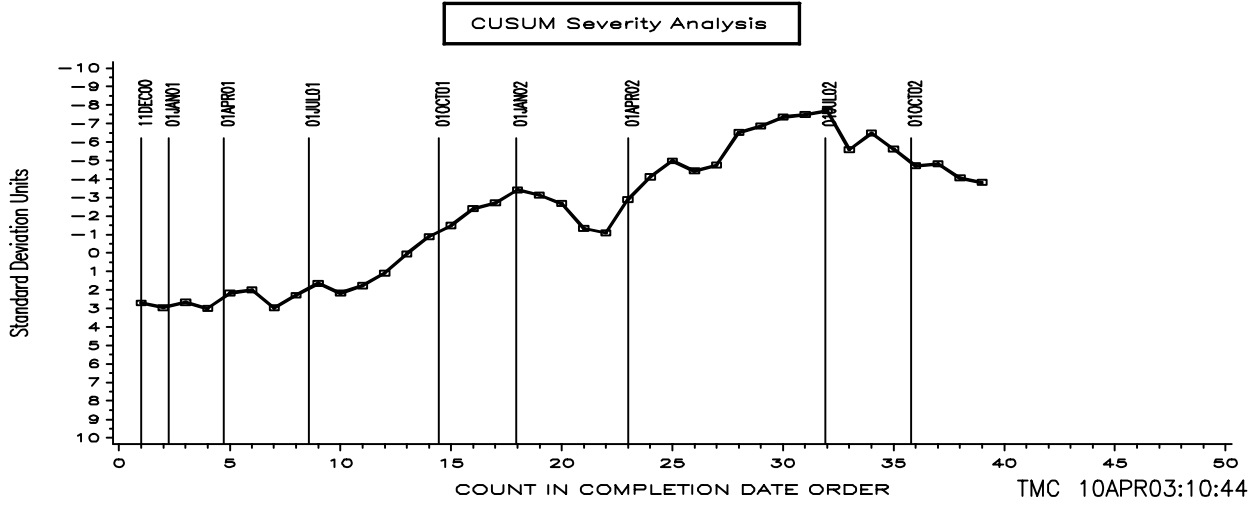
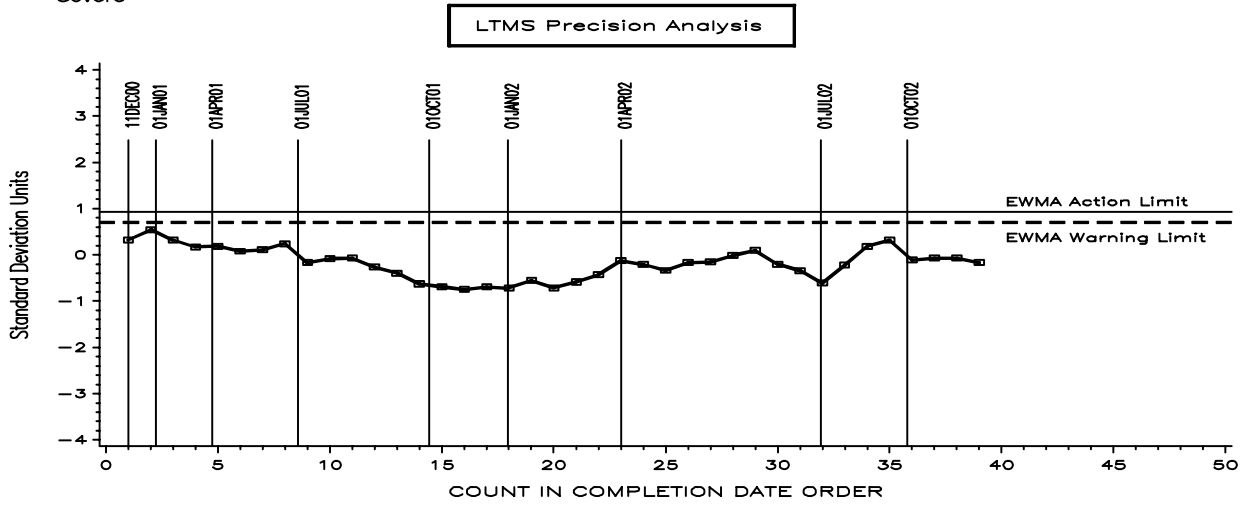
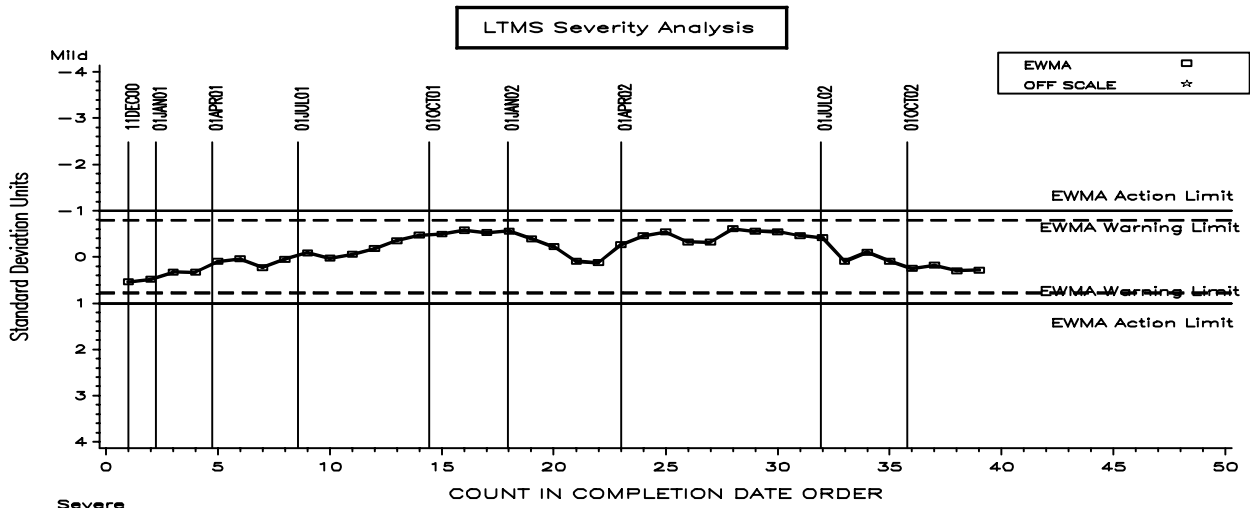
**March 20, 2002 to March 26, 2002 (Precision)**

