



Test Monitoring Center

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

MEMORANDUM: 02-043

DATE: May 24, 2002

TO: James McCord,
Chairman, Single Cylinder Diesel Surveillance Panel

FROM: Scott Parke

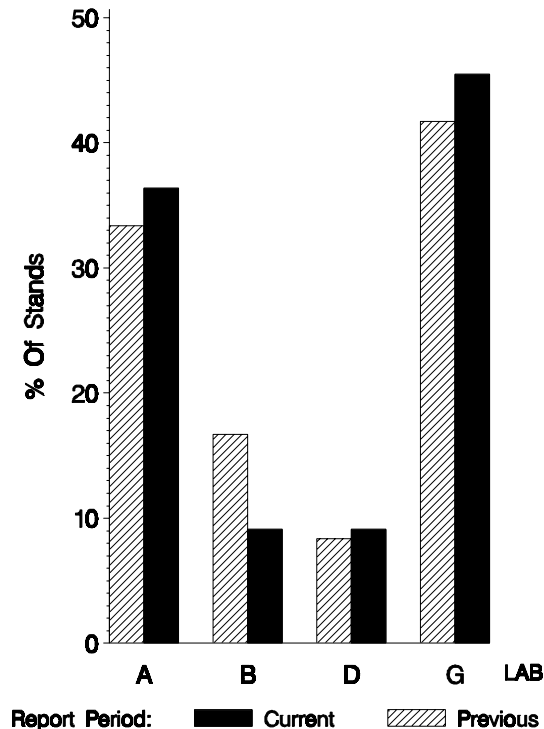
SUBJECT: 1M-PC Testing from October 1, 2001 through March 31, 2002

Fifteen calibration tests were reported to the Test Monitoring Center during the period from October 1, 2001 through March 31, 2002. The data from the operationally valid tests is shown on page 8. Following is a summary of testing activity this period.

| | Reporting Data | Calibrated on 3-31-02 |
|------------------|----------------|-----------------------|
| Number of Labs | 4 | 4 |
| Number of Stands | 11 | 10 |

Stands reporting data this period were distributed as shown below:

