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

MEMORANDUM: 04-033

DATE: April 23, 2004

TO: Don Bartlett, Chairman, L-37 Surveillance Panel

FROM: Donald Lind

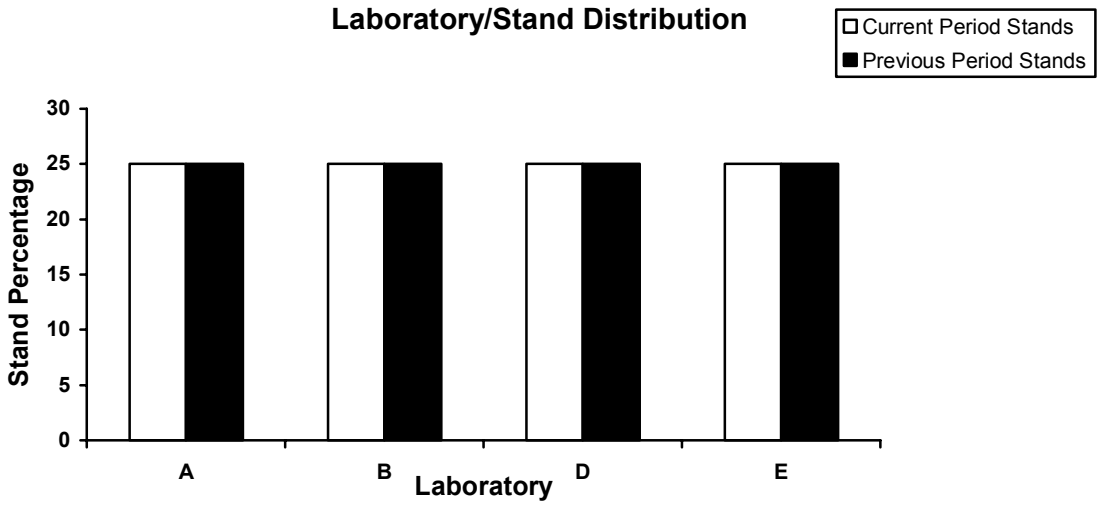
SUBJECT: L-37 Reference Test Status from October 1, 2003 through March 31, 2004

The following is a summary of the L-37 reference oil tests that were reported to the Test Monitoring Center during the period October 1, 2003 through March 31, 2004.

Lab/Stand Distribution

	Reporting Data	Calibrated as of 3/31/04
Number of Laboratories	4	4
Number of Stands	4	4

The following chart shows the laboratory/stand distribution:



The following summarizes the status of the reference oil tests reported to the TMC:

	TMC Validity Codes	Number of Tests
Operationally and Statistically Acceptable	AC	12
Failed Acceptance Criteria	OC	2
Operationally Invalid (Lab Judgment)	LC	0
Not Acceptable For Intended Purpose	MC	0
Aborted	XC	0
Total		14

Lubrited Hardware

There were nine operationally valid reference tests conducted on lubrited hardware. Six were conducted on gear batch V1L686/P4L626A, two were conducted on gear batch C1L308/P4L309R, and one was conducted on gear batch C1L426/P4L404A. Five of the tests conducted on gear batch V1L686/P4L626A were operationally and statistically acceptable and one failed the acceptance criteria. One of the two tests conducted on gear batch C1L308/P4L309R was operationally and statistically acceptable, the other test failed the acceptance criteria. The one test conducted on gear batch C1L426/P4L404A was operationally and statistically acceptable.

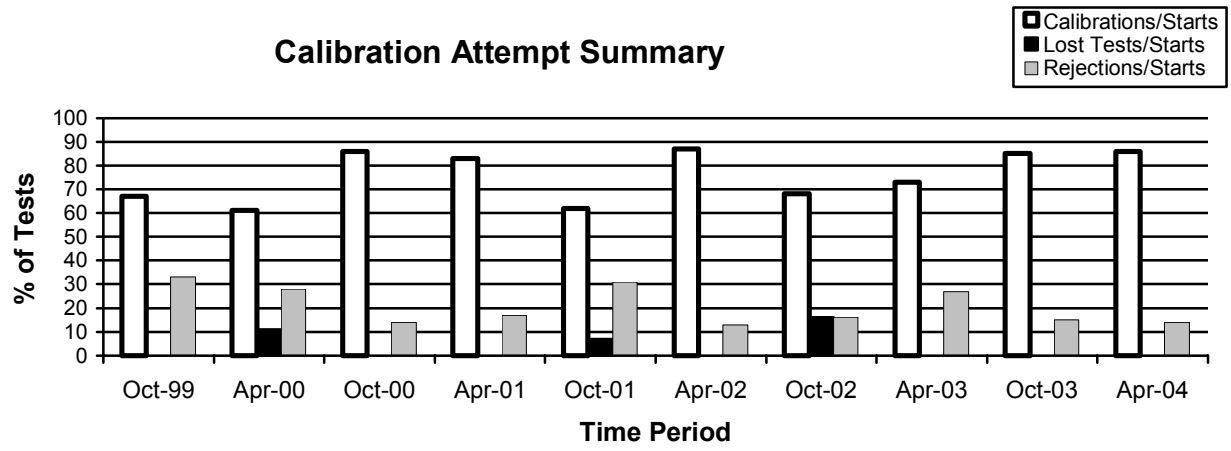
Non-lubrited Hardware

There were five operationally valid reference tests conducted on non-lubrited hardware, one on gear batch C1L426/P4L415A, and four on gear batch V1L176/P4L741A. All five tests were operationally and statistically acceptable.

Additional Tests

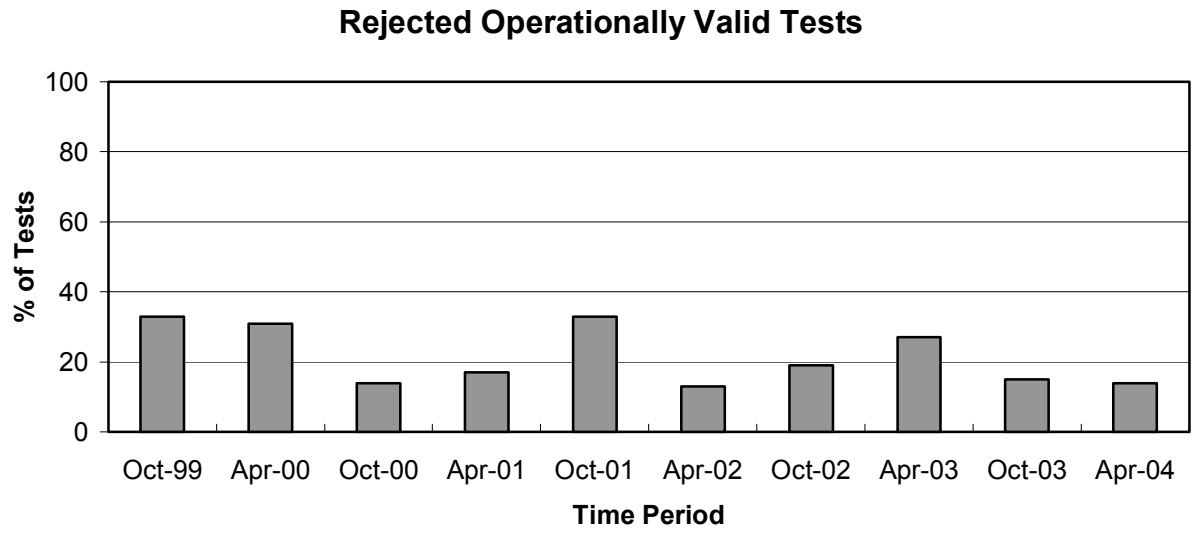
There were 25 additional tests conducted this report period. All 25 tests were conducted to evaluate the new lubrited hardware, gear batch L247/T758A.

