



## Test Monitoring Center

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MEMORANDUM: 11-023  
DATE: June 7, 2011  
TO: Jim Moritz, Chairman, Cummins Surveillance Panel  
FROM: Jeff Clark  
SUBJECT: ISB and ISM Calibration Testing for the April 2011 ASTM Report Period

The following is a summary of ISB and ISM reference oil tests completed during the April 2011 ASTM report period, which began on October 1, 2010 and ended on March 31, 2011.

| Test Status                             | TMC Validity Code | Number of Tests |     |
|---|-------------------|-----------------|-----|
|   |                   | ISB             | ISM |
| Acceptable Calibration Test             | AC                | 2               | 4   |
| Failed Calibration Test (LTMS Criteria) | OC                | 2               | 0   |
| Operationally Invalid Test              | LC                | 1               | 0   |
| Aborted                                 | XC                | 1               | 0   |
| Total                                   |                   | 6               | 4   |

One ISB test failed due to severe Average Tappet Weight Loss and one test failed due to severe Average Camshaft Wear. One ISB test was invalid due to a failed EGR valve and one test was aborted due to an engine failure that resulted from the test oil being contaminated with fuel.

### ISB Severity:

Both parameters for the ISB spent the entire period in severity alarm, in the severe direction. This was the continuation of a long-term severity problem. After this report period closed, the Cummins Surveillance Panel determined that the severity shift was hardware related, and correction factors were implemented for both parameters. These correction factors were 'back-applied' to the relevant reference tests so that reference test monitoring would accurately capture industry severity status going forward. As a result, these trends are no longer seen in the industry control charts. Additionally, severity and precision commentary in this report includes the application of the correction factors.

Figure 1 (attached) shows the current industry EWMA severity and cusum charts for Average Camshaft Wear (ACSW). ACSW is currently in control.

Figure 2 (attached) shows the current industry EWMA severity, and cusum charts for Average Tappet Weight Loss (ATWL). ATWL is currently in control but is trending an average of 0.37  $\Delta$ /s severe for the period.

ISM Severity:

PC-9-HS fuel, a fuel that was introduced to return the T-11 test to its original severity, was introduced to ISM testing on February 9, 2011. Three of the four tests this report period were run on this fuel.

Figure 3 (attached) shows the current industry EWMA severity and cusum charts for Crosshead Weight Loss (CWL). CWL is within control chart limits, but is trending an average of 0.35  $\Delta$ /s mild for the period.

Figure 4 (attached) shows the current industry EWMA severity and cusum charts for Filter Plugging Delta P (FPD). FPD is currently in an industry action for severity, in the mild direction. For this period, FPD is trending an average of 1.12  $\Delta$ /s mild for the period. It is worth noting that the current mild trend for FPD began well before the introduction of the new filter batch in May 2010.

Figure 5 (attached) shows the current industry EWMA severity and cusum charts for Average Sludge Rating (ASR). ASR is currently within control chart limits and on target.

Figure 6 (attached) shows the current industry EWMA severity and cusum charts for Injector Adjusting Screw Weight Loss (IAS). IAS is currently within control chart limits, but is trending an average of 0.65  $\Delta$ /s severe for the period.

Reference Test Precision Estimates:

Precision estimates, and any relevant commentary, will be provided on an annual basis in the sections below. No ISB estimate is available for 2010 since only one test was run.

The ISB preliminary precision estimates for 2011 show improvement for both ACSW and ATWL compared to historical levels.

**ISB Precision Estimates**

| <b>Parameter</b> | <b>2005</b> | <b>2006</b> | <b>2007</b> | <b>2008</b> | <b>2009</b> | <b>2011</b> |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| df               | 15          | 5           | 5           | 3           | 4           | 3           |
| ACSW             | 6.69        | 5.58        | 3.45        | 7.94        | 4.23        | 2.84        |
| ATWL             | 14.13       | 22.29       | 15.62       | 17.66       | 28.60       | 3.57        |

The ISM precision estimates for 2010 shows ASR and IAS to be within historical levels. CWL shows improvement compared to recent years, while FPD shows great degradation in precision. The preliminary 2011 estimates show improvement for all parameters except IAS which shows some degradation.

**ISM Precision Estimates**

| <b>Parameter</b> | <b>2007</b> | <b>2008</b> | <b>2009</b> | <b>2010</b> | <b>2011</b> |
|------------------|-------------|-------------|-------------|-------------|-------------|
| df               | 9           | 5           | 4           | 6           | 3           |
| CWL              | 1.9         | 1.9         | 1.6         | 1.3         | 1.0         |
| FPD (ln units)   | 0.3736      | 0.3211      | 0.1062      | 0.5537      | 0.2289      |
| ASR              | 0.13        | 0.18        | 0.04        | 0.13        | 0.06        |
| IAS              | 4.0         | 5.8         | 3.3         | 4.0         | 6.7         |

Reference Oils:

The table below shows the supply levels of reference oils for both the ISB and ISM. The TMC is looking into a new re-blend of 831 sometime in 2012, if the surveillance panel agrees that activity levels would support the need for the oil.

**Reference Oil Inventory and Estimated Life<sup>A</sup>**

| <b>Oil</b>   | <b>Tests</b>    | <b>Original Blend Amount</b> | <b>Quantity Used in last 6 months</b> | <b>TMC Inventory</b> | <b>Lab Inventory<sup>B</sup></b> | <b>Estimated Life<sup>C</sup></b> |
|--------------|-----------------|------------------------------|---------------------------------------|----------------------|----------------------------------|-----------------------------------|
| <b>831-1</b> | <b>C13, ISB</b> | <b>1300</b>                  | <b>197</b>                            | <b>459</b>           | <b>130</b>                       | <b>~1.5 years</b>                 |
| <b>830-2</b> | <b>ISM</b>      | <b>3786</b>                  | <b>311</b>                            | <b>1201</b>          | <b>250</b>                       | <b>~2.5 years</b>                 |

<sup>A</sup>Inventories are expressed in gallons.