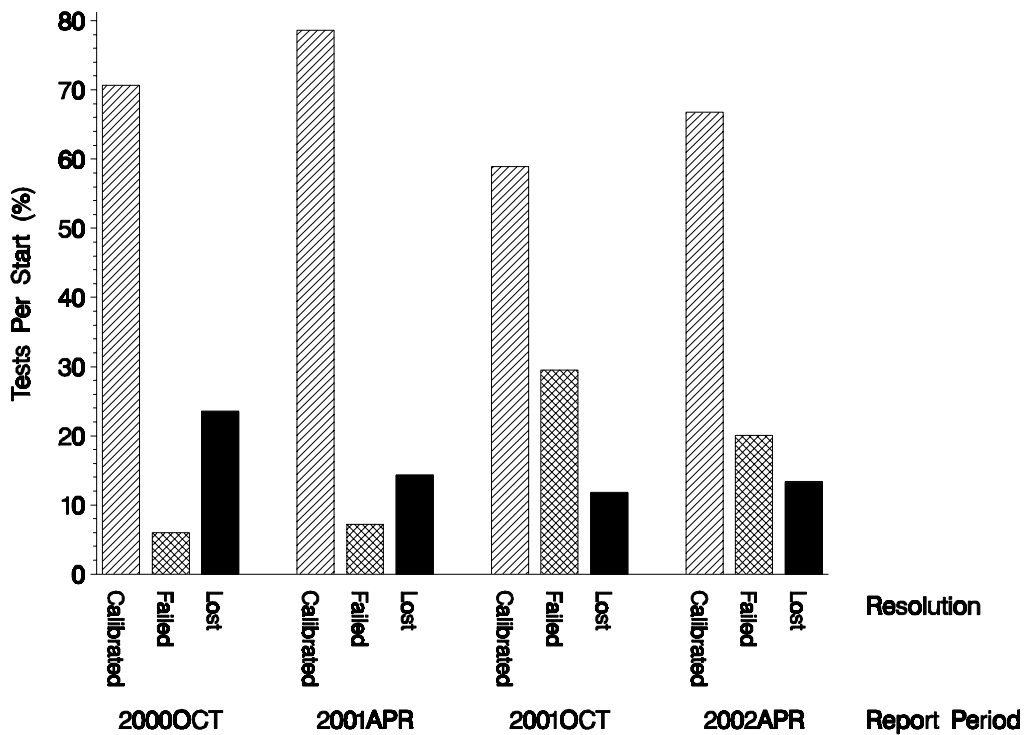
1M – PC LABORATORY / STAND DISTRIBUTION



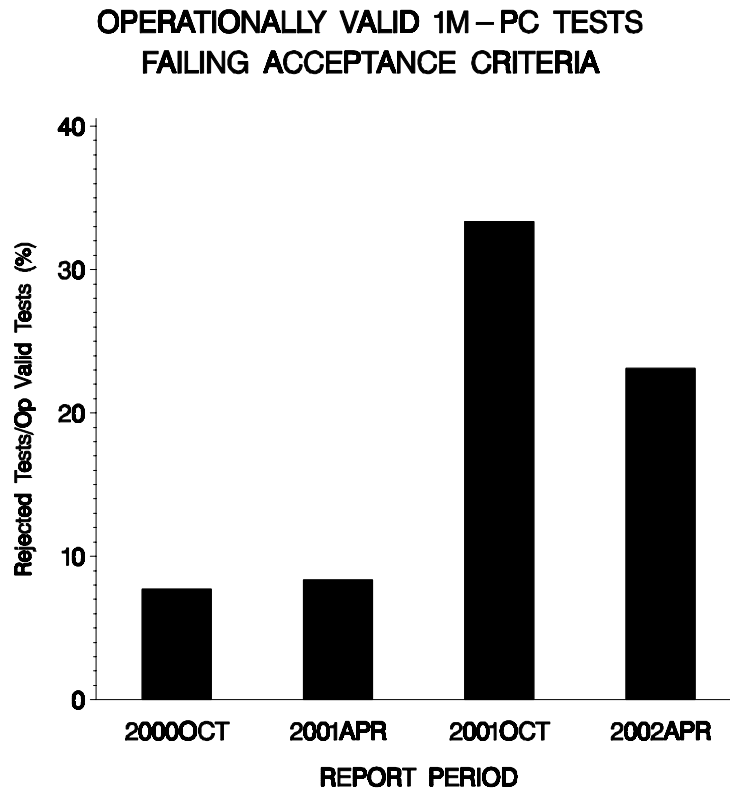
Test Distribution by Oil and Validity

| | | | Totals | | |
|---------------------------------|----|----|-----------|-------------|-------------|
| | | | 873-1 | Last Period | This Period |
| Accepted for Calibration | AC | 10 | 10 | 10 | 10 |
| Rejected Mild | OC | 0 | 0 | 0 | 0 |
| Rejected Severe | OC | 3 | 5 | 3 | 3 |
| Rejected for EWMA Precision | OC | 0 | 0 | 0 | 0 |
| Rejected for Shewhart Precision | OC | 0 | 0 | 0 | 0 |
| Operationally Invalid (lab) | LC | 1 | 2 | 1 | 1 |
| Operationally Invalid (lab/TMC) | RC | 1 | 0 | 1 | 1 |
| Aborted Calibration | XC | 0 | 0 | 0 | 0 |
| Total | | | 15 | 17 | 15 |

1M – PC CALIBRATION ATTEMPT SUMMARY



The test-per-start ratio for calibrated, failed, and lost tests is shown above.

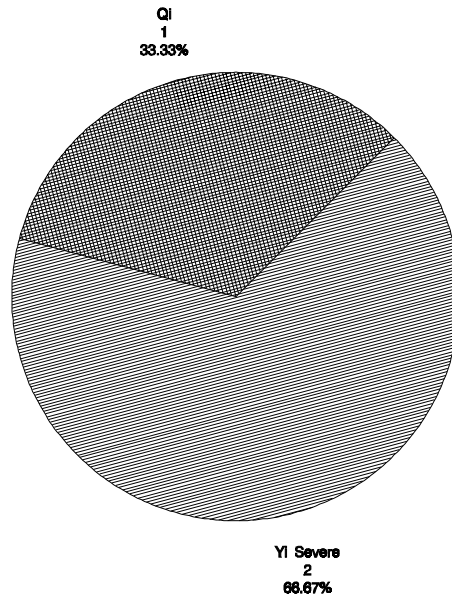


One LTMS deviation was written this period (this is the second deviation ever written for 1M-PC). A stand that had been producing consistent severe results for TGF (results that, in the current era of 1M-PC, would be considered typical). Produced a TGF of 20% for a test in May 2001. At the time, no investigation was done to determine what might have caused this result to be atypically mild. The next reference test produced 79% TGF and in addition to failing put the stand into an EWMA precision alarm. After that test, the lab gave the stand a thorough but largely fruitless examination, made some minor modifications, and ran a shakedown run that produced 59% TGF. The subsequent reference run produced 60% TGF.