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

Updated 4/10/03

**FIGURE 4**  
T-10 INDUSTRY OPERATIONALLY VALID DATA

OIL CONSUMPTION



**TABLE 7**  
**OIL CONSUMPTION INDUSTRY ALARM LOG**

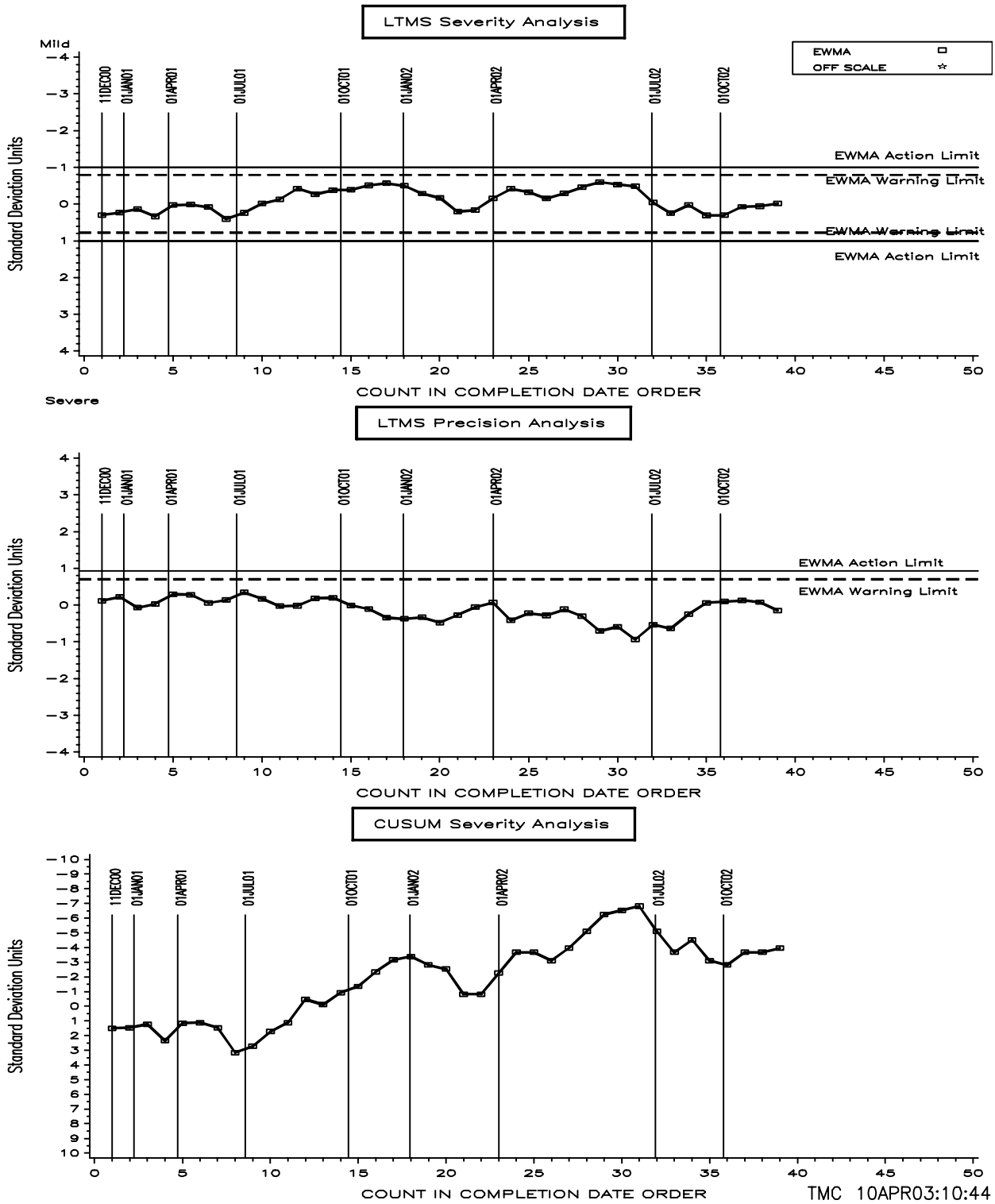
No alarms have occurred.