<sup>B</sup>Active laboratories.

<sup>C</sup>Time estimate is based on most recent activity levels.

Information Letters:

No ISB or ISM Information Letters were issued this period.

TMC Laboratory Visits:

No laboratory visits were conducted this period.

Quality Index:

No ISM Quality Index deviations were issued this period. For the history of the ISM, a total of two deviations have been issued.

Additional Information:

The ISB and ISM timelines are attached as Figures 6 and 7. The ISB and ISM databases and alarm logs can be accessed on the TMC's homepage. If you have any questions on how to access this information, contact the TMC.

JAC/jac/mem11-023.jac.doc

## Attachments

c: F.M. Farber, TMC

Cummins Surveillance Panel

<ftp://ftp.astmtmc.cmu.edu/docs/diesel/cummins/semiannualreports/ISM/ISM-04-2011.pdf>

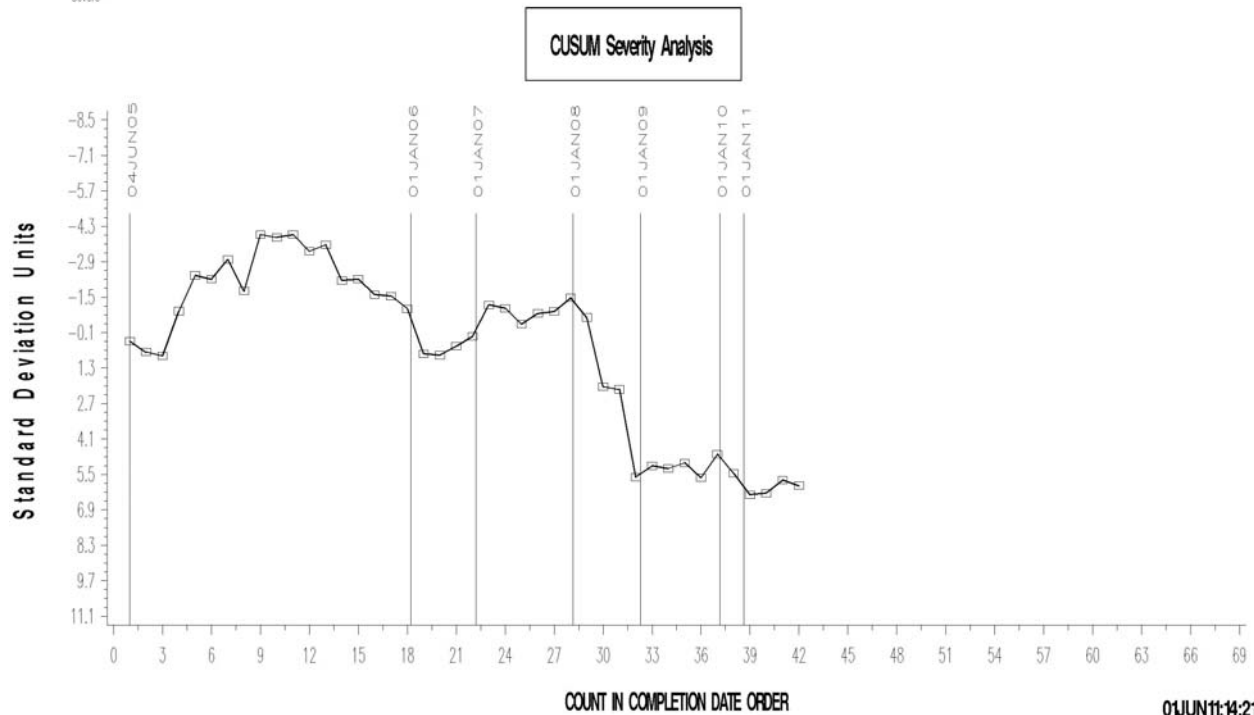
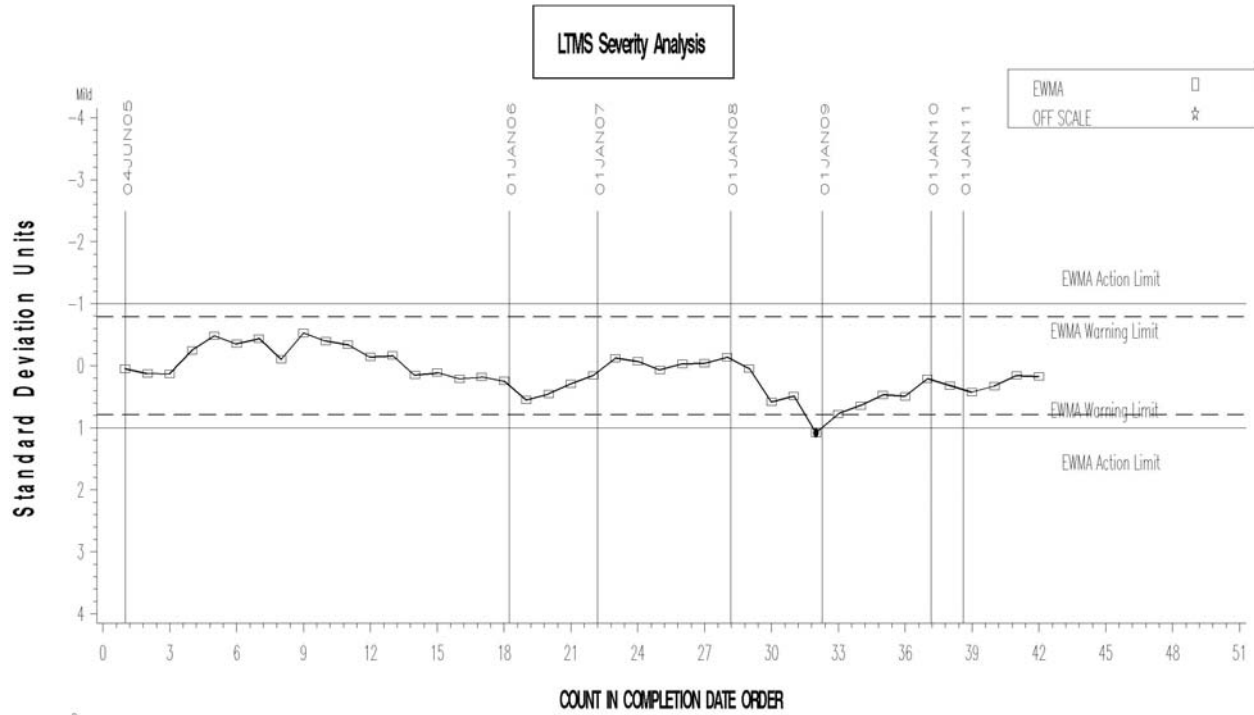
<ftp://ftp.astmtmc.cmu.edu/docs/diesel/cummins/semiannualreports/ISB/ISB-04-2011.pdf>