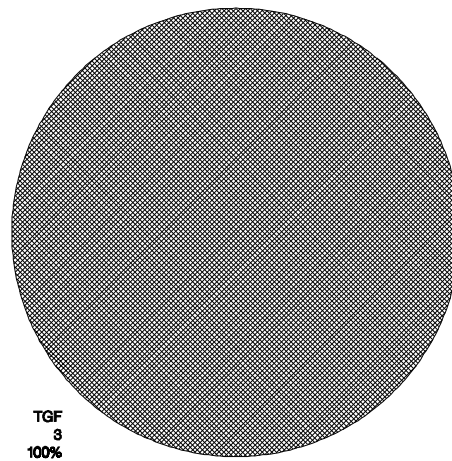
Considering the history of both this stand and the lab as a whole, it was clear that the TGF=20% result was an anomaly that in hindsight should have received more scrutiny. Had this run not occurred, the stand would not have exceeded EWMA precision limits therefore, an LTMS deviation was written to calibrate this stand.

Shown below is the distribution by type and parameter of the alarms causing the failures for this period.

**DISTRIBUTION OF 1M-PC
LTMS STAND ALARMS
(By Alarm Type)**



**DISTRIBUTION OF 1M-PC
LTMS STAND ALARMS
(By Test Parameter)**

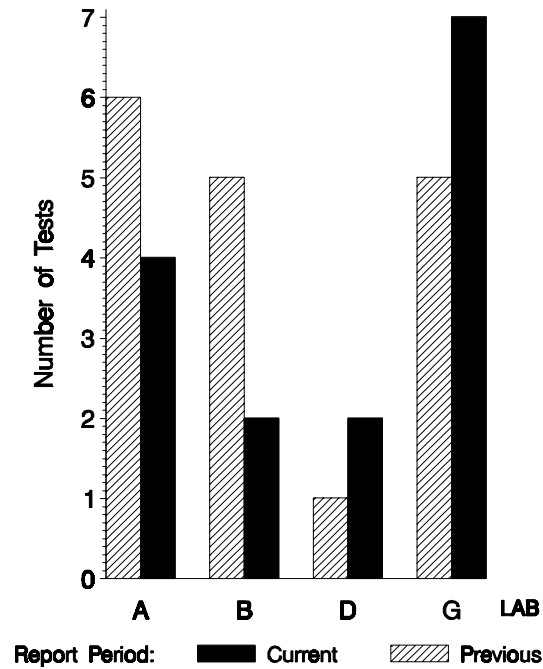


Three tests failed this period; 2 had severe TGF; 1 exceeded the TGF stand precision limit.

By lab, the tests run this report period were distributed as shown below:

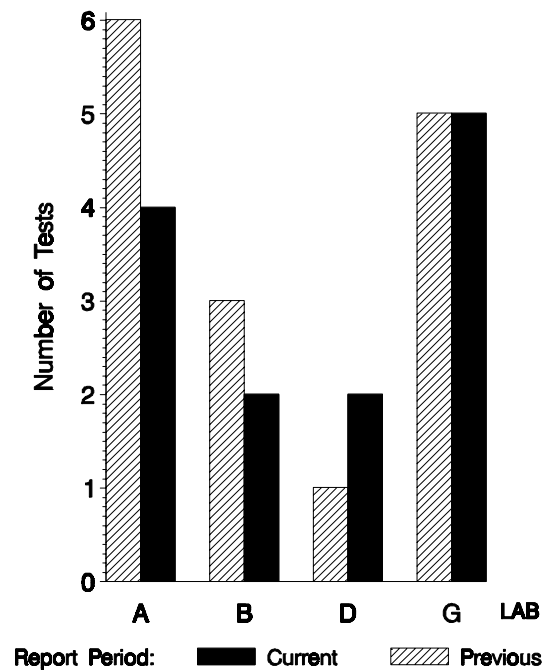
**NUMBER OF 1M-PC TESTS REPORTED
BY LAB AND REPORT PERIOD**

(All Test Starts - Both Valid & Invalid)