Updated 4/10/03



**FIGURE 5**  
T-10 INDUSTRY OPERATIONALLY VALID DATA

DELTA PB 250-300 HOURS



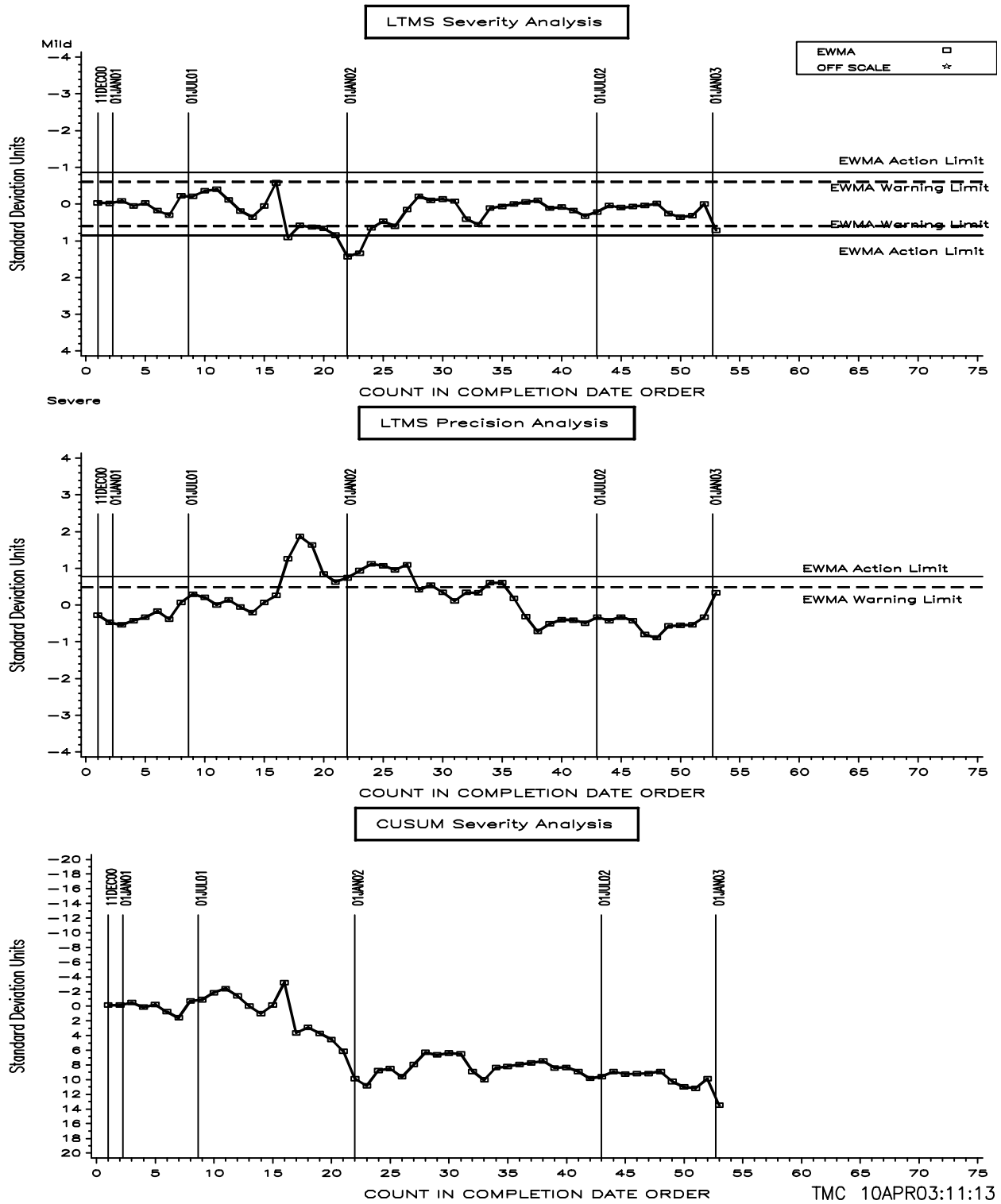
**TABLE 8**  
**DELTA PB 250-300 HOURS INDUSTRY ALARM LOG**

No alarms have occurred.

Updated 4/10/03

**FIGURE 6**  
T10A INDUSTRY OPERATIONALLY VALID DATA

MRV VISCOSITY @ 75H



## **TABLE 9**

### **MRV VISCOSITY INDUSTRY ALARM LOG**

#### **November 13, 2001 to March 26, 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.

#### **April 22, 2002 to May 1, 2002 to date (Precision warning)**

A two-test excursion occurs. No indication of a true industry problem.

#### **March 20, 2003 to Date (Severity, severe direction)**

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

Updated 4/10/03

**TABLE 10**  
**T-10/ T-10A TIMELINE**

<b>Date</b>	<b>Info. Letter</b>	<b>Event</b>
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 DEG C
20010820		LTMS IMPLEMENTED
20010906		PROCEDURE DRAFT NO.2 ISSUED
20011024		ABBREVIATED TEST T-10A APPROVED
20011029		PROCEDURE DRAFT NO. 3 ISSUED
