L-60-1 (D5704) Taskforce Meeting Minutes

SwRI Tech Center, Ann Arbor, MI

05/06/2014

Meeting was called to order at 10:15

Attendees:

Afton	M. Keisler; J. Chalkley
Intertek	A. Trader
Lubrizol	M. Umerley (Acting Chairmen); J. Gropp; C. Prengaman
SwRI	R. Warden
TMC	S. Parke

M. Umerley shared that L. Hamilton was ill and was not going to be attending the meeting. Matt will be leading the meeting in the chair's absence and recording the minutes.

	Action Item	Responsible Party
1)	Look at longer term data from workshops to quantify If ACV changes over time.	TMC
2)	Direct the raters look at gears without the jig at the upcoming workshop.	TMC
3)	report back with graduated cylinder model number; 1 lab, B, to	Lab A & G
4)	report back with glass "standard" graduated cylinder specifications.	Lab B
5)	Motion to be proposed in May 7th ASTM meeting: 10.10 Remove test gears and gear case between 30 and 60 minutes from test completion.	Surveillance Panel
6)	Verify bushing and nut sizes per drawing.	All Labs
7)	Further work will be done to add language regarding time from copper strip preparation to use time requirements, similar to 8.4.1.	Surveillance Panel
8)	Labs to check if the filter capacitor is present.	All Labs
9)	Labs to verify calibration procedure for alternator watt-meter.	All Labs
10)	Motion to be proposed in May 7th ASTM meeting: TMC to allocate 30 gallons of 155-1 to L-60-1 testing. Labs to run 2 tests (1 per reference period) on each test stand within the next 6 months. Reference periods will be increased by 1 test to allow for the donated test. Tests are to use the 12-11 batch of hardware.	Surveillance Panel

The Agenda was reviewed and is included; see attachment # 1

S. Parke reviewed the industry reference data; see memo 14-002

Mean of test parameters comparing new and old test gear batch were reviewed. Both oils 148-1 & 151-2, limiting only 2010 and newer data

148-1 - Statistical difference between hardware batches: Pentane & toluene

152-1 - Statistical difference between hardware batches: Average carbon varnish (ACV) & Average sludge

Only lab D data was reviewed, and that differs slightly.

The newer gear batch is more mild on 3 out of 4 parameters, but more severe for ACV on 152-1.

Pre ~2002 data is being taken with a grain of salt due to large number of changes / improvements around that time, gear-batch changes, and new oil introduction.

Current data is predominately batch 11-00, but approaching 50/50 split with 11-12.

EWMA only looks at ~7 tests, and does dampen shifts, but only to a limited extent.

J. Gropp asked – what is the current concern, i.e. why are we looking deeper into this.

M. Keisler shared they do occasionally fail on insoluble, but have been able to re-run and pass.

J. Gropp shared that insoluble were considered to be a measure of base oil cleanliness, and may not be as much of a concern today. The targets for this were set many years ago.

M. Umerley reminded the rating jig was implemented in May 2013 – this may have an effect. Raters have shared comments that the jig does improve repeatability (in their opinion).

J. Gropp asked if it would be worthwhile to have the raters look at the results of not using the jig. This prompted discussion on if the data would repeat, and what it would mean.

S. Parke shared that 1-2 raters have left; 2-3 new raters have come in the last 1-2 years.

S. Parke shared that ~10 pieces could be used – 10 with jig & 10 without jig at the upcoming rating workshop

If we did see a difference – what could we do? Taskforce is still considering what we would do if we were to confirm this difference.

There is a concern over how the ACV changes over time on the gears (as compared to L-37 / L-42). This data hasn't been reviewed in any depth, but S. Parke doesn't feel it has shifted much over time.

S. Parke will look at longer term data from workshops to quantify If ACV changes over time. He doesn't feel sludge data will be helpful from the workshop parts.

C. Prengaman proposed to have the raters look at gears without the jig at the upcoming workshop. The group verbally agreed.

The group looked deeper at reference data, and what adjusted targets would look like.

Current K factor is 1.8 for Shewhart limits.

Discussion over stand items:

-Oil Charge (120 +- 5ml)

Different items used – Glass graduated cylinder, plastic graduated cylinder (2), plastic syringe – 60ml syringe

How the oil goes in also differs – one lab uses syringe, funnel sets the graduated cylinder upside-down in it and lets it sit for ~10 min, one lab pours by hand, then waits till it slows down in drips, one lab uses a chemistry grabber to hold the graduated cylinder for ~10 min and let drain.

Starting oil weights differ some by lab – some range ~99-100 grams, others are ~107-110 grams.

S. Parke to summarize the data for review during lunch.

Discussion over using the same equipment. Labs to look into using the same plastic graduated cylinder with appropriate accuracy.

250 ml 2ml subdivision with 2ml tolerance (top is removed) is being used at Lab A.