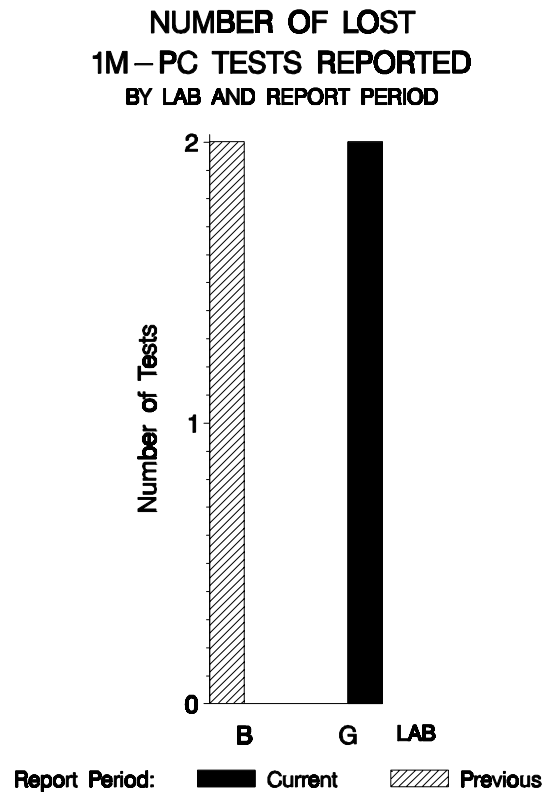


With all operationally invalid tests removed, the distribution looks like this:

**NUMBER OF OPERATIONALLY VALID
1M-PC TESTS REPORTED
BY LAB AND REPORT PERIOD**



And the by-lab distribution of lost tests:



Lost Tests per Start by Oil and Lab:

| Lab | 873-1 | | | Total | | |
|-------|-------|--------|----|-------|--------|----|
| | Lost | Starts | % | Lost | Starts | % |
| A | 0 | 4 | 0 | 0 | 4 | 0 |
| B | 0 | 2 | 0 | 0 | 2 | 0 |
| D | 0 | 2 | 0 | 0 | 2 | 0 |
| G | 2 | 7 | 29 | 2 | 7 | 29 |
| Total | 2 | 15 | 13 | 2 | 15 | 13 |

Lost tests are those that were either aborted, rejected by lab, or operationally invalid.

Causes for Lost Tests:

| Lab | Cause | Oil | Validity | | | Loss Rate | | |
|-----|--|-------|----------|----|----|-----------|--------|-----|
| | | 873-1 | LC | RC | XC | Lost | Starts | % |
| G | Scuff at EOT. No cause found. | ● | ● | | | 2 | 7 | 29% |
| | Post-test inspection revealed incorrect prechamber orifice size. Test produced severe TGF. | ● | | ● | | | | |
| | Lost | 2 | 1 | 1 | 0 | | | |
| | Starts | 15 | 15 | 15 | 15 | | | |
| | % | 13% | 7% | 7% | 0% | | | |

| Average Δ /s by Lab | | | |
|----------------------------|----|-------|-------|
| Lab | n | TGF | WTD |
| A | 4 | 1.211 | 0.516 |
| B | 2 | 1.708 | 1.575 |
| D | 2 | 1.677 | 0.592 |
| G | 5 | 1.081 | 0.681 |
| Industry | 13 | 1.309 | 0.754 |

DATA FROM ALL OPERATIONALLY VALID TESTS REPORTED THIS PERIOD:

| LTMS | | | | | | | |
|-------------|------------|--------------|------------|-----------|-----------|-------------|-------------|
| DATE | LAB | STAND | OIL | TG | WD | TGYI | WDYI |
| 20011014 | B | 7 | 873-1 | 72 | 315.7 | 1.925 | 1.648 |
| 20011020 | G | 10A | 873-1 | 60 | 234.3 | 1.180 | 0.036 |
| 20011107 | G | 13A | 873-1 | 79 | 373.5 | 2.360 | 2.792 |
| 20011112 | G | 1A | 873-1 | 68 | 255.4 | 1.677 | 0.453 |
| 20011114 | G | 8A | 873-1 | 25 | 239.1 | -0.994 | 0.131 |
| 20011117 | A | 1 | 873-1 | 61 | 208.3 | 1.242 | -0.479 |
| 20011118 | B | 7 | 873-1 | 65 | 308.4 | 1.491 | 1.503 |
| 20011204 | A | 3 | 873-1 | 48 | 268.0 | 0.435 | 0.703 |
| 20011204 | G | 13A | 873-1 | 60 | 232.2 | 1.180 | -0.006 |
| 20011207 | A | 5 | 873-1 | 69 | 279.0 | 1.739 | 0.921 |
| 20011213 | D | 2 | 873-1 | 74 | 277.1 | 2.050 | 0.883 |
| 20011225 | A | 2 | 873-1 | 64 | 278.9 | 1.429 | 0.919 |
| 20020102 | D | 2 | 873-1 | 62 | 247.7 | 1.304 | 0.301 |