Distribution: Email

**FIGURE 1**  
**CUMMINS ISB INDUSTRY OPERATIONALLY VALID DATA**



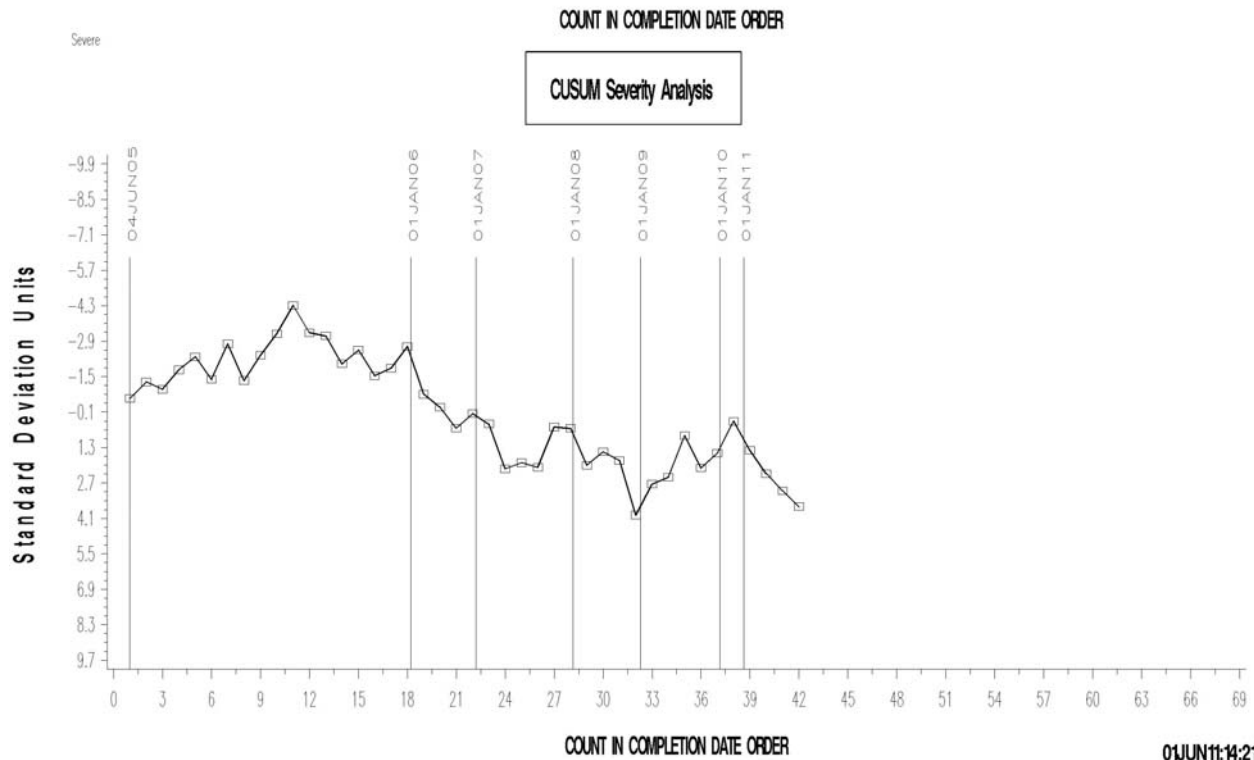
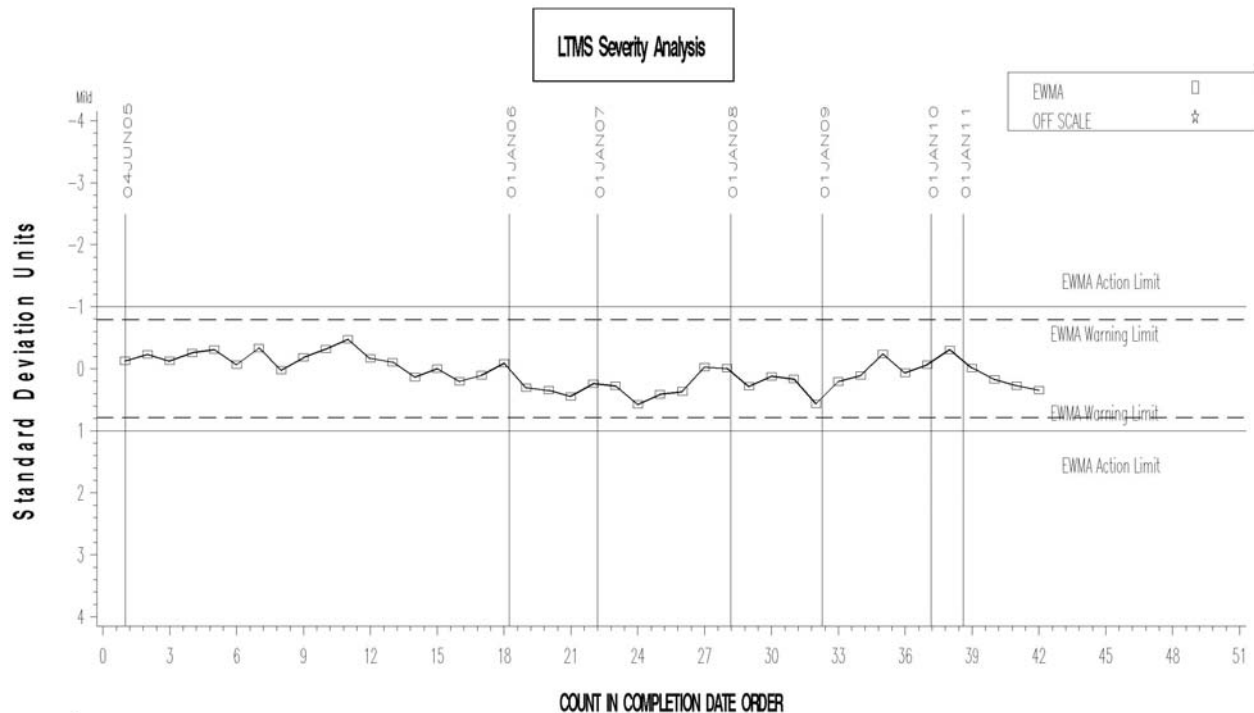
**AVERAGE CAMSHAFT WEAR**