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

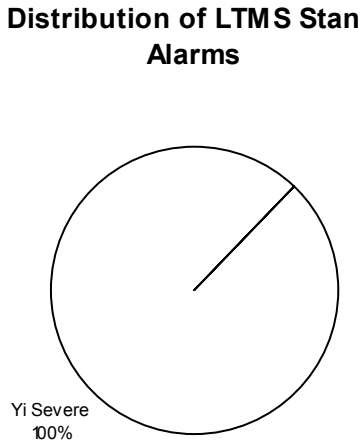


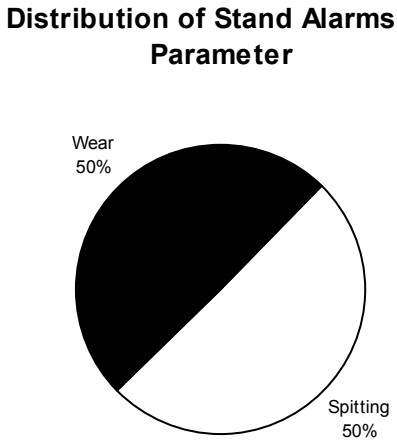
The calibration per start rate has increased slightly when compared to the previous period and the rejected per start rate has decreased slightly with respect to the previous period. The lost test per start rate has remained the same with respect to the previous period.

The operationally valid statistically rejected test rate, as shown below, indicates a slight decrease with respect to the previous period.



A detailed list of reasons tests failed the acceptance criteria is shown in Table 1. The following charts summarize these reasons with a breakdown by parameter of the failed tests.





No LTMS deviations were written this period. There have been no LTMS deviations written in previous report periods.

Severity and Precision

The mean Δ/s by gear batch, overall mean Δ/s, and shift in merits for the operationally and statistically valid calibration tests reported this period are tabulated below for lubrited and non-lubrited hardware.

LUBRITED HARDWARE						
Parameter	Gear Batch	N	Δ/s	s [D]	Overall Δ/s	Overall Shift In Merits
Wear	V1L686/P4L626A	6	-0.33	0.87	-0.18	-0.21 [C]
	C1L426/P4L404A	1	0.52	----		
	C1L308/P4L309R	2	-0.09	0.61		
Ridging	V1L686/P4L626A	6	0.00	0.71	-0.10	-0.10 [A, C]
	C1L426/P4L404A	1	-1.27	----		
	C1L308/P4L309R	2	0.16	0.00		
Rippling	V1L686/P4L626A	6	0.01	0.61	-0.14	-0.10 [A, C]
	C1L426/P4L404A	1	-0.98	----		
	C1L308/P4L309R	2	-0.15	0.00		
Pitt/Spall	V1L686/P4L626A	6	-0.03	0.09	-0.15	-0.13 [B, C]
	C1L426/P4L404A	1	1.13	----		
	C1L308/P4L309R	2	-1.14	1.30		

[A] Level for determining shift in merits (8.0) [B] Level for determining shift in merits (9.3)
[C] Used SA standard deviation as published in the LTMS document for determining shift in merits
[D] A straight standard deviation was used. The number of tests conducted this report period was too small to calculate an accurate pooled standard deviation.

NON-LUBRITED HARDWARE						
Parameter	Gear Batch	N	Δ/s	s [D]	Overall Δ/s	Overall Shift In Merits
Wear	V1L176/P4L741A	4	-0.46	0.70	-0.27	-0.21 [C]
	C1L426/P4L415A	1	0.47	----		
Ridging	V1L176/P4L741A	4	0.18	1.43	0.29	0.08 [A, C]
	C1L426/P4L415A	1	-0.15	----		
Rippling	V1L176/P4L741A	4	-0.47	1.25	-0.26	-0.39 [A, C]
	C1L426/P4L415A	1	0.60	----		
Pitt/Spall	V1L176/P4L741A	4	-0.34	0.47	-0.11	-0.04 [B, C]
	C1L426/P4L415A	1	0.82	----		

[A] Level for determining shift in merits (8.0) [B] Level for determining shift in merits (9.3)
[C] Used SA standard deviation as published in the LTMS document for determining shift in merits
[D] A straight standard deviation was used. The number of tests conducted this report period was too small to calculate an accurate pooled standard deviation.

Shown below are tables of the mean Δ/s by gear batch and hardware for all laboratories reporting data this report period.

Mean Δ/s (LUBRITED HARDWARE)												
Lab	Wear			Ridging			Rippling			Pitt/Spall		
	V1L686 P4L626A	C1L308/ P4L309R	C1L426/ P4L404A	V1L686 P4L626A	C1L308/ P4L309R	C1L426/ P4L404A	V1L686 P4L626A	C1L308/ P4L309R	C1L426/ P4L404A	V1L686 P4L626A	C1L308/ P4L309R	C1L426/ P4L404A
A	0.18	----	----	0.10	----	----	0.00	----	----	0.06	----	----
B	-0.85	----	----	-0.44	----	---	-0.18	----	----	-0.10	----	---
D	0.19	----	0.52	0.62	----	-1.27	0.29	----	-0.98	0.03	----	1.13
E	----	-0.09	----	----	0.16	---	----	-0.15	----	----	-1.14	---

Mean Δ/s (NON-LUBRITED HARDWARE)												
Lab	Wear			Ridging			Rippling			Pitt/Spall		
	V1L686 P4L626A	C1L426/ P4L415A	V1L176/ P4L741A	V1L686 P4L626A	C1L426/ P4L415A	V1L176/ P4L741A	V1L686 P4L626A	C1L426/ P4L415A	V1L176/ P4L741A	V1L686 P4L626A	C1L426/ P4L415A	V1L176/ P4L741A
A	----	----	-0.81	----	----	1.33	----	----	-1.30	----	----	-0.58
B	----	----	-0.81	----	----	-1.61	----	----	1.33	----	----	-0.58
D	----	----	0.59	----	----	-0.32	----	----	-0.61	----	----	0.35
E	----	0.47	----	----	-0.15	----	----	0.60	----	----	0.82	----

Industry Control Charts

Lubrited

Figures 1 through 4 are the lubrited industry control charts for pinion Wear, Rippling, Ridging, and Pitting/Spalling, respectively. Severity and precision EWMA charts for pinion Wear, Ridging, Rippling, and Pitting/Spalling were in control this report period.

