



Test Monitoring Center

6555 Penn Avenue
Pittsburgh, PA 15206-4489
(412) 365-1000

MEMORANDUM: 02-072
DATE: October 1, 2002
TO: Wim Van Dam, Chairman, Mack Test Surveillance Panel
FROM: Jeff Clark
SUBJECT: T-9 Calibration Testing for the October 2002 ASTM Report Period

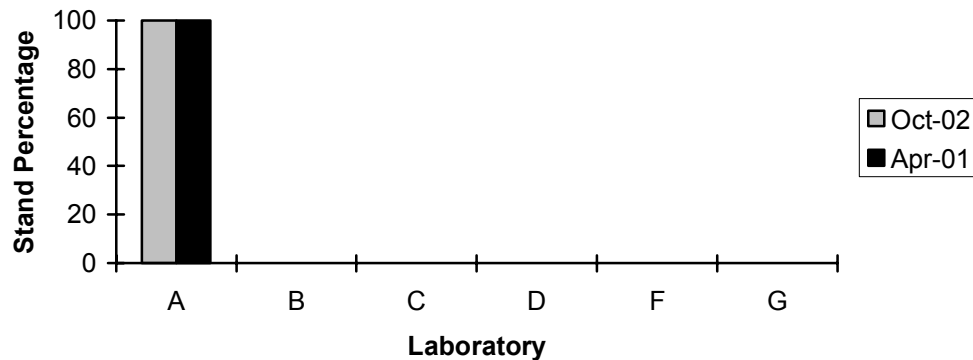
Two T-9 reference oil tests were completed during the October 2002 ASTM report period, which began on April 1, 2002 and ended on September 30, 2002.

Lab / Stand Distribution:

	Reporting Data	Calibrated as of 9/30/02
Number of Laboratories	1	1
Number of Stands	2	2

The following chart shows the laboratory / stand distribution for tests completed this report period:

Laboratory / Stand Distribution

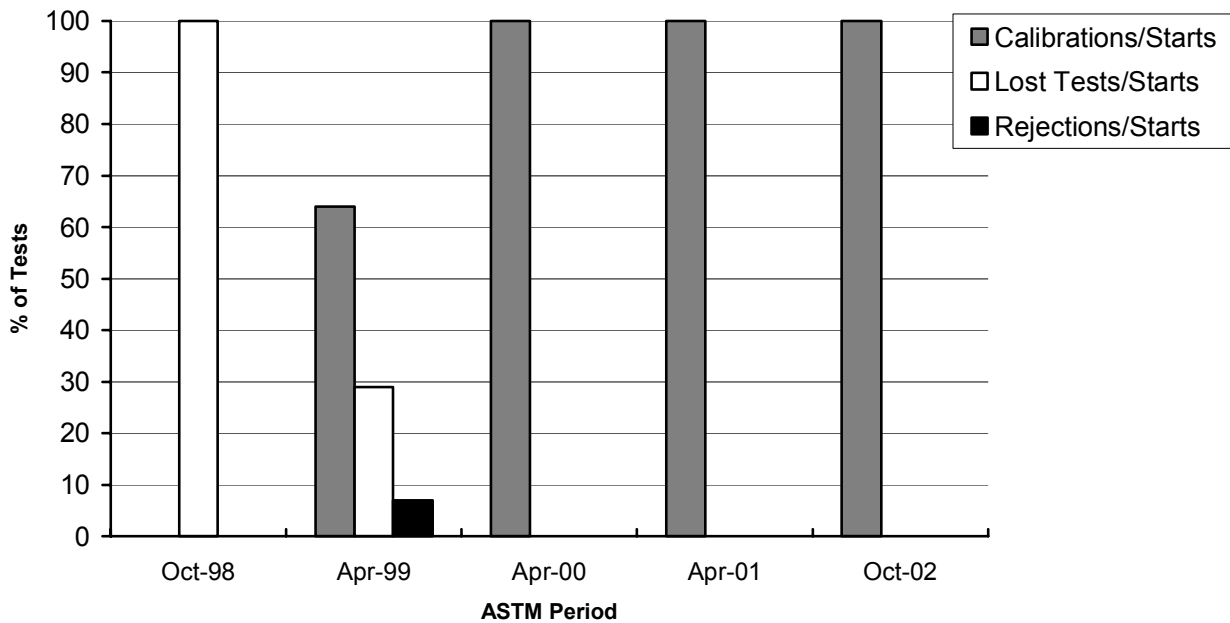


The following summarizes the status of the reference oil tests completed this ASTM report period:

Test Status	TMC Validity Code	Number of Tests
Operationally and Statistically Acceptable	AC	2
Failed LTMS Acceptance Criteria	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		2

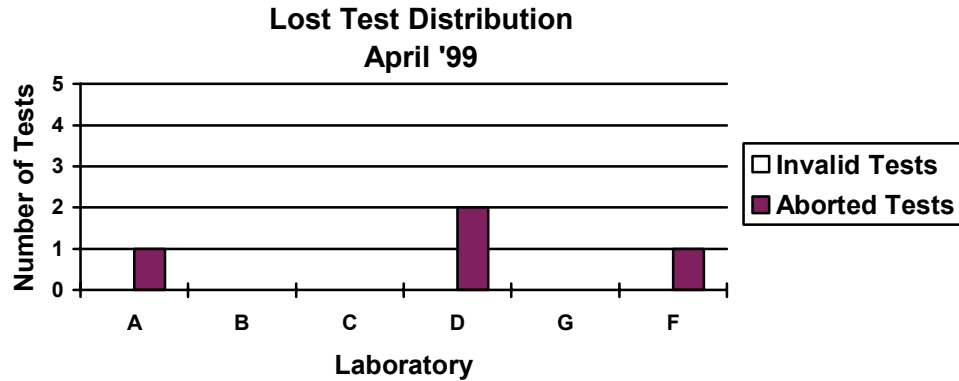
Calibrations per start, lost tests per start and rejections per start rates are summarized below:

Calibration Attempt Summary



“Engineering Judgment” was not applied in the interpretation of LTMS guidelines during this report period. A total of three LTMS deviations have been issued in the history of the T-9 test.

Table 1 lists the reasons any test failed the acceptance criteria. A detailed list of reasons for operationally invalid tests is shown in Table 2. Table 3 lists the reasons for aborted tests during this report period. No aborted or operationally invalid tests have been reported since the April '99 report period. Aborted and operationally invalid tests by laboratory for the April '99 report period are summarized with the following chart:



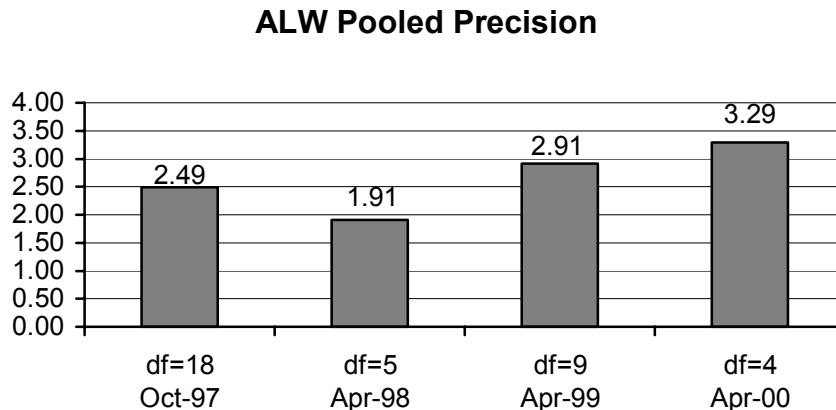
Severity and Precision:

Figure 1 shows the current industry EWMA severity, EWMA precision, and cusum charts for Adjusted Liner Wear (ALW). ALW is currently within control chart limits. For this period, ALW is trending an average of 0.16 Δ/s severe. This is equivalent to 0.46 microns. For a history of ALW industry alarms, refer to the industry alarm log shown in Table 4.