# FIGURE 2 CUMMINS ISB INDUSTRY OPERATIONALLY VALID DATA



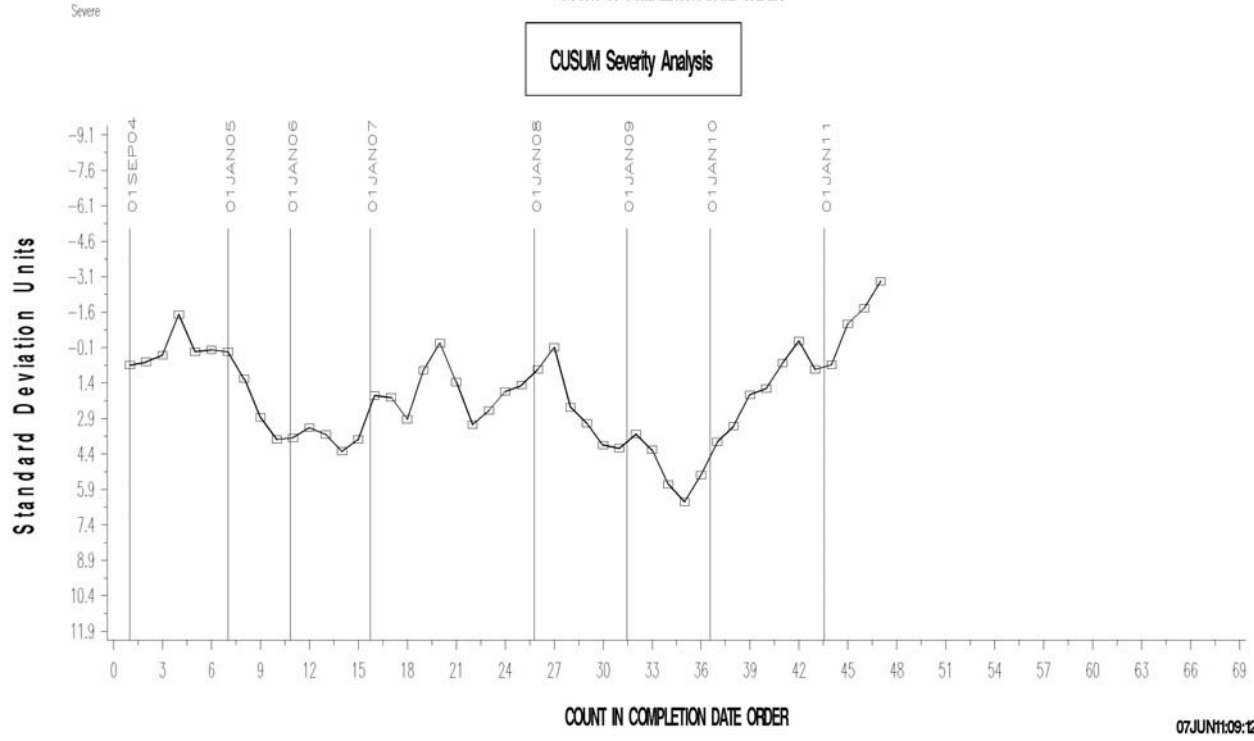
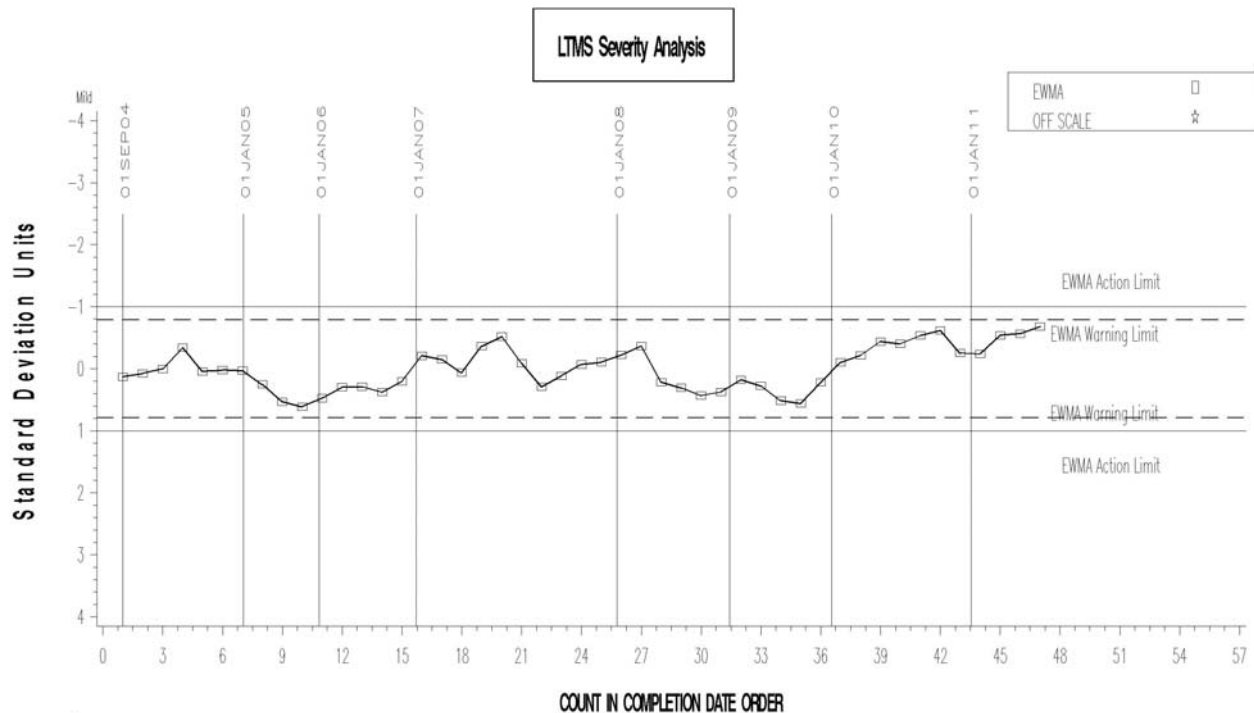
## AVERAGE TAPPET WEIGHT LOSS