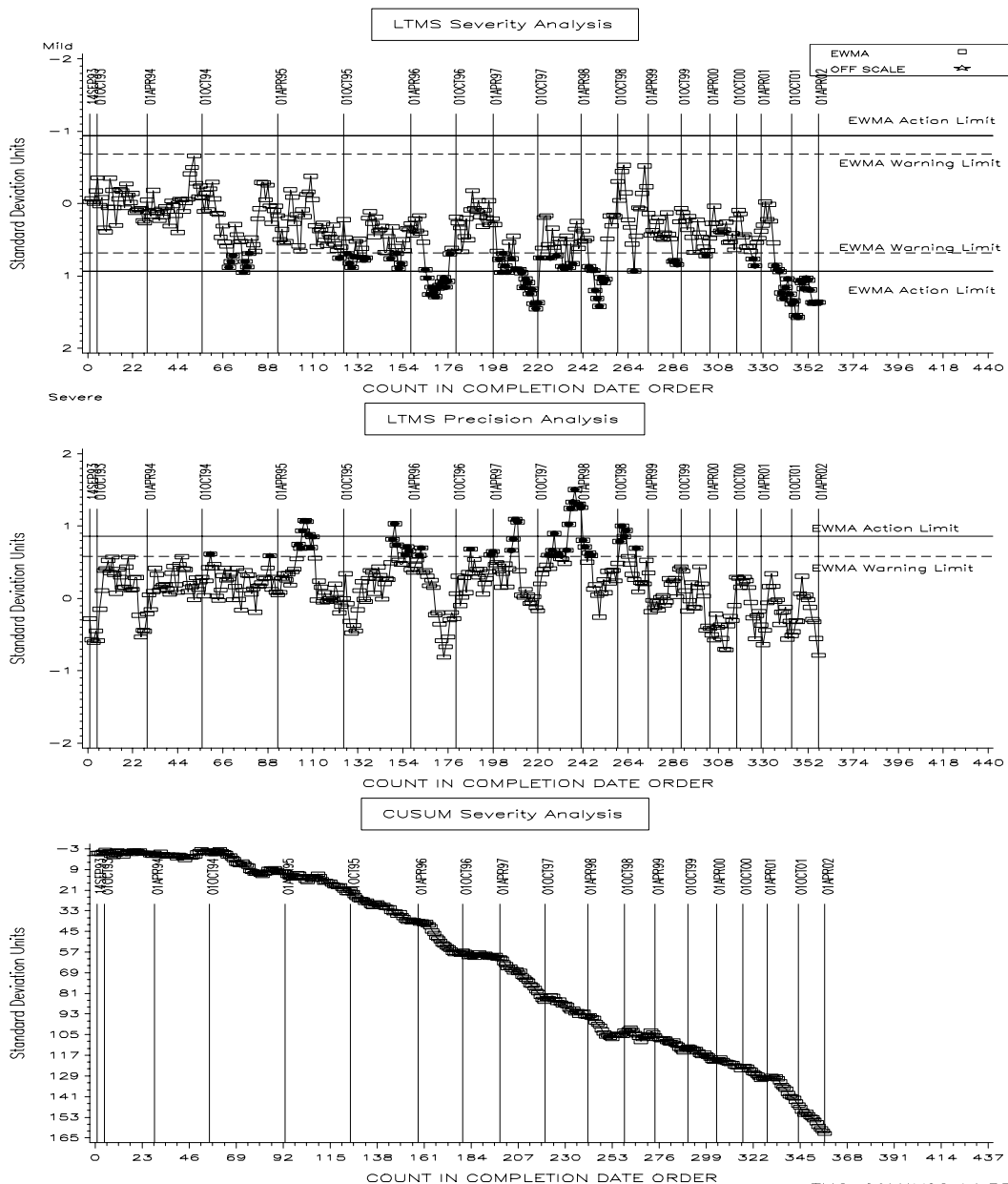
DISCUSSION OF INDUSTRY PERFORMANCE OVER THIS PERIOD

TGF:

TGF over this period was again severe and continues to exceed the EWMA action limit. Industry average TGF Y_i was 1.309 (see table on previous page). Using 873-1's test target standard deviation of 16.1 to compute an average Δ yields 21% TGF. Despite repeated inquiries into a cause for this change in severity, none has yet been found. There is some indication that the recent change in liner suppliers might be responsible for compounding the problem. Runs on a reblend of 873 (873-2) are currently running in all 1M-PC labs.