Non-lubrited

Figures 5 through 8 are the non-lubrited industry control charts for pinion Wear, Rippling, Ridging, and Pitting/Spalling, respectively. Severity and precision EWMA charts for pinion Wear, Ridging, Rippling, and Pitting/Spalling were in control this report period.

TMC Lab Visits

There were two lab visits this report period with three discrepancies to report. The discrepancies were; there were missing stand instrument calibration records, the labs were not preparing the test axle as outlined in Section 8 of the test procedure, and there was no documentation to confirm the cleaning solvent specification.

Information Letters

There was one information letter issued this report period Information Letter 03-04, Sequence Number 29 was issued on October 9, 2003. Items changed with this information letter are documented in the L-37 timeline (Table 2).

Reference Oil Status

The following is a listing of reference oils with the expected number of tests remaining at the Test Monitoring Center and at the testing laboratories. L-37 reference oils are shipped in quantities of one gallon per test.

Oil	Number of Tests Remaining				
	Lab A	Lab B	Lab D	Lab E	TMC
127	4	3	3	4	17
128-1	7	4	6	3	47
128-2	4	5	5	5	256
151-2	2	0	1	3	*
151-3	7	1	6	5	**

* 0 Gallons (Multiple test area usage)
** 190 Gallons (Multiple test area usage)

DML/dml

Attachments

c: ftp://ftp.astmtmc.cmu.edu/docs/gears/l37/semiannualreports/l37-04-2004.pdf
L-37 Surveillance Panel
J. L. Zalar
F. M. Farber

Distribution: Email

Listing of Tables and Figures Included as Part of This Report to the L-37 Surveillance Panel

Table 1

Summary of Reasons for Rejected Tests

Reasons	No. of Tests
Stand shewhart severity alarm (Spitting Severe)	1
Stand shewhart severity alarm (Wear Severe)	1