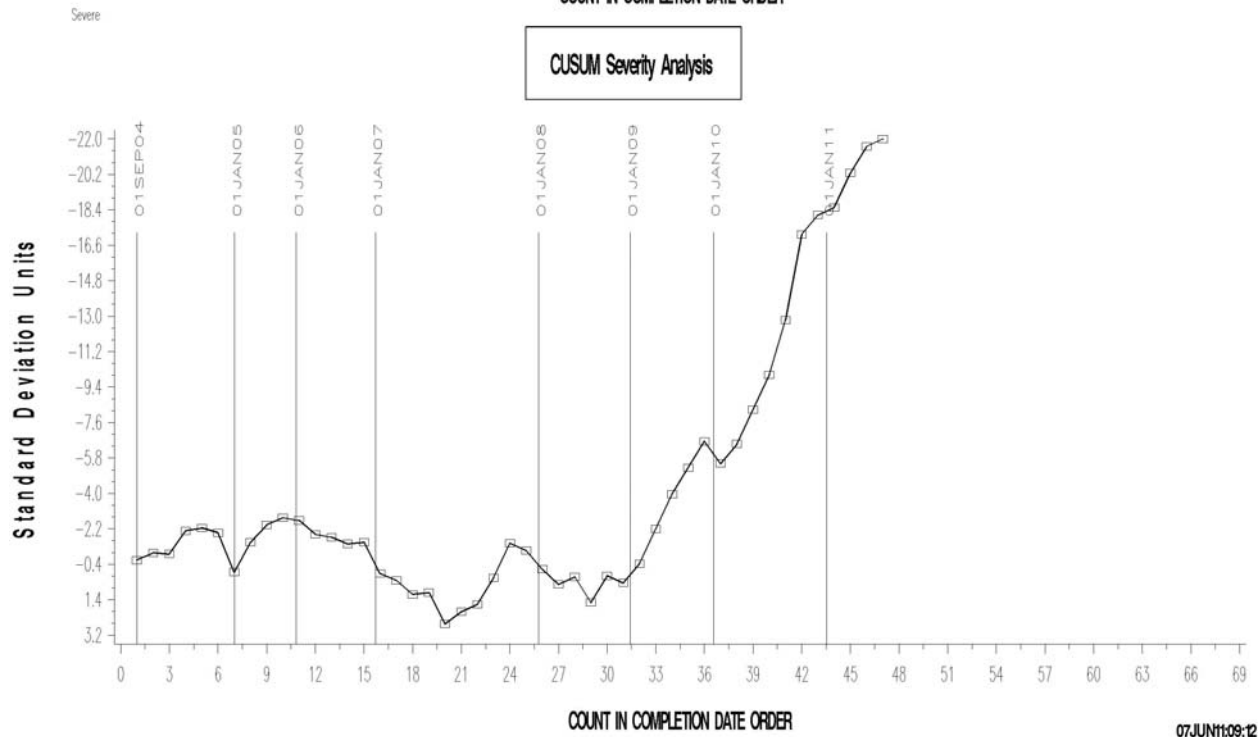
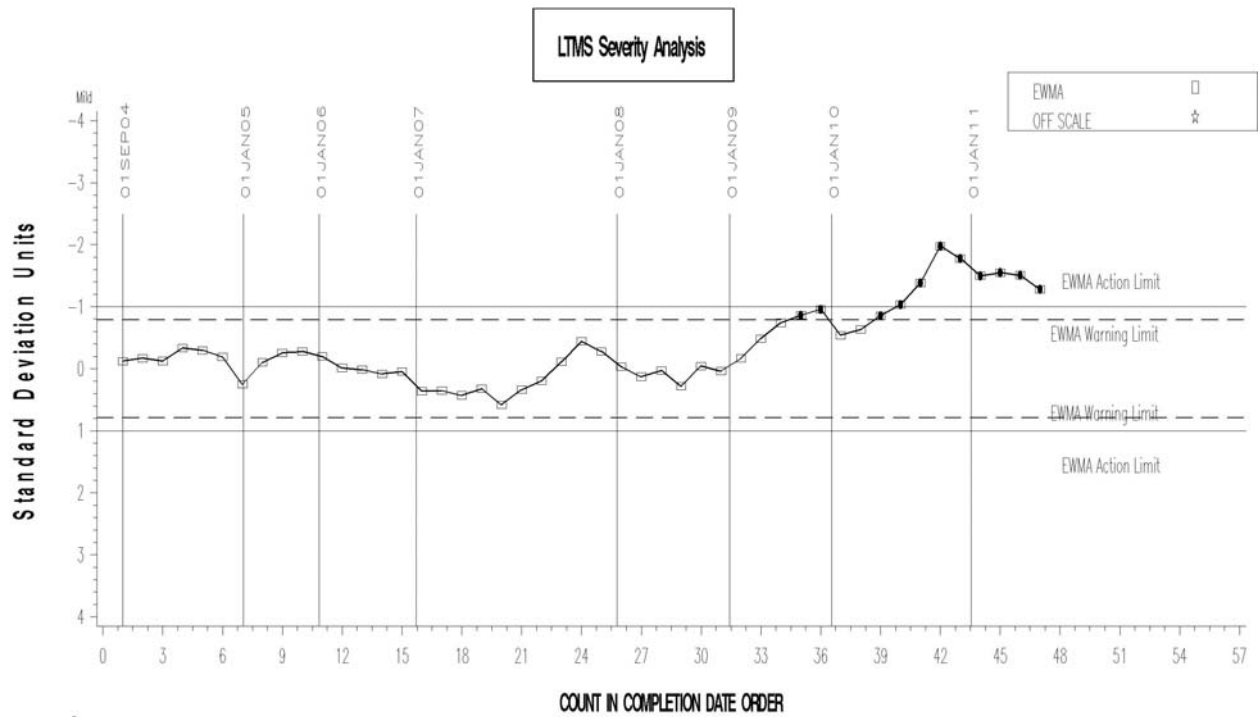
# FIGURE 3