*Further investigation will be done to attempt to standard on device used to measure the oil charge.

2 labs, A and G, to report back with graduated cylinder model number; 1 lab, B, to report back with glass "standard" graduated cylinder specifications.

-Rig Heat-Up Time (45-60)

Labs feel that the current range is suitable; it may be difficult to tighten this range. Heat-up times vary from lab to lab and within labs.

-Drain test stand for 30 minutes +- 5 minutes

Does everyone crack the case cover the same? All labs typically open the drain, wait until dripping & then crack cover to drain off cover face.

-Large Gear Speed 1750 +-50 rpm

One lab runs slightly higher ~1780 due to fixed motor speed, one lab runs at 1760 +- 5. One lab targets 1750, another lab targets ~1715

Does temperature of the gear surface matter – are they the same? The group felt this would be difficult to measure and does not want to explore at this time.

-Remove gear case & test gears within 60+5 minutes (current procedure)

Discussion about what was the original intent.

Agreement was reached for a Motion to be proposed at May 7th ASTM meeting:

10.10 Remove test gears and gear case between 30 and 60 minutes from test completion.

-Rate test parts within 64 hours of test completion, minimum of 1 hour before rating.

Discussed test parts being rated within 64 hours and decided this should stay as it is.

-Ratable Area under nut

All labs are using slightly different nuts in size – in both diameter and thickness.

Lab B uses a nut that has a built in shoulder (washer).

All Labs are directed to verify bushing and nut sizes per drawing.

-Test Stand Location/Environment

3 labs are in air conditioned environments, 1 lab controls starting ambient temperature in a small space, then allows the space to run uncontrolled during the test.

The different environments were discussed but the group decided that there is no need to make a change at this time.

-Copper Strip

All labs using material to specification, all labs sanding per procedure, all labs believe they use new/fresh screen-cut area for the copper strip polishing.

Some labs prep the gears further ahead than others (within procedural requirements).

Further work will be done to add language regarding time from copper strip preparation to use time requirements, similar to 8.4.1.

-Compressed Air

All labs use tanks dedicated to the L-60-1 stand, incoming gas temperature is assumed to be close to ambient lab temperature. Everyone confirms that they currently comply with D5704 Section 7.1 and feels that the current description is adequate.

-Alternator / Alternator load

Labs to check if the filter capacitor is present.

Labs to verify calibration procedure for alternator watt-meter.

Reference Oil Discussion – Current oils are starting to reduce in inventory.

155-1 replaces RO 151 as it is no longer able to be blended

Do we allocate a portion of 155-1 just for L-60-1 testing?

Agreement was reached for a Motion to be proposed at May 7th ASTM meeting:

TMC to allocate 30 gallons of 155-1 to L-60-1 testing.

Labs to run 2 tests (1 per reference period) on each test stand within the next 6 months. Reference periods will be increased by 1 test to allow for the donated test. Tests are to use the 12-11 batch of hardware.

Meeting was adjourned.

Respectfully Submitted;

Larry Hamilton

Larry Hamilton
L-60-1 Surveillance Panel Chairman

Attachment #1

L-60-1 Task Force

1. TMC presentation of L-60-1 data
2. 10.1 Oil Charge 120 ± 5 ml; (can we tighten this up? Should we not? Calibrated graduated cylinders for accuracy?)
3. 10.3 Rig heat-up time 45 to 60 minutes; (15 minute window? Good, bad, just right?)
4. 10.8 Drain test stand for 30 minutes ± 5 minutes; (do Labs drain for 25 or 35 minutes? Can we tighten this up? Should we not?)
5. 10.6 Large gear speed 1750 ± 50 RPM; (can we tighten this up? Should we not?)
6. 10.10 Remove gear case and test gears within 60 + 5 of test completion (was this meant to be ± 5? Or should it just state 65 minutes) Q. at what time does each Lab remove the gears? Does it make any difference if you remove gears at 25 minutes or 65 minutes after EOT?
7. 10.10 Is the residual oil from gear case added to oil drain as gears are removed? Could this contribute to higher Pentane, Toluene? Obviously this could help with oil loss (10.8) if that was a problem.
8. 11.2 Rate test parts within 64 hours of test completion; minimum of 1 hour before rating (could this make a difference in sludge rating if rated at 1 hour or at 64 hours?)
9. 11.4.8 Ratable area (related to Carbon/Varnish), Measurement / size; of Nut and Washer (side A) ASTM Drawing number B-1996-629-Z (note: no washer in A2.1 in parts list or exploded view) and bearing bushing (side B) ASTM Drawing number A-6-6376-24-Z
10. 13.1.1 Viscosity; within 48 hours of end of test
11. 13.1.3 Pentane and toluene; within 48 hours of end of test
12. Stand locations / environment
13. 7.2 / 8.6 Cooper Strips, per-cut by one supplier?
14. 7.1 / 8.10 Compressed Air, one supplier?
15. Temp of air bubbling through oil
16. Actual alternator load? Consider more accurate application?