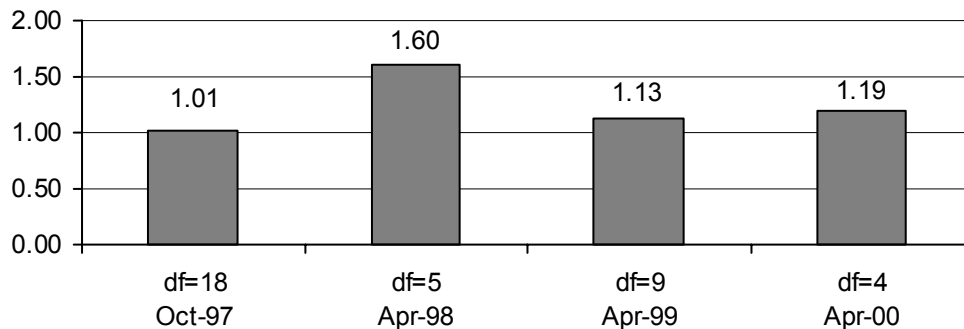
Figure 2 shows the current industry EWMA severity, EWMA precision, and cusum charts for Delta Pb. Delta Pb is currently within control chart limits. However, since January 2001, Delta Pb is trending an average of -1.46 Δ/s mild. This is equivalent to 1.64 square root units or 12 ppm at the CH-4 single-test pass/fail limit. For a history of Delta Pb industry alarms, refer to the industry alarm log shown in Table 5.

Figure 3 shows the current industry EWMA severity, EWMA precision, and cusum charts for Top Ring Weight Loss (TRWL). TRWL is currently within control chart limits. For this period, TRWL is trending an average of 0.77 Δ/s mild. This is equivalent to 12.9 mg. For a history of TRWL industry alarms, refer to the industry alarm log shown in Table 6.

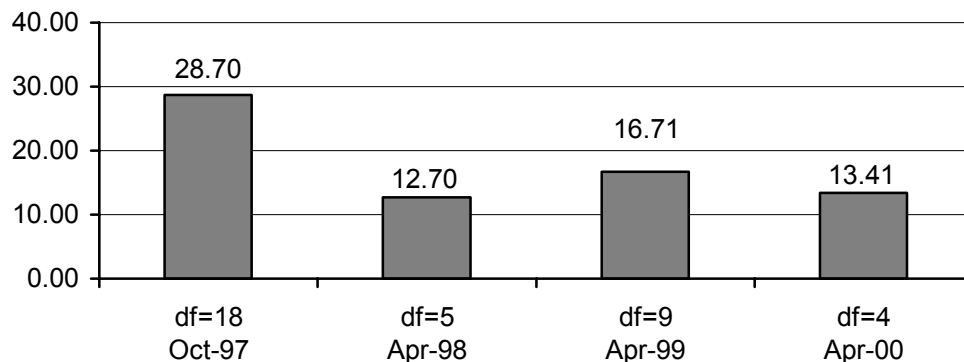
Precision, as estimated by the pooled standard deviation, is shown in the following figures. Due to low test volume, no estimate is available since the April '00 period. The April '00 ALW precision estimate shows some degradation compared to historical levels. The Delta Pb precision estimate is comparable to historical levels. The precision estimate for TRWL is comparable to recent levels. For future comparison purposes, the TMC will continue to report precision by ASTM period.



Delta Pb Pooled Precision



TRWL Pooled Precision



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

Reference Oils and Hardware:

The following table shows the current T-9 reference oil test targets:

Parameter	Oil	N	Mean (cSt)	s
ALW (microns)	1005	-	24.4700	2.3500
	1005-1	10	24.6400	2.9064
Delta Pb (trans. units)	1005	-	5.7970	1.2030
	1005-1	10	7.2980	1.1251
TRWL (mg)	1005	-	84.3400	29.2900
	1005-1	10	93.7000	16.7136

As previously reported, a correction factor for TRWL has been implemented due to a severity shift associated with a new top piston ring design that was introduced into the T-9 test in December 1998. The correction factor was introduced May 1, 1999 and was updated January 1, 2000, and again July 1, 2001. The correction factor applies to all tests, both candidate and calibration, run on the new top piston ring hardware. The correction factor history is shown in the table below:

Parameter	N	Correction Factor (mg)	Effective Date
TRWL	3	34.1769	19990501
TRWL	5	36.9000	20000101
TRWL	10	31.4000	20010701

Information Letters:

No information letters were issued this ASTM period.