ISM INDUSTRY OPERATIONALLY VALID DATA

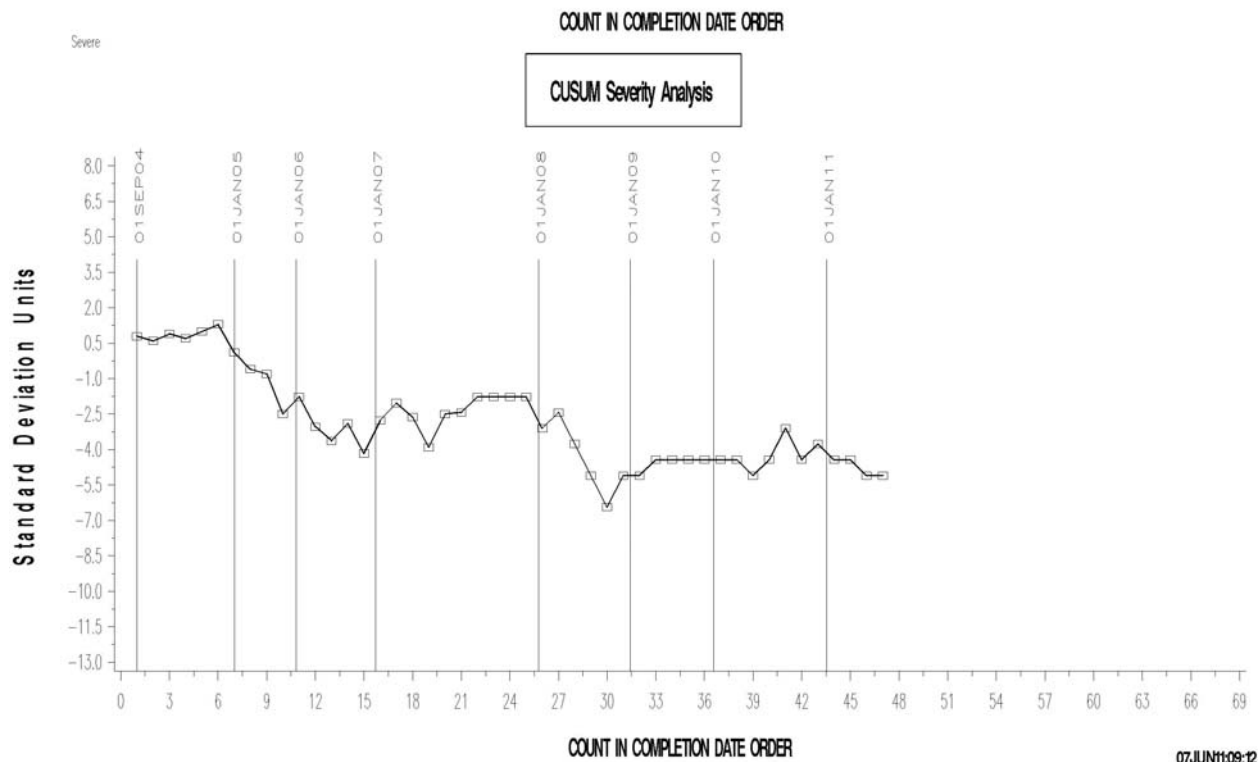
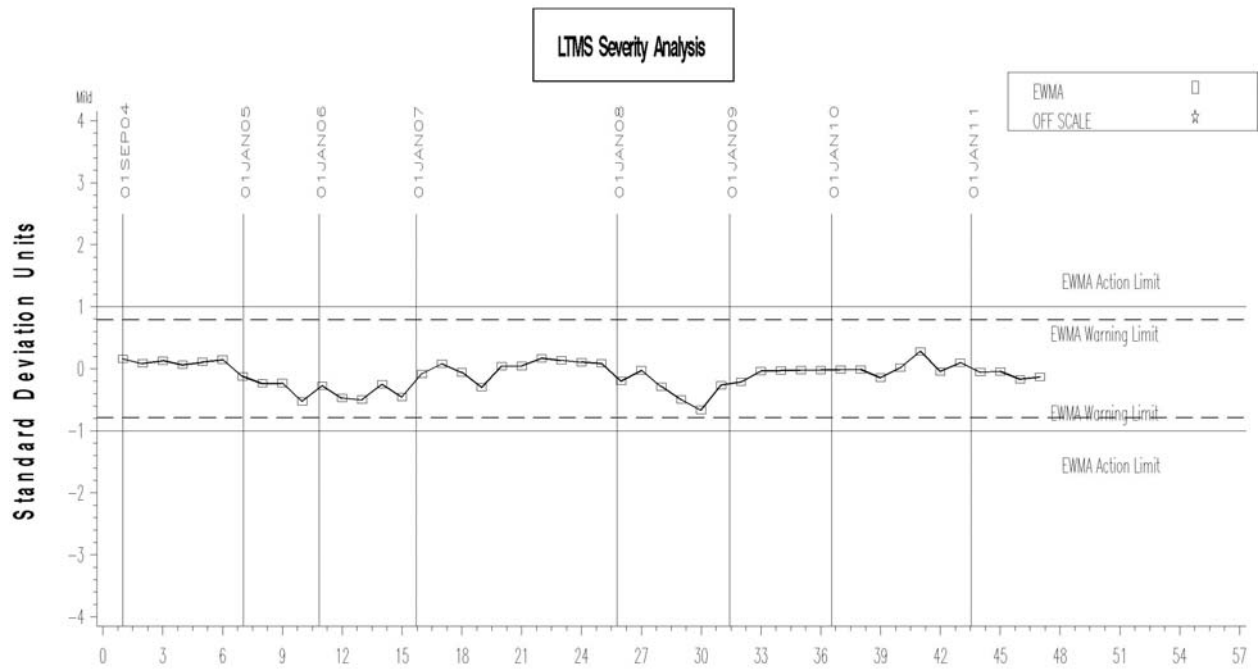
CROSSHEAD WEIGHT LOSS ADJUSTED TO 3.9 % SOOT