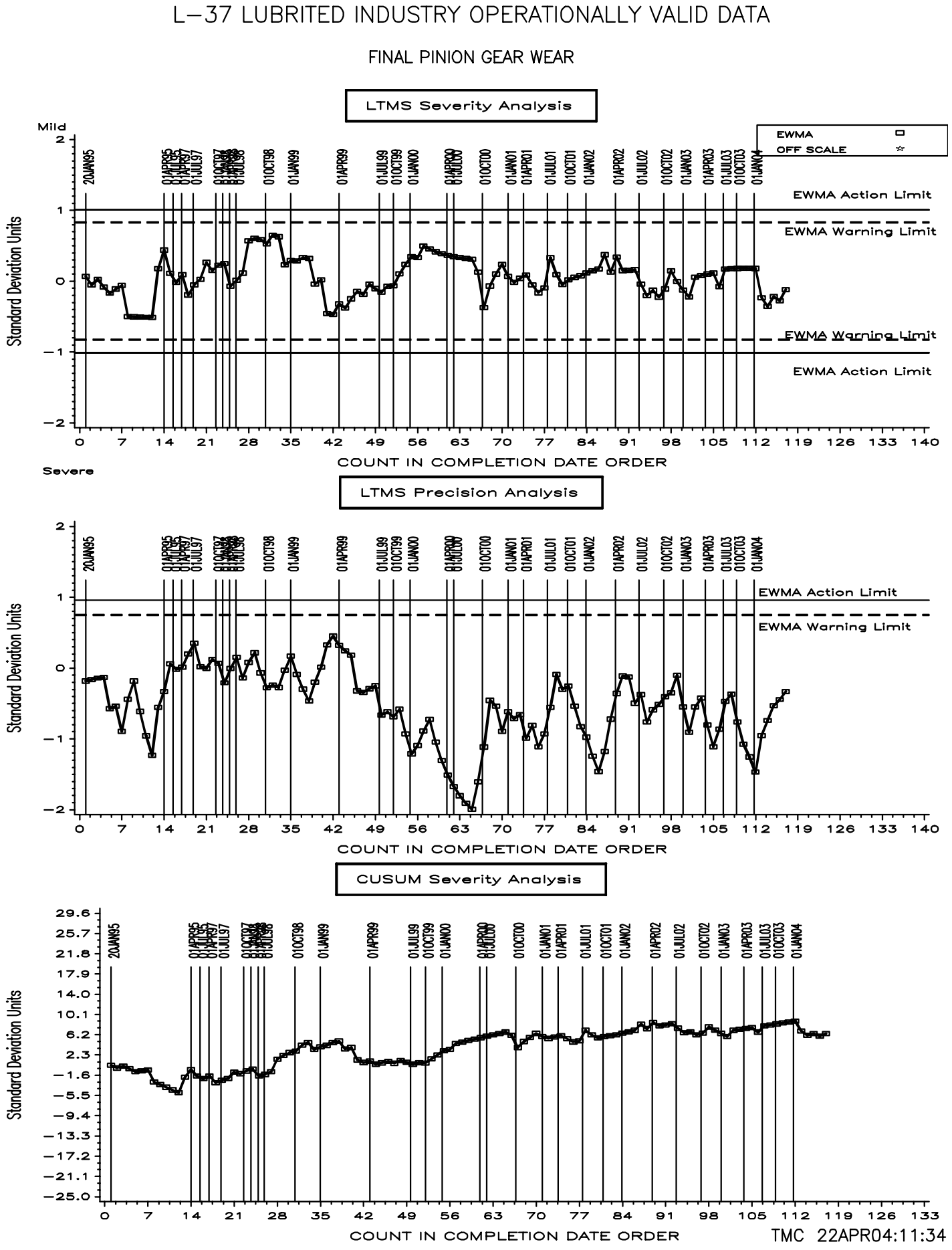
Table 2

	L-37 Timeline	
Effective Date	Topic	IL#
19931221	Report Forms and Dictionary Version 19931209	1
19940104	Rear Cover Plate Sensor Loc.	2
19940104	Data Reporting Response Time	2
19940317	Referencing Schedule	3
19940428	Report Forms and Dictionary Version 19940422	4
19940728	Report Forms and Dictionary Version 19940707	5
19950820	Rating Scale Revision	6
19950820	Report Form 5 Wording Change	6
19950820	Report Forms and Dictionary Version 19950424	6
19960309	Rating Revisions of the Rating Scale	96-1
19960325	Rating Revisions affecting Spalling and Pitting	96-2
19960116	TMC Address	96-2
19960603	Report Forms and Dictionary Version 19960425	96-3
19960603	Revised Wording of Rating Scale	96-3
19960317	Rating Revisions to the Wear Step Area	96-4
19970825	Revised Reference Testing Frequency and Number of Tests for Stands Out of Calibration > 6 months	97-1
19980309	Report Forms and Dictionary Version 19971223	98-1
19980309	Revised Alternate Rating Method For Drive Side Pinion Gear Pitting Values on Gear Set C1L426/P4L415A	98-1
19980309	Test Reporting Clarifications	98-1
19980309	Revisions to Stand Calibration Requirements	98-2
19980309	Restrictions On Reference Oil Analysis	98-2
19980309	Reporting of Non-standard Tests to the TMC	98-2
19980309	LTMS Implementation	98-2
19980310	Report Forms and Dictionary Version 19980203	98-3
19980603	Deviation Percentage Calculation Clarification	98-4
19980901	Combining of Pitting and Spalling Ratings	98-4
19981116	Numerical Rating Precision Clarification	98-5
19990101	Developed Reference Oil Test Targets by Gear Batch (Grandfathered For All Test Starting 19950101)	
19990113	Addition of Exclusion Zone for Determining the Pitting/Spalling Result on Non-lubrited Hardware, Gear Batch V1L303/P4L514A	99-1
19990113	Deletion of Section A8.3.5	99-1
19990503	Updated Reference oil 128-1 Targets (18 Tests), Gear Batch V1L303/P4L514A (Grandfathered For All Test Starting 19950101)	
19990510	Revisions to Precision and Bias Statement	99-2
19990728	Cover Plate Thermocouple Location	99-3
20000613	Root/Tip Polishing Comment for V1L686/P4L626A Non-lubrited Gears	00-1, Sequence No. 20
20000613	Pitting/Spalling Table A9.1 Clarifications	00-1, Sequence No. 20
20001001	CRC Reference Photography of Gear Distress Photographs	00-2, Sequence No. 21
20001115	Correction Factor for V1L686/P4L626A Lubrited Gears	01-1, Sequence No. 22
20010612	Ring Correction Factor for V1L686/P4L626A Lubrited Gears	01-2, Sequence No. 23
20011101	Addition of Annex 12 Addressing Distress Rating Exclusion Comments	01-2, Sequence No. 23
20011101	Revised Report Forms	01-2, Sequence No. 23
20020101	CRC Rating Manual 21	02-1, Sequence No. 24
20020211	Revised Report Forms and Data Dictionary	02-1, Sequence No. 24
20020211	Rating With Magnification	02-2, Sequence No. 25

Table 2 (Continued)

	L-37 Timeline	
Effective Date	Topic	IL#
20030401	Rater Calibration Monitoring System	03-1, Sequence No. 26
20030327	Revised Wear Rating Definitions	03-2, Sequence No. 27
20030421	Deletion of Catastrophic Distress Levels for Wear, Rippling, and Ridging	03-3, Sequence No. 28
20030421	Non-interpretable Tests	03-3, Sequence No. 28
20030421	Tooth Breakage	03-3, Sequence No. 28
20030421	Rating Corrosion On Ring and Pinion	03-3, Sequence No. 28
20030909	Addition of SAE J2360 As a Reference Document	03-4, Sequence No. 29
20030909	Revised Speed Specification for Balancing Dynamometer Connecting Shafts	03-4, Sequence No. 29
20030909	Revised Speed Specification for Balancing Drive Shafts	03-4, Sequence No. 29
20030909	Revised Test Axle Preparation	03-4, Sequence No. 29
20030909	Revised Note 1	03-4, Sequence No. 29
20030909	Discontinue Optional Inspection of Gear Set	03-4, Sequence No. 29
20030909	Shutdown and Downtime Revisions	03-4, Sequence No. 29
20030909	Recording Test Parameters	03-4, Sequence No. 29
20030909	New Note 2 for Gear Test Phase Conditions	03-4, Sequence No. 29
20040101	Revised Cleaning Solvent Specification	03-4, Sequence No. 29

Figure 1


L–37 LUBRITED INDUSTRY OPERATIONALLY VALID DATA
FINAL PINION GEAR WEAR
LTMS Severity Analysis
Mild
Severe
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
CUSUM Severity Analysis
TMC 22APR04:11:34