Quality Index:

No Quality Index deviations were issued this ASTM period. For the history of the T-9 test, no Quality Index deviations have been issued.

TMC Laboratory Visits:

No TMC laboratory visits were conducted this ASTM period.

Additional Information:

Table 7 contains the T-9 Timeline which details changes to the test since January 1, 1997.

The T-9 database, for operationally valid calibration tests, can be accessed from the TMC's web site at <http://www.astmtmc.cmu.edu>.

JAC/jac/mem02-072.jac.doc

Attachments

c: J.L. Zalar, TMC
F.M. Farber, TMC
Mack Surveillance Panel
<ftp://ftp.astmtmc.cmu.edu/docs/diesel/mack/semiannualreports/T9-10-2002.pdf>

distribution: Email

Table 1

Summary of Reasons for Rejected Tests

	No. of Tests
No statistically rejected tests this ASTM period	-

Table 2

Summary of Reasons for Invalid Tests

	No. of Tests
No invalid tests this ASTM report period	-

Table 3

Summary of Reasons for Aborted Tests

	No. of Tests
No aborted tests this ASTM report period	-

FIGURE 1
T9 INDUSTRY OPERATIONALLY VALID DATA
ADJUSTED LINER WEAR

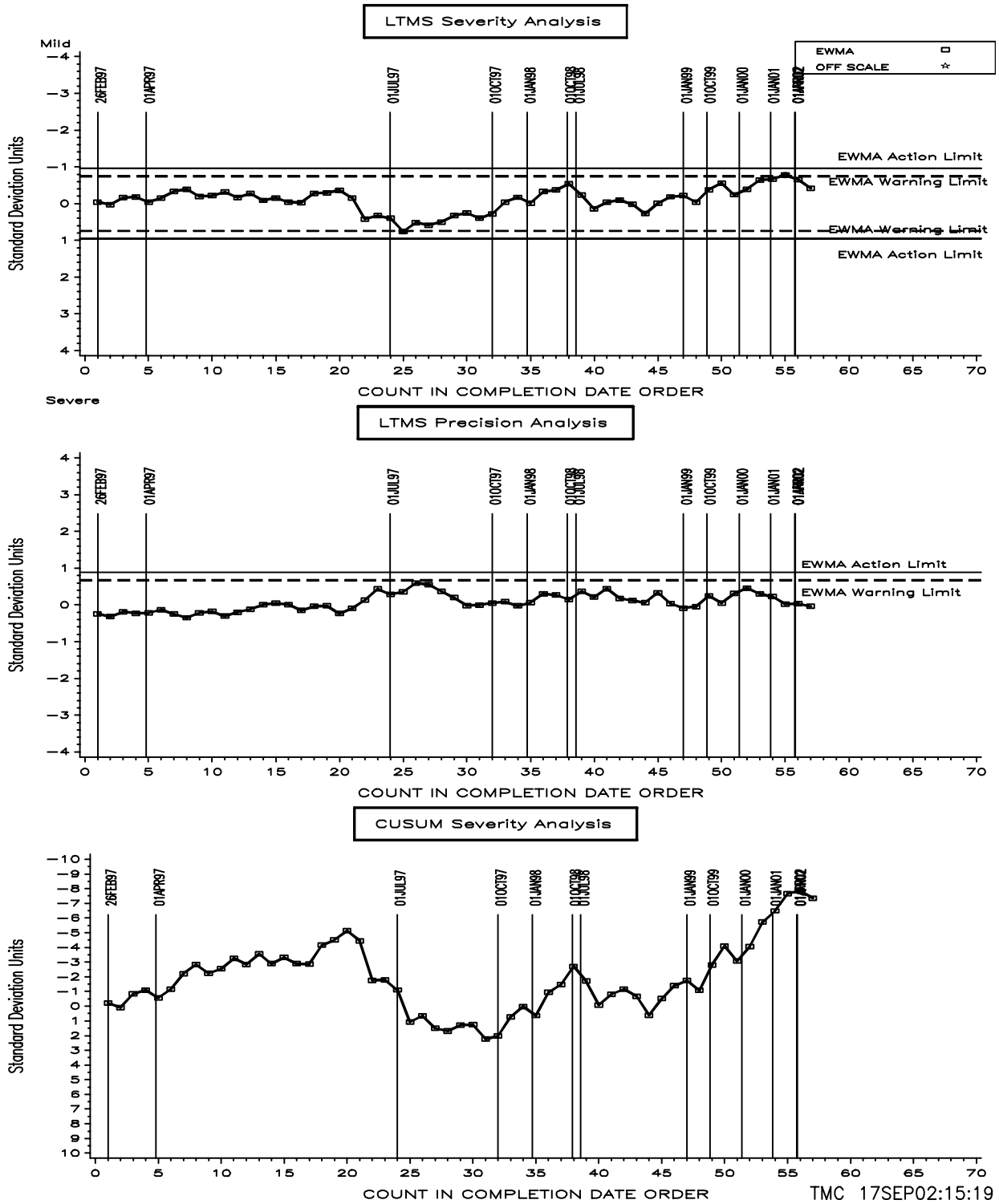


TABLE 4
T-9 AVERAGE LINER WEAR INDUSTRY ALARM LOG

July 6, 1997 to July 10, 1997 (Severity, Severe direction)

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

March 30, 2001 to April 12, 2002 (Severity, Mild direction)

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

Updated 9/17/02

FIGURE 2
T9 INDUSTRY OPERATIONALLY VALID DATA
DELTA PB

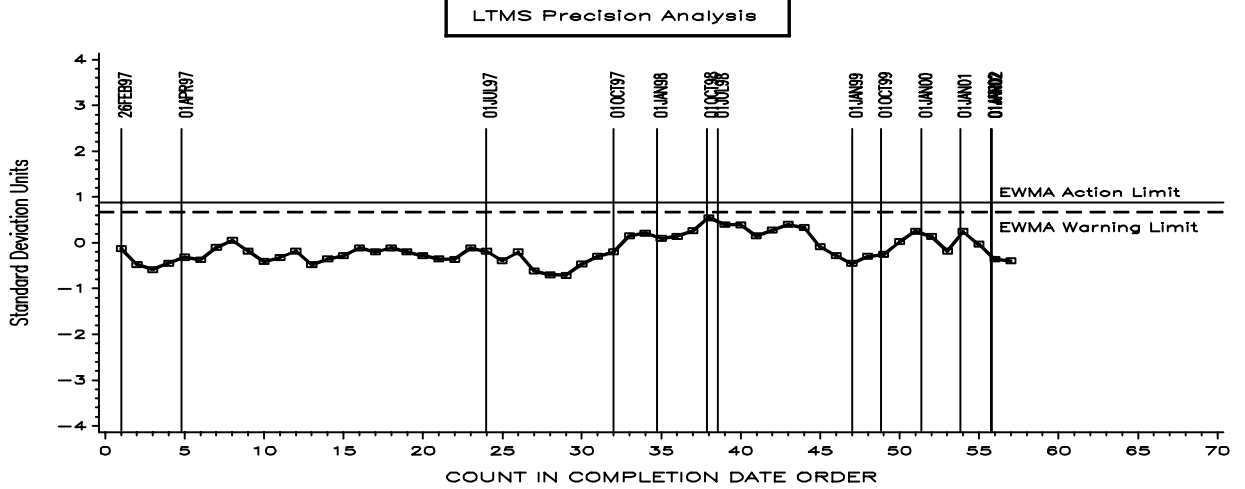
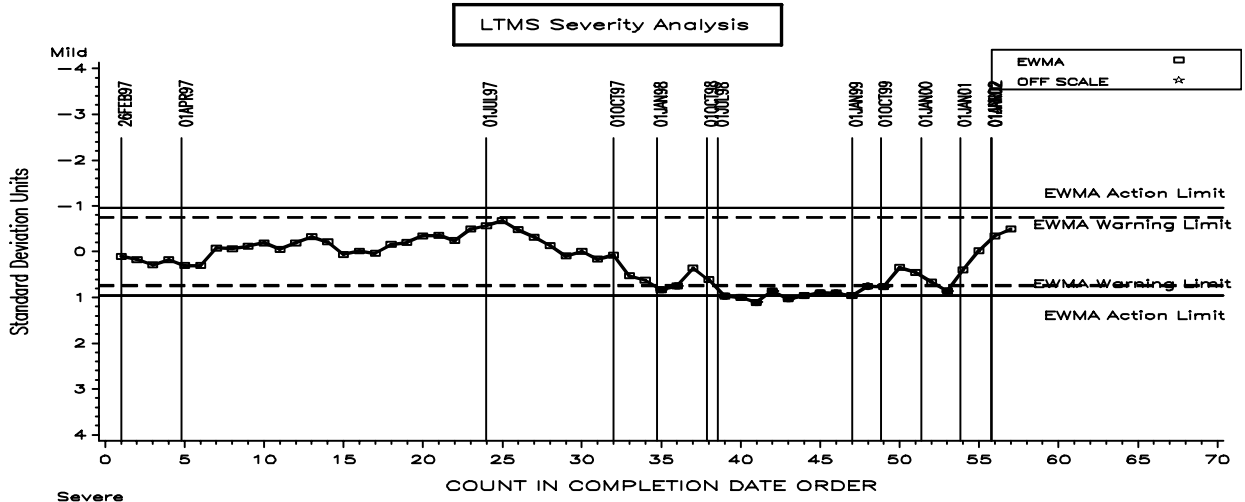