**FIGURE 4**  
**ISM INDUSTRY OPERATIONALLY VALID DATA**  
**FILTER PLUGGING DELTA P**



**FIGURE 5**  
**ISM INDUSTRY OPERATIONALLY VALID DATA**  
**AVERAGE SLUDGE RATING**

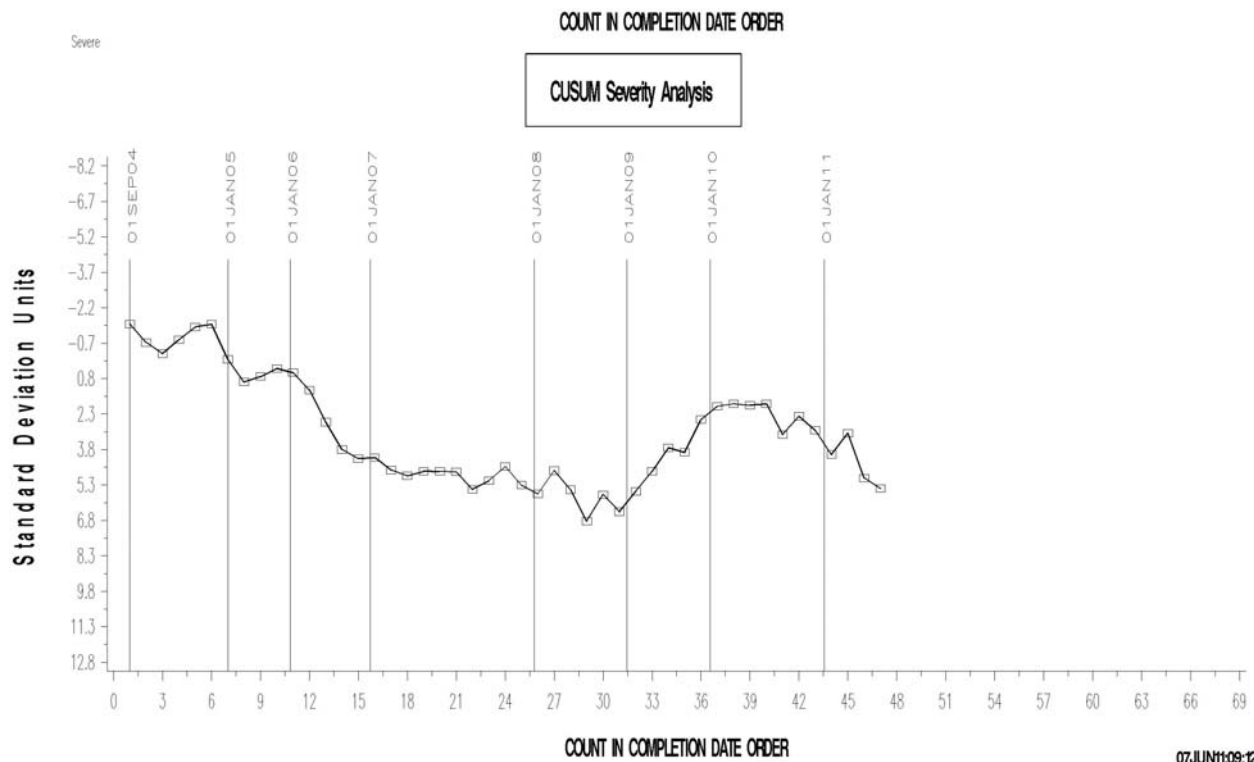
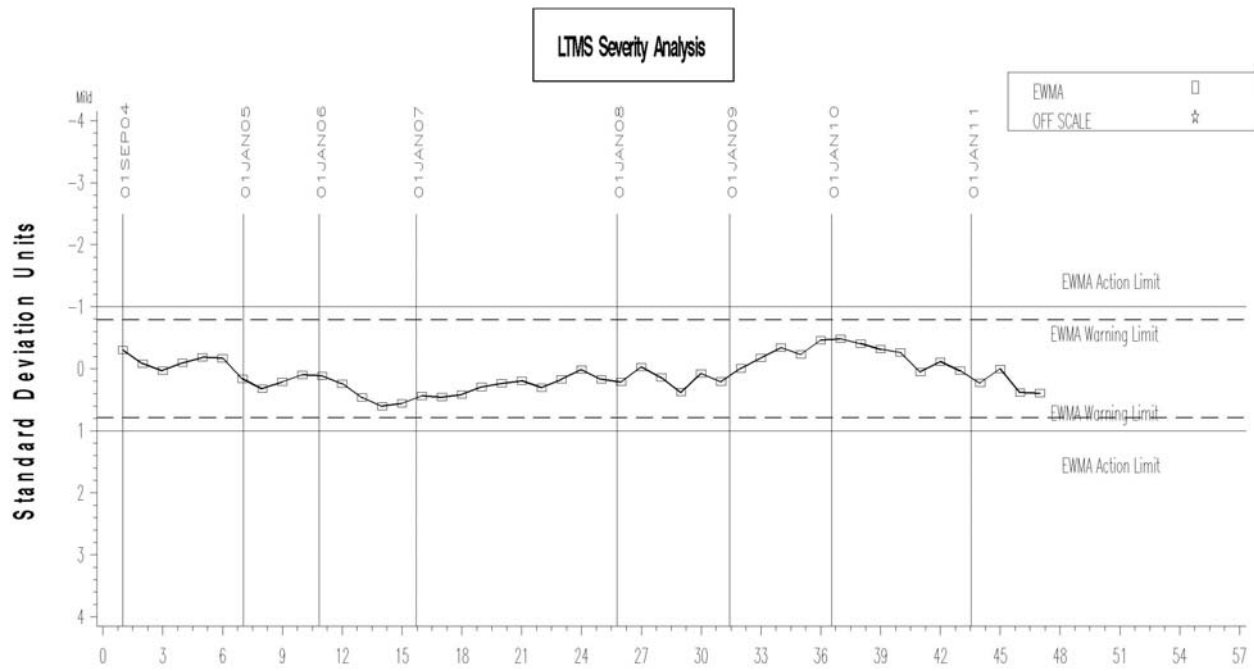