L−37 LUBRITED INDUSTRY OPERATIONALLY VALID DATA

FINAL PINION GEAR RIPPLING

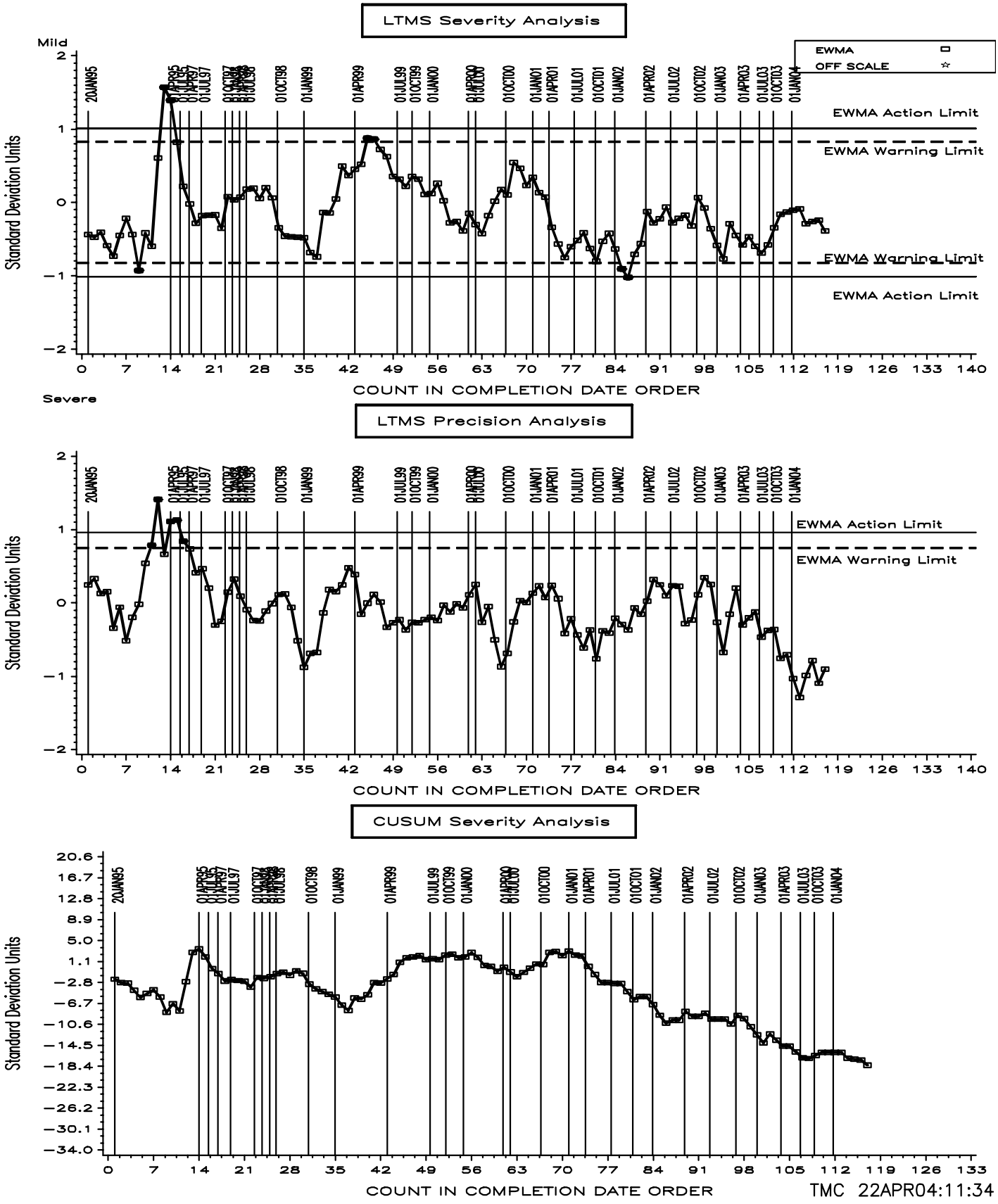


Figure 3

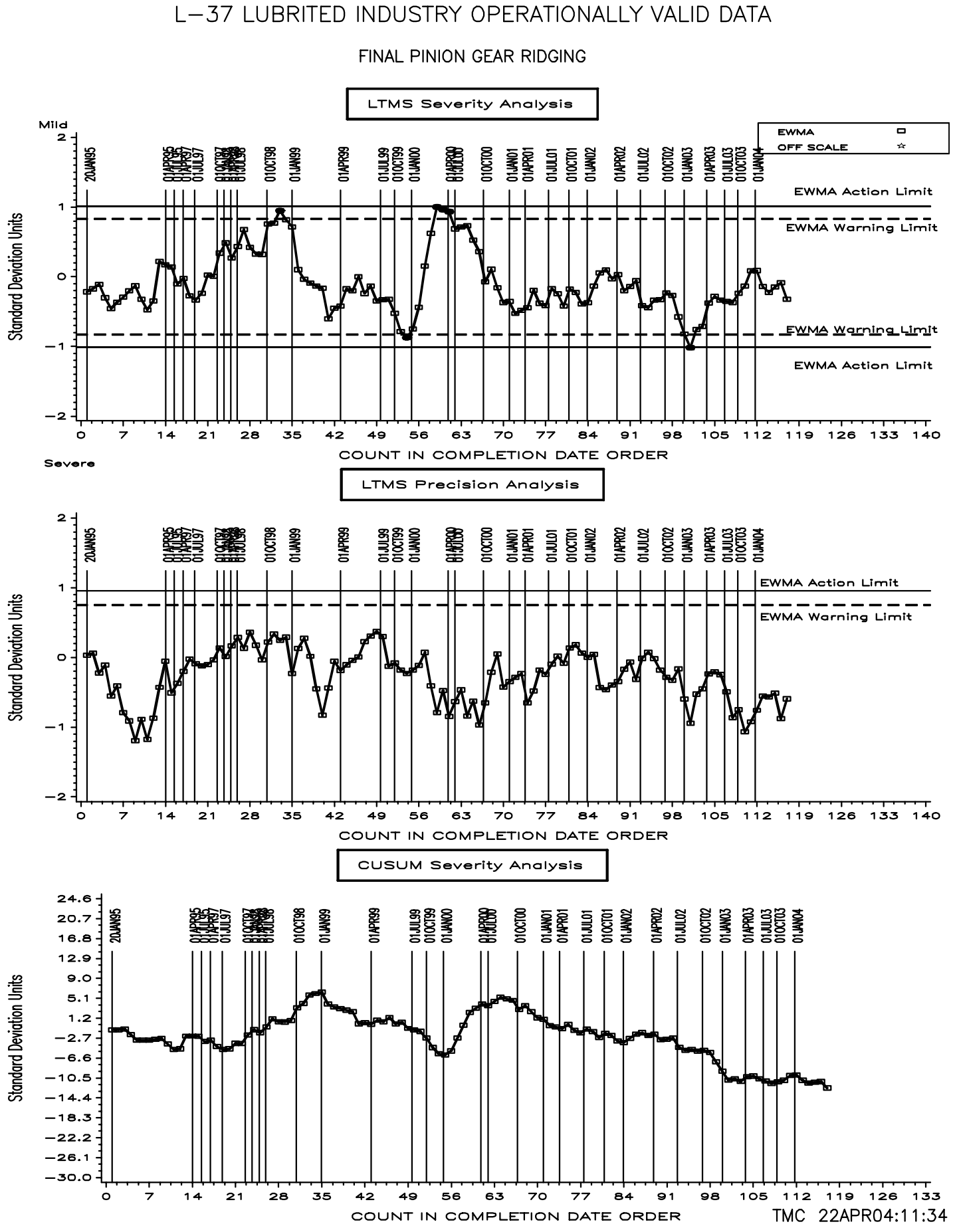

L–37 LUBRITED INDUSTRY OPERATIONALLY VALID DATA
FINAL PINION GEAR RIDGING
LTMS Severity Analysis
Mild
Severe
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
EWMA Action Limit
EWMA Warning Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
TMC 22APR04:11:34