CATERPILLAR 1M-PC INDUSTRY OPERATIONALLY VALID DATA

Top Groove Fill

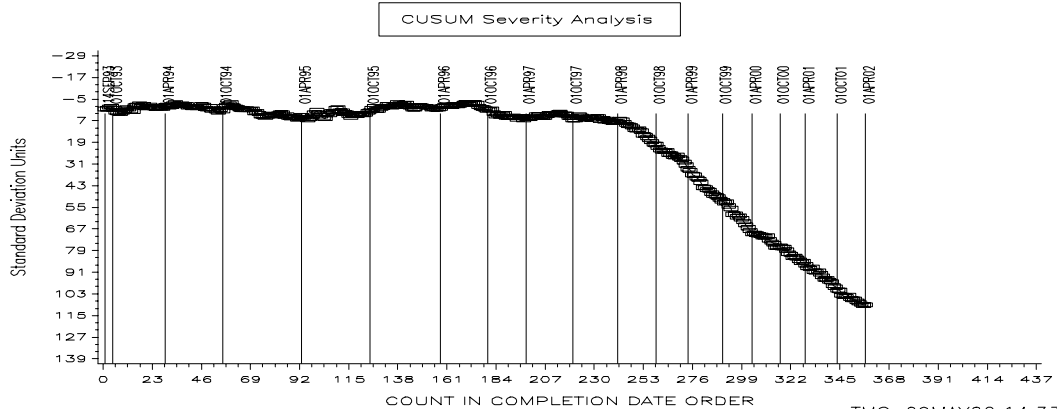
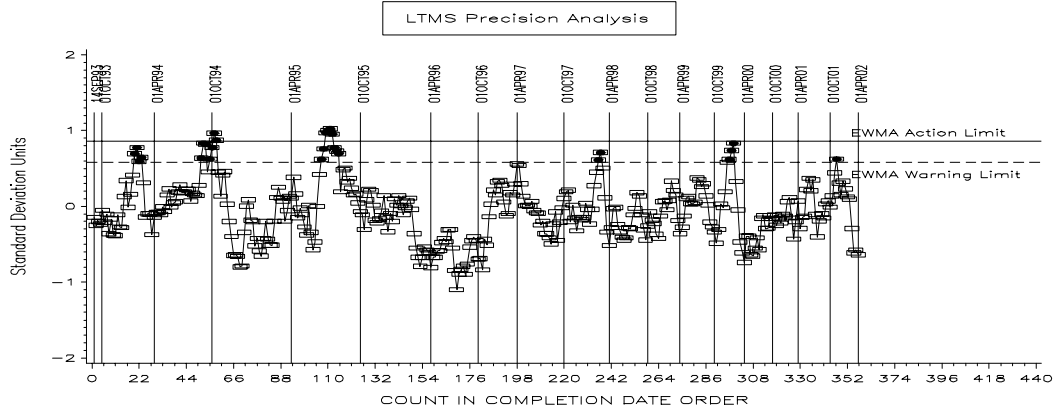
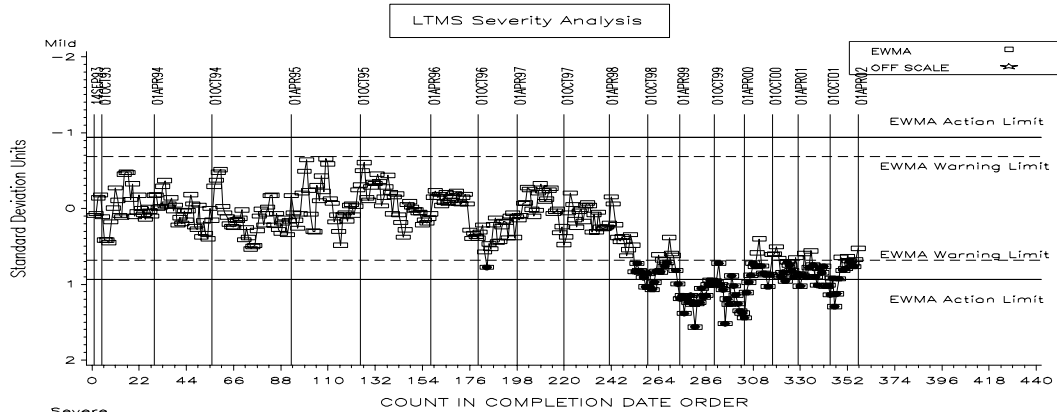


WTD:

WTD also continues to be severe (and has since April '98). Industry average WTD Yi was 0.754 (equivalent to 38.1 demerits severe when multiplied by 873-1's standard deviation of 50.5). Precision remained within acceptable limits this period.