TABLE 5
T-9 DELTA PB INDUSTRY ALARM LOG

February 5, 1998 to March 6, 1998 (Severity, Severe direction)

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

October 23, 1998 to November 25, 1999 (Severity, Severe direction)

A series of warning and action alarms occur. Due to eighty percent of the data being generated from one lab, it is difficult to determine if this is a true industry trend or a laboratory trend. The Mack Surveillance Panel has investigated the trend. Items investigated include potential differences between reference oil reblends and possible effects of conrod bearing batch changes. No causes were found.

March 25, 2000 to March 1, 2001 (Severity, Severe direction)

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

Updated 9/17/02

FIGURE 3
T9 INDUSTRY OPERATIONALLY VALID DATA
AVERAGE TOP RING WEIGHT LOSS

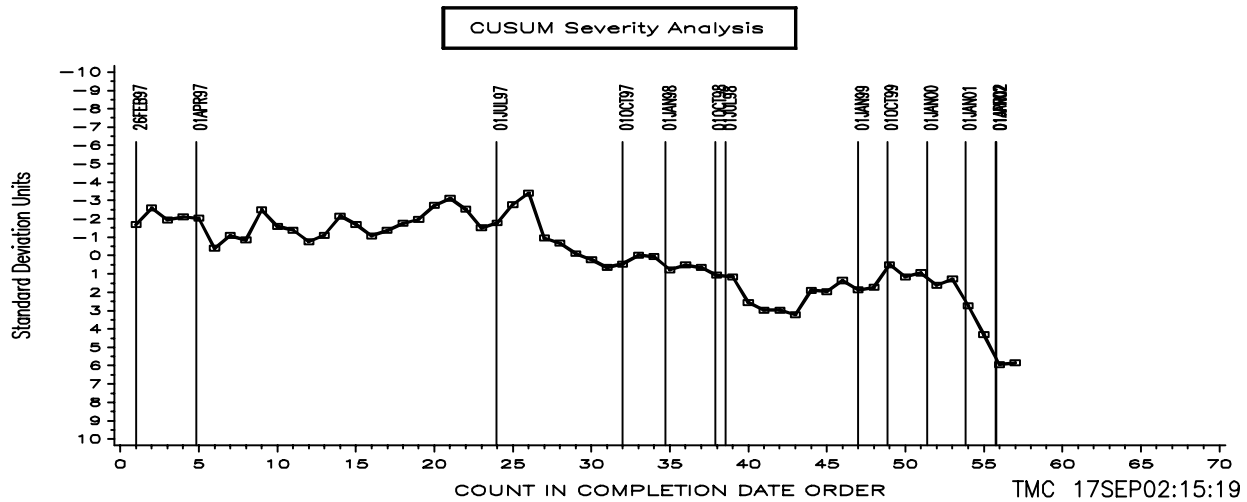
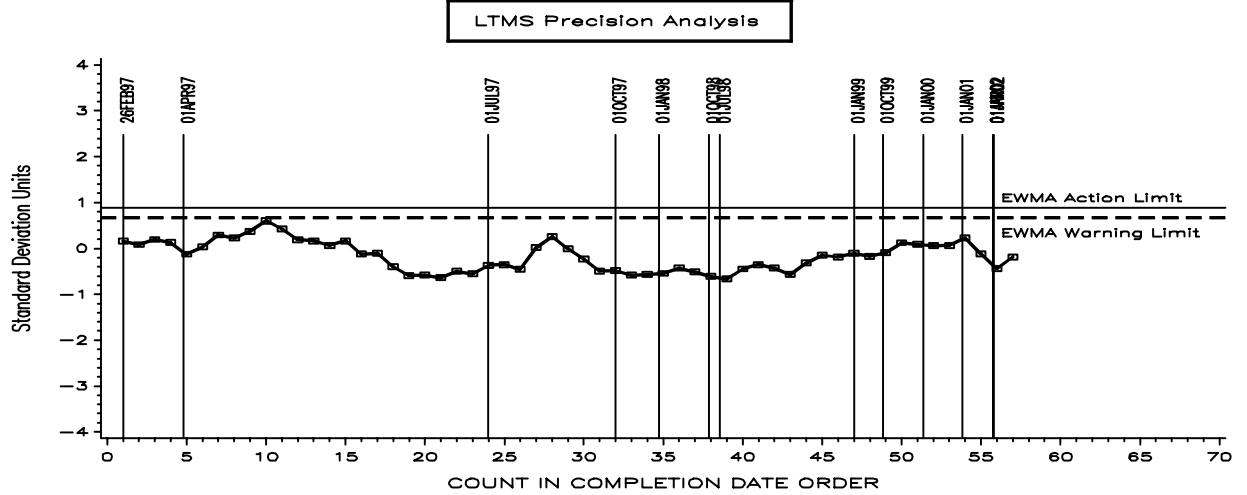
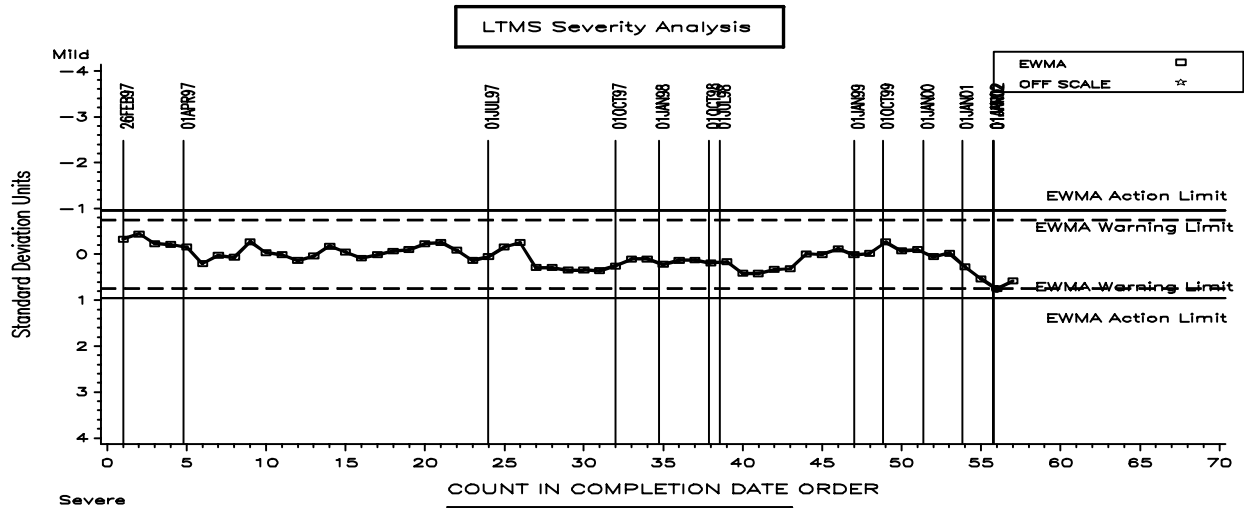


TABLE 6
T-9 TOP RING WEIGHT LOSS INDUSTRY ALARM LOG

April 12, 2002 to May 20, 2002 (Severity, Severe direction)