Figure 4

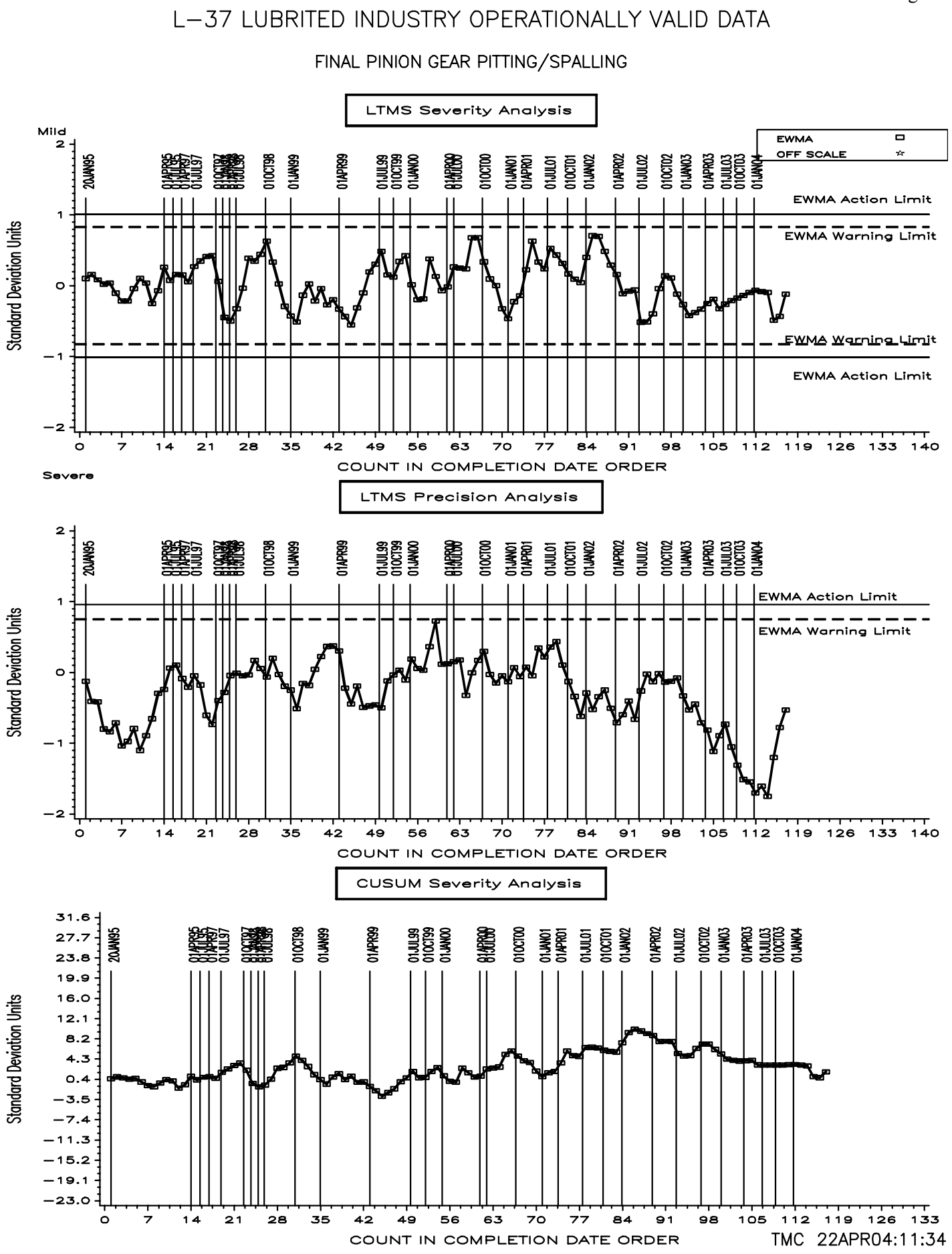

L–37 LUBRITED INDUSTRY OPERATIONALLY VALID DATA
FINAL PINION GEAR PITTING/SPALLING
LTMS Severity Analysis
Mild
Severe
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
CUSUM Severity Analysis
TMC 22APR04:11:34

Figure 5

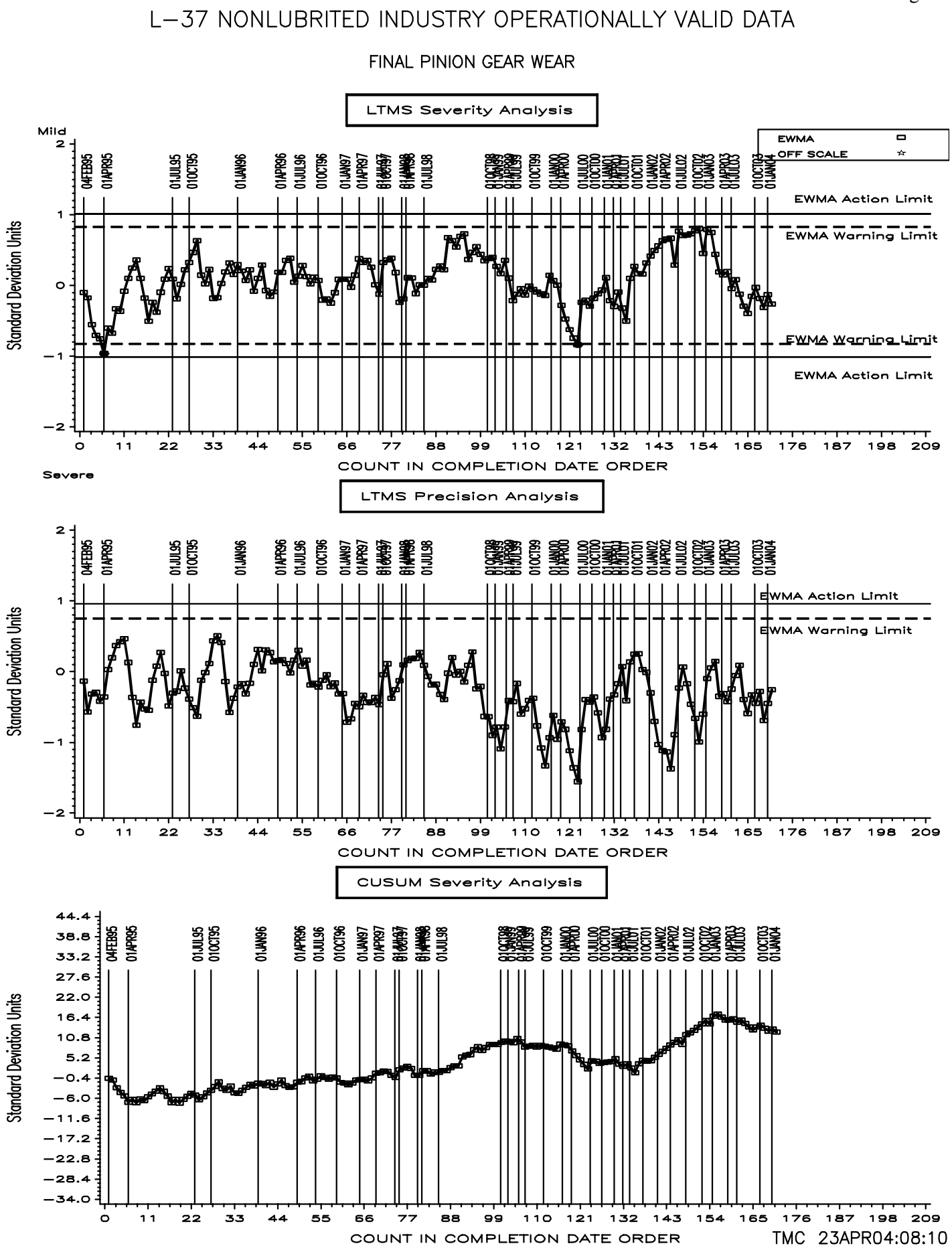

L–37 NONLUBRITED INDUSTRY OPERATIONALLY VALID DATA
FINAL PINION GEAR WEAR
LTMS Severity Analysis
Mild
Severe
Standard Deviation Units
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
EWMA Action Limit
EWMA Warning Limit
COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
COUNT IN COMPLETION DATE ORDER
TMC 23APR04:08:10