CATERPILLAR 1M-PC INDUSTRY OPERATIONALLY VALID DATA

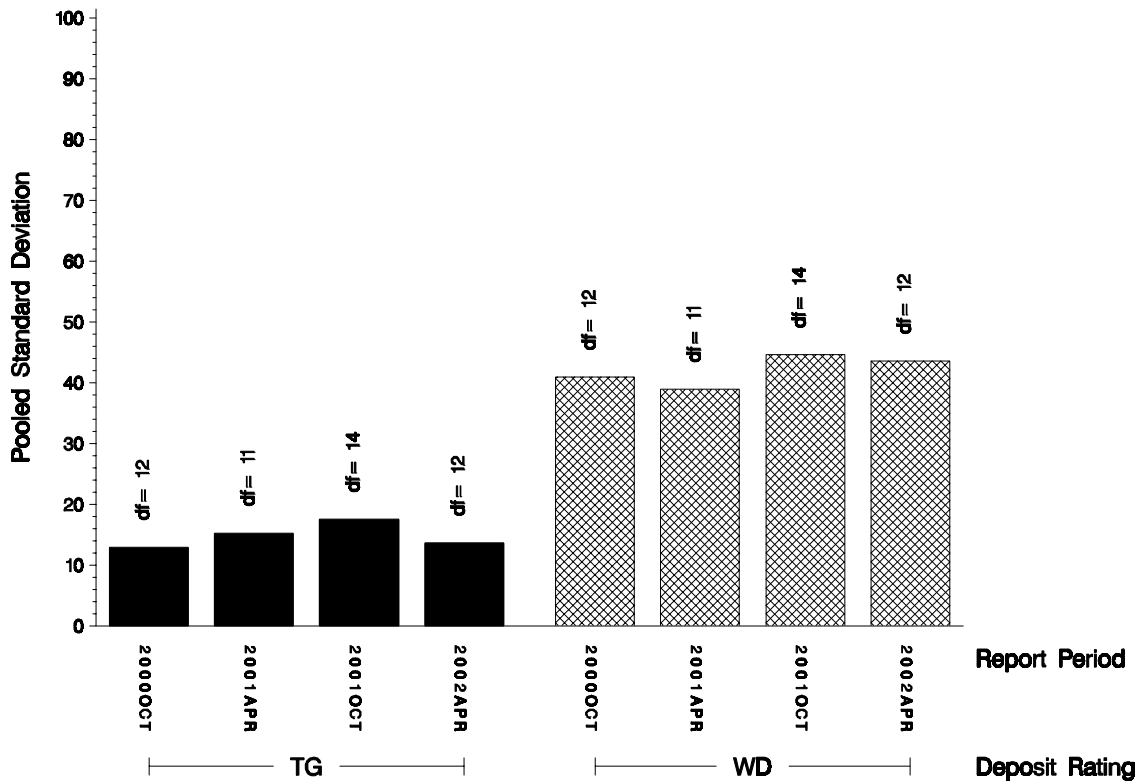
Weighted Total Demerits



POOLED S:

Shown below is a bar chart comparing the pooled s values for the 1M-PC test parameters over the last four report periods. Precision for both parameters, as measured by pooled s, is comparable to previous periods.

1M – PC REFERENCE TEST PRECISION
POOLED STANDARD DEVIATION BY SIX – MONTH ASTM REPORT PERIOD



STATUS OF REFERENCE OIL SUPPLY:

At the end of this report period, the testing oil supply stood as outlined in the table below:

| Oil | Cans @ Labs | @ TMC | |
|--------------|-------------|------------|-------------|
| | | Cans | Gallons |
| 873-1 | 16 | 2 | 25 |
| 873-2 | 15 | 150 | 1500 |
| Total | 31 | 152 | 1525 |

* Future reblends of any oils marked with an asterisk are not obtainable by TMC.

In spite of the recent difficulties experienced with the 1M-PC test, when queried in February of this year, the surveillance panel expected 1M-PC testing to continue for the foreseeable future and instructed the TMC to proceed with procurement of the 873-2 reblend. This oil is now available for testing and is currently being run in at least one stand in each of the 1M-PC test labs.