20011105		REFERENCE OIL 820-1 INTRODUCED FOR TESTING
20011126		PROCEDURE DRAFT NO.4 ISSUED
20011127		PROCEDURE DRAFT NO. 5 ISSUED
20020122		REFERENCE OIL 820-2 INTRODUCED FOR TESTING
20020305	02-1	ENGINE CALIBRATION REQUIREMENT 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
20020517		T-10A TARGETS UPDATED; 14 TESTS ON OIL 820-2
20020617		T-10 TARGETS UPDATED; 12 TESTS ON OIL 820-2
20020722	02-2	T-10A FLUSH-N-RUN REBUILD SET AT THREE CALIBRATION PERIODS OR 1350 TEST HOURS
20020722	02-2	INJECTOR OPENING PRESSURE TO BE CHECKED EACH CALIBRATION PERIOD (AT REBUILD FOR T-10A)
20020925		T-10A TARGETS UPDATED; 26 TESTS ON OIL 820-2
20020925		T-10 TARGETS UPDATED; 16 TESTS ON OIL 820-2
20020925		PHASE-IN APPROVED FOR NEW EXHAUST MANIFOLD DESIGN AND STAINLESS STEEL VENTURI
20020925	02-2	OUTLIER SCREENING PROFILES UPDATED FOR CLW AND TRWL
20030122		T-10A TARGETS UPDATED; 30 TESTS ON OIL 820-2
20030122		T-10 TARGETS UPDATED; 20 TESTS ON OIL 820-2
20030214	03-1	OIL PUMP AND CONROD BEARING PART NUMBERS UPDATED; THRUST WASHERS ADDED TO CRITICAL PARTS LIST