Figure 6

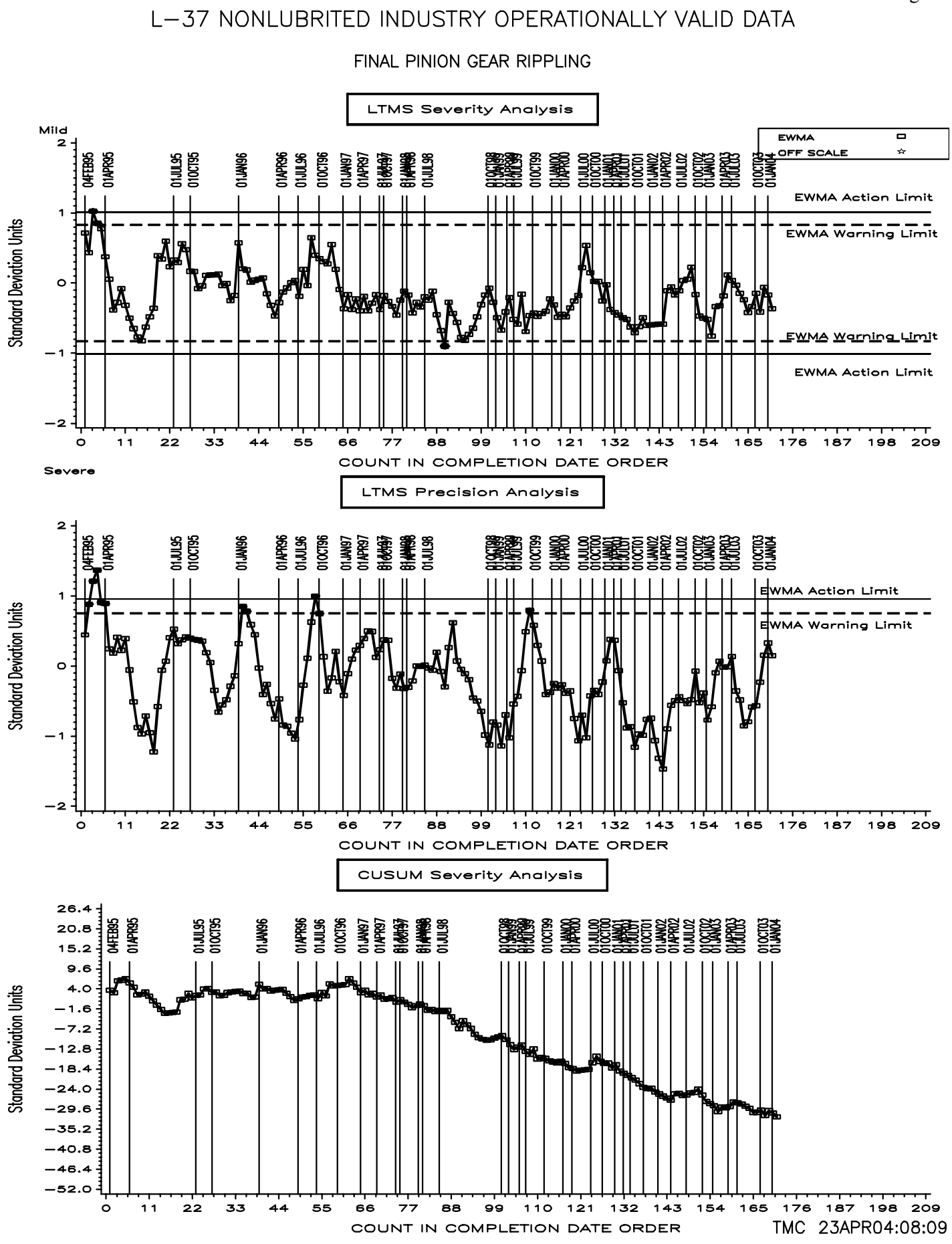
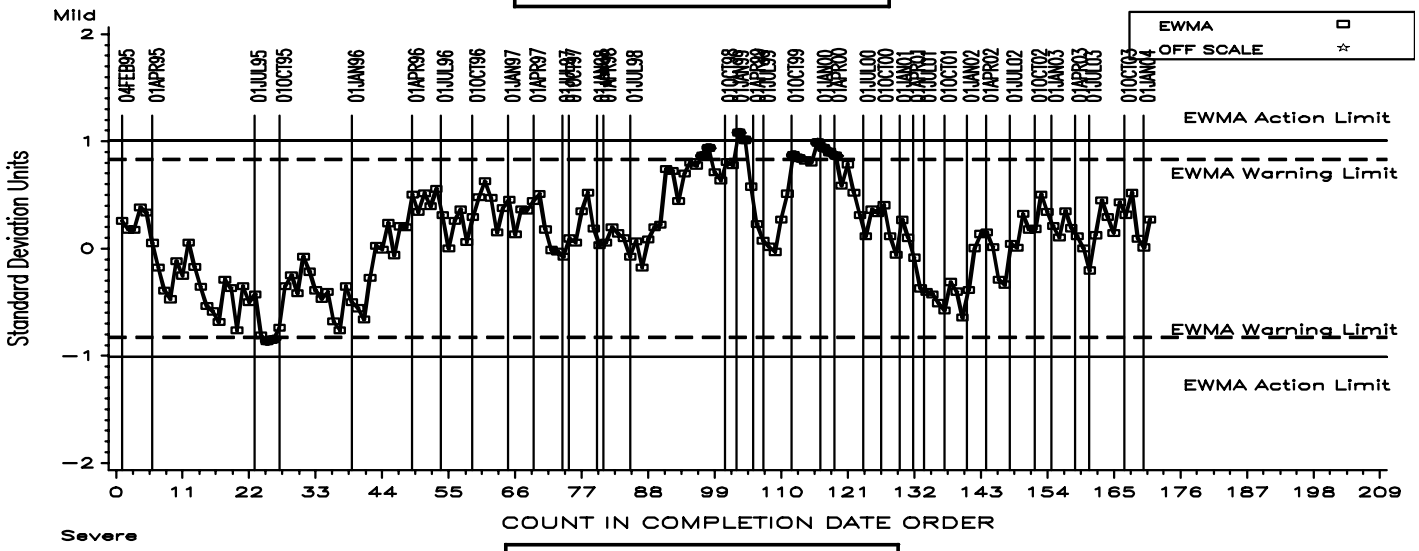

L–37 NONLUBRITED INDUSTRY OPERATIONALLY VALID DATA
FINAL PINION GEAR RIPPLING
LTMS Severity Analysis
Mild
Severe
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
EWMA Action Limit
EWMA Warning Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
TMC 23APR04:08:09