TIMELINE OF SIGNIFICANT EVENTS IN THE LIFE OF THE 1M-PC TEST:

| Effective Date | Info Letter | |
|----------------|-------------|---|
| 19940419 | | FIRST USE OF 873-1 |
| 19940927 | | FIRST EXHAUST BARREL TEST |
| 19941031 | | LAST USE OF 873 |
| 19941225 | | LAST NON-EXHAUST BARREL TEST |
| 19950401 | | LTMS INTRODUCTION |
| 19950728 | 95-1 | REWRITTEN PROCEDURE ISSUED ALONG WITH INFORMATION LETTER 95-1 |
| 19950728 | 95-1 | LINER WEAR STEP MEASUREMENT TECHNIQUE CHANGED TO CONFORM TO 1K/1N |
| 19950728 | 95-1 | REMOVAL OF MAXIMUM ALLOWABLE LSC SPECIFICATION |
| 19950728 | 95-1 | ADOPTION OF THE STANDARDIZED TEST REPORT COVER SHEET |
| 19950728 | 95-1 | EXHAUST BACKPRESSURE SPECIFICATION CHANGED TO ABSOLUTE PRESSURE |
| 19950728 | 95-1 | EXHAUST TEMPERATURE SPECIFICATION LOWERED |
| 19950926 | 95-1 | IMPLEMENTATION OF DATA DICTIONARY AND REPORT FORMS (VERSION=19950607) |
| 19960315 | 96-1 | FUEL FLOW MEASUREMENT DEVICE SPECIFICATION CLARIFIED |
| 19960315 | 96-1 | HUMIDITY CALIBRATION SCHEDULING REQUIREMENT CHANGED |
| 19960315 | 96-1 | EDITORIAL CHANGES |
| 19960414 | 96-1 | FORMS CHANGES |
| 19980209 | 98-1 | REVISED WARRANTY PROCEDURE & FORMS |
| 19980209 | 98-1 | FUEL SUPPLIER NAME CHANGE |
| 19980209 | 98-1 | COOLANT ADDITIVE NAME CHANGE (PENCOOL 2000) |
| 19980209 | 98-1 | TMC FAX NUMBER CHANGE |
| 19980430 | 98-2 | ADD FUEL, LTMS, AND OTHER 1K/1N-TYPE FORMS & EXAMPLES TO TEST REPORT |
| 19980824 | 98-3 | ADD RATING WORKSHEET (FORM 4A) TO TEST REPORT |
| 19981109 | 98-4 | ADD AREAS FOR CLEAN TO RATING SHEETS 5 & 5A |
| 19981109 | 98-5 | CORRECTION TYPO IN 98-2 TO FUEL AND COOLANT SUPPLIER NAMES |
| 19990419 | 99-1 | UPDATED INTAKE AIR FILTER REQUIREMENTS |
| 19990419 | 99-1 | RE-CALIBRATION REQUIREMENTS WHEN CRANK IS REMOVED |
| 19990419 | 99-1 | VISUAL INSPECTION OF INTAKE AIR BARRELS |
| 19990419 | 99-1 | COOLANT SYSTEM FLUSHING REQUIREMENTS |
| 19990419 | 99-1 | TEST STAND INSTRUMENTATION CALIBRATION REQUIREMENTS |
| 19990419 | 99-1 | USE OF MOBIL EF-411 AS BUILD-UP/FLUSHING OIL |
| 19990419 | 99-1 | TIME ZONE FOR USE IN EOT REPORTING |
| 19990419 | 99-1 | FUEL INJECTION PUMP REPLACEMENT |
| 19990419 | 99-1 | EDITORIAL |
| 20010508 | | FIRST 1Y3995 LINER TEST |

RATING:

During this report period, one second referee rating was requested. When this rating produced further disagreement, the testing lab had a second rater of their own rate the piston. With no satisfactory consensus reached, the original lab and referee ratings were accepted for that test.

Rating Re-rate Summary

| | |
|--|----------|
| Total number of re-rates requested | <u>1</u> |
| Number of tests where lab rating was changed | 0 |
| Number of tests where referee rating was changed | 0 |
| Number of tests where no changes were made | 1 |

LAB VISITS:

No 1M-PC lab visits were completed during this period.

INFORMATION LETTERS:

No information letters were issued during this period.

FUEL BATCH APPROVAL:

During this period, the following fuel batches were approved for testing: 0110708, 0111849, 0112962, 0201074, and 0202115.

SUMMARY

- Over the course of this report period, industry TGF continued to be severe. The WTD severe trend begun during the April '98 report period continues. There seems to be some indication that the new liner supply is exacerbating the problem. Runs are currently underway on 873-2 that should determine whether or not "shelf-life" is a problem for the 873-1 reference oil.

- Precision for both TGF and WTD remained within limits throughout the period.

SDP/sdp/astm0402.doc/m02-043.sdp.doc

c: J. L. Zalar
F. M. Farber
Dwayne Tharp
Single Cylinder Diesel Surveillance Panel
<ftp://ftp.astmtmc.cmu.edu/docs/diesel/scote/semiannualreports/1mpc-04-2002.pdf>

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