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

Updated 9/17/02

Table 7
T-9 Timeline

<u>Effective Date</u>	<u>Information Letter</u>	<u>Event</u>
19970226		INTAKE VALVE SWITCH FROM 20 DEGREE TRW TO 30 DEGREE EATON
19970226		VALVE LASH CHECK FREQUENCY CHANGED FROM EVERY 200 HOURS TO EVERY 125 HOURS
19970407		DATA ACQUISITION MINIMUM FREQUENCY CHANGED FROM 2 MINUTES TO 6 MINUTES
19970407		CRANKCASE PRESSURE CHANGED FROM A CONTROL PARAMETER TO A NON-CONTROLLED PARAMETER
19970701		MACK AIR FILTER AND MACK FILTER HOUSING SPECIFIED
19970701		CRANKCASE ASPIRATION (BLOWBY) CONFIGURATION SPECIFIED
19970808		PROCEDURE DRAFT NO. 3 ISSUED
19970904		MAXIMUM SHUTDOWN LIMITS OF 200 HOURS AND 10 SHUTDOWNS SPECIFIED
19970904		MAXIMUM 5 DEGREE INJECTION TIMING DIFFERENCE SPECIFIED FOR STAGE 1
19971007		NEW STAND CALIBRATION WITH 1 TEST APPROVED
19971020		OUTLIER SCREENING FOR IMPLEMENTED FOR LINER WEAR
19971020		REPLACEMENT OF MAIN BEARINGS AT EVERY TEST SPECIFIED
19971208		MAXIMUM SHUTDOWN LIMIT INCREASED TO 15 SHUTDOWNS
19980121		NEW STAND CALIBRATION REQUIRES TWO ACCEPTABLE TESTS
19980202		PROCEDURE DRAFT NO. 4 ISSUED
19980204		OIL 1004-3 REMOVED AS REFERENCE OIL
19980408		OIL 1005-1 INITIAL TARGETS, BASED ON 1005 RESULTS
19980408	98-1	OUTLIER SCREENING IMPLEMENTED FOR TOP RING WEIGHT LOSS
19980408	98-1	PB ADJUSTMENT FOR OUTLIER CONROD BEARING IMPLEMENTED
19980408	98-1	MACK PRIMARY AND SECONDARY FILTERS SPECIFIED FOR FUEL SYSTEM
19980408	98-1	SCREENING FOR TOP RING FLAKING IMPLEMENTED FOR TOP RING WEIGHT LOSS AND LINER WEAR
19980622	98-2	PENCOOL 3000 COOLANT ADDITIVE MAY BE USED IN THE ENGINE COOLING SYSTEM
19980622	98-2	VISCOSITY MEASUREMENTS MAY BE DONE ACCORDING TO EITHER D 445 OR D 5967, ANNEX A3
19980911	99-1	TWO ENGINES MAY BE CALIBRATED IN A STAND, ENGINE CAL PERIOD IS TWO YEARS, STAND CAL PERIOD IS ONE YEAR
19981001	99-1	LEAD CONTENT TO BE MEASURED AT LEAST TWICE AT 400 AND 500 HOURS
19981204		NEW TOP PISTON RING DESIGN INTRODUCED
19981207		NEW INTAKE VALVE DESIGN INTRODUCED
19990501		CORRECTION FACTOR OF +34.1769 MG ADDED TO TRWL RESULTS FOR TESTS WITH NEW PISTON RINGS AND VALVES
19990501		OIL 1005-1 TEN TEST TARGETS
19990819	99-1	QUALITY INDEX USED TO JUDGE TEST OPERATIONAL VALIDITY
20000101		TRWL CORRECTION FACTOR UPDATED: +36.9 MG ADDED TO TRWL RESULTS FOR TESTS WITH NEW PISTON RINGS AND VALVES
20010701		TRWL CORRECTION FACTOR UPDATED: +31.4 MG ADDED TO TRWL RESULTS FOR TESTS WITH NEW PISTON RINGS AND VALVES
20020306	02-1	LINER MEASUREMENT PROCEDURE REVISED SO THAT ONLY PDI DEVICES USED FOR MEASUREMENTS