Figure 7

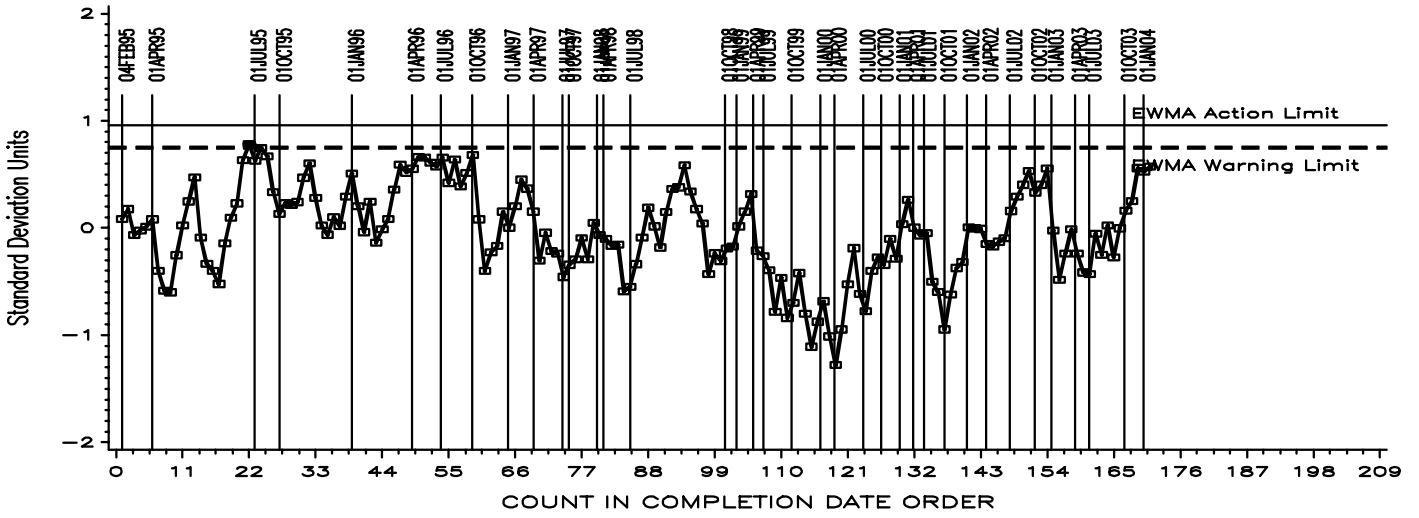
L−37 NONLUBRITED INDUSTRY OPERATIONALLY VALID DATA

FINAL PINION GEAR RIDGING

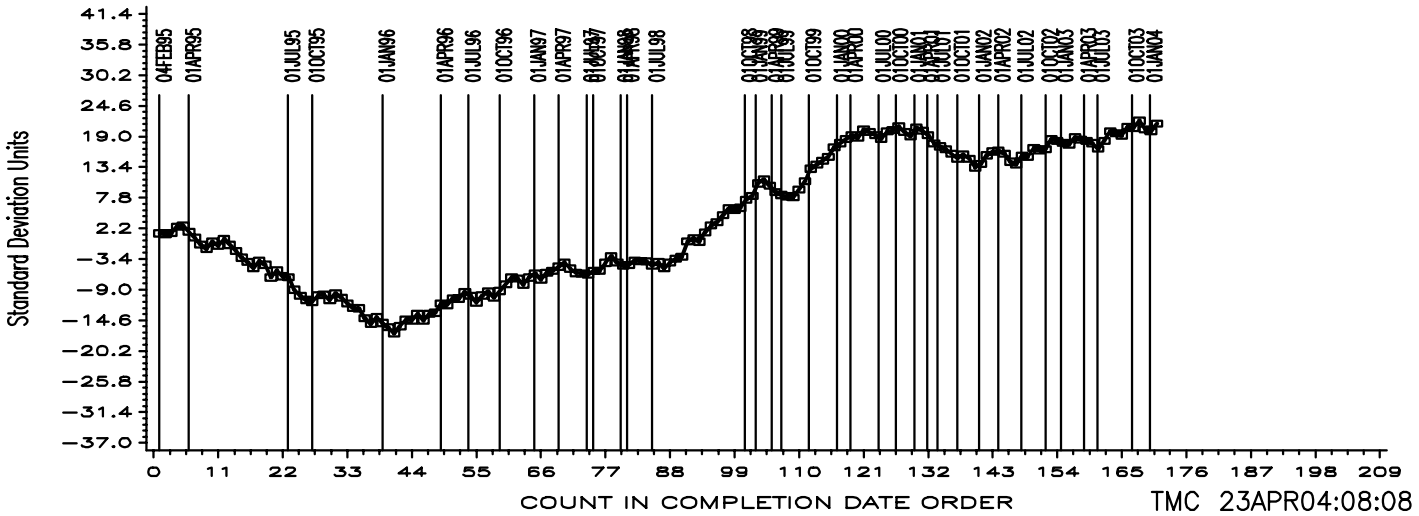
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



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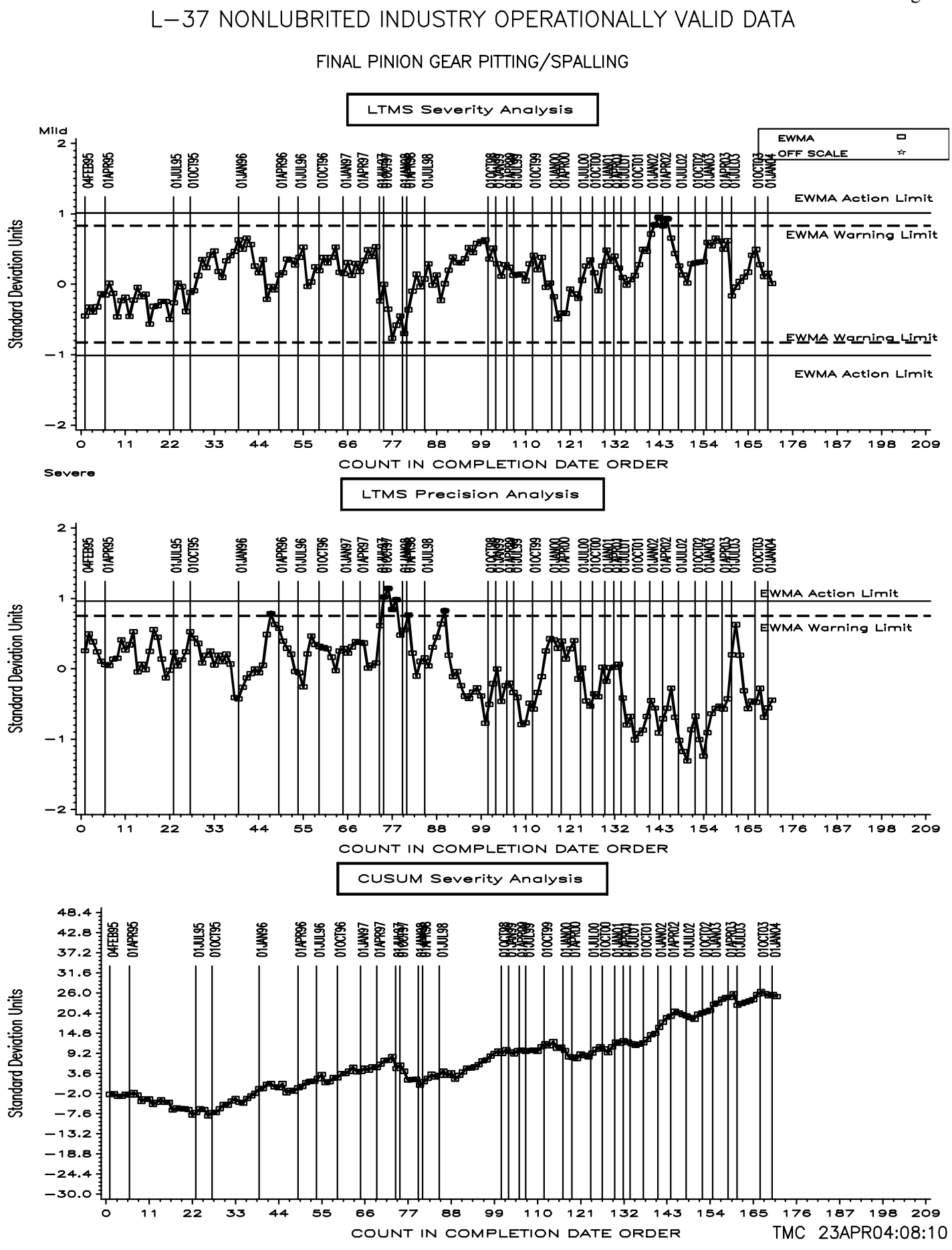
L–37 NONLUBRITED INDUSTRY OPERATIONALLY VALID DATA
FINAL PINION GEAR PITTING/SPALLING
LTMS Severity Analysis
Mild
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
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COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
TMC 23APR04:08:10