# FIGURE 6

ISM INDUSTRY OPERATIONALLY VALID DATA

INJECTOR SCREW WEIGHT LOSS ADJUSTED TO 3.9% SOOT



## FIGURE 7

### ISB Timeline

09:09 Tuesday, June 7, 2011 1

| Obs | effective_date | info_letter_number | event  |
|-----|----------------|--------------------|--|
| 1   | 20050520       |                    | BEGINNING OF PC-10 MATRIX  |
| 2   | 20050915       |                    | COMPLETION OF PC-10 MATRIX   |
| 3   | 20051123       |                    | LTMS IMPLEMENTED   |
| 4   | 20060804       |                    | ISB Procedure Draft - August 4, 2006 issued.   |
| 5   | 20061128       |                    | ISB Procedure Draft - November 28, 2006 issued.  |
| 6   | 20061218       | 06-1               | Vulkan Driveline coupling supply information added.  |
| 7   | 20061218       | 06-1               | Intake Air Tube diameter corrected from 3.5" to 4.0".  |
| 8   | 20070125       | 07-1               | Soot adjustment calculation modified for ATWL.   |
| 9   | 20070129       |                    | ISB Procedure Draft - January 29, 2007 issued.   |
| 10  | 20070202       | 07-1               | D 129 removed from fuel sulfur measurement methods.  |
| 11  | 20070202       | 07-1               | DACA II Report specified for accuracy and resolution of measurement systems.                     |
| 12  | 20070807       |                    | 14 TEST TARGETS FOR OIL 831 (PC-10B).  |
| 13  | 20080309       |                    | OIL 831-1 INTRODUCED.  |
| 14  | 20090819       | 09-1               | Hardcopy reference test reports no longer sent to TMC.   |
| 15  | 20110421       | 11-1               | Correction Factors implemented for tests using Batch B tappets and Batches E, F, or G camshafts. |

## FIGURE 8

### *ISM Timeline*

09:09 Tuesday, June 7, 2011 1

| Obs | effective_date | info_letter_number | event   |
|-----|----------------|--------------------|---|
| 1   | 20040324       |                    | BEGINNING OF DEVELOPMENT AND DISCRIMINATION MINI-MATRIX                                       |
| 2   | 20050217       |                    | DECISION TO SCREEN INJECTOR ADJUSTING SCREWS FOR TOOLING MARKS.                               |
| 3   | 20050322       |                    | COMPLETION OF MINI-MATRIX ANALYSIS AND IMPLEMENTATION OF SOOT ADJUSTMENTS FOR WEAR PARAMETERS |
| 4   | 20050328       |                    | LTMS IMPLEMENTED  |
| 5   | 20051201       |                    | TEN-TEST TARGETS IMPLEMENTED FOR OIL 830-2  |
| 6   | 20070130       | 07-1               | DRAFT 10 OF THE TEST PROCEDURE RELEASED.  |
| 7   | 20070208       | 07-1               | DACA II REPORT USED FOR OPERATIONAL MEASUREMENT ACCURACY & PRECISION                          |
| 8   | 20070208       | 07-1               | D 129 REMOVED FROM LIST OF FUEL SULFUR MEASUREMENTS.  |
| 9   | 20070208       | 07-1               | NON-INTERPRETABLE TESTS INCLUDED IN CALIBRATION PERIOD TEST COUNT.                            |
| 10  | 20070402       | 07-2               | CALIBRATION PERIOD SET AT 12 MONTHS OR 12 TESTS.  |
| 11  | 20070628       | 07-3               | Industry correction factor of +19.1 mg implemented for Injector Adjusting Screw weight loss.  |
| 12  | 20070628       | 07-3               | Industry correction factor of +1.7 mg implemented for Crosshead weight loss.                  |
| 13  | 20070807       |                    | TWENTY-ONE TEST TARGETS IMPLEMENTED FOR OIL 830-2   |
| 14  | 20090819       | 09-1               | Hardcopy reference test reports no longer sent to TMC.  |
| 15  | 20100304       | 10-1               | Update Crosshead Weight Loss Industry correction factor from +1.7 mg to +1.3 mg.              |
| 16  | 20110209       |                    | First test completed using PC-9-HS fuel.  |
| 17  | 20110430       | 11-1               | Update Crosshead Weight Loss Industry correction factor from +1.3 mg to +2.5 mg.              |