Items to bring

Reference test reports (hard copy) three to six reports.

Gear Retaining Nut and Bearing Bushing

Oil charging measuring device

One piece of screen cut from your stock

Pictures of stand set-up

L-60-1 Rating template

A Program of ASTM International

Test Monitoring Center

@ Carnegie Mellon University
6555 Penn Avenue, Pittsburgh, PA 15206, USA

http://astmtmc.cmu.edu
412-365-1000

MEMORANDUM: 14-002

DATE: April 21, 2014

TO: L-60-1 Surveillance Panel

FROM: Scott Parke

SUBJECT: Updated data analysis for May 6, 2014 task force meeting

In preparation for the May 6, 2014 L-60-1 task force meeting, I have updated all of the various analyses that TMC has presented to the group over the past 18 months or so. This updated information follows. I will be prepared to review this information during the meeting and answer any questions.

Pages 3-7 show a comparison of the performance of the new (12-11) and old (11-00) gear batches. The means for various data groups are statistically compared.

Pages 8-19 give a graphical presentation of the information shown on pages 3-5. These plots show the data spread as well as bars indicating the mean and plus and minus one standard deviation. Statistically significant differences are indicated by red bars while the others are green.

Pages 20-24 show the industry control charts. Coloring indicates the various gear batches used over the years. The colors overlap where multiple gear batches were used simultaneously. Two red lines indicate the introduction dates for the two current reference oils.

Page 25 shows the current targets compared to targets computed using the first 30 tests and the most recent 30 tests in both transformed and original units.

Pages 26-30 show the industry control charts if targets from the first 30 tests on 148-1 and 151-2 are used.

Pages 31-35 show the industry control chart for 148-1 exclusively. These plots are shown to try to illustrate when (if ever) changes occurred in 148-1 results. These charts use updated targets but since only one oil is shown, the targets are irrelevant.

Pages 36-40 show the industry control chart for 151-2 exclusively. These plots are shown to try to illustrate when (if ever) changes occurred in 151-2 results. These charts use updated targets but since only one oil is shown, the targets are irrelevant.

SDP/sdp/mem14-002.sdp.doc

cc: Frank Farber
Jeff Clark
ftp://ftp.astmtmc.cmu.edu/docs/gear/l601/memos/mem14-002.pdf

Distribution: email

L-60-1 Gear Batch Comparisons
(April 2014 update)

GEAR batch (all data)
IND=148-1

	NEW	OLD
	23	200
ACVTI	1.317	1.282
ASLTI	0.635	0.658
PENTI	-0.525	-0.713
TOLTI	-0.647	-1.014
VISITI	3.689	3.704

N size for the group

Test parameter means

GEAR batch (all data)
IND=151-2

	NEW	OLD
	21	241
ACVTI	1.358	1.583
ASLTI	0.568	0.487
PENTI	0.818	0.702
TOLTI	0.343	0.214
VISITI	3.612	3.613

Highlighting indicates statistically significant difference at 95% confidence

L-60-1 Gear Batch Comparisons
(April 2014 update)

Restricting analysis to more recent data as was done for initial gear batch approval

GEAR batch (all data)
IND=148-1

	NEW	OLD
	23	200
ACVTI	1.317	1.282
ASLTI	0.635	0.658
PENTI	-0.525	-0.713
TOLTI	-0.647	-1.014
VISITI	3.689	3.704

GEAR batch (date >=20100101)
IND=148-1

	NEW	OLD
	23	66
ACVTI	1.317	1.304
ASLTI	0.635	0.614
PENTI	-0.525	-0.729
TOLTI	-0.647	-0.977
VISITI	3.689	3.698

GEAR batch (all data)
IND=151-2

	NEW	OLD
	21	241
ACVTI	1.358	1.583
ASLTI	0.568	0.487
PENTI	0.818	0.702
TOLTI	0.343	0.214
VISITI	3.612	3.613

GEAR batch (date >=20100101)
IND=151-2

	NEW	OLD
	21	68
ACVTI	1.358	1.554
ASLTI	0.568	0.422
PENTI	0.818	0.730
TOLTI	0.343	0.295
VISITI	3.612	3.620

L-60-1 Gear Batch Comparisons
(April 2014 update)

Considering only Lab D data.

GEAR batch (all data)
IND=148-1

	NEW	OLD
	23	200
ACVTI	1.317	1.282
ASLTI	0.635	0.658
PENTI	-0.525	-0.713
TOLTI	-0.647	-1.014
VISITI	3.689	3.704

GEAR batch (date >=20100101)
IND=148-1

	NEW	OLD
	23	66
ACVTI	1.317	1.304
ASLTI	0.635	0.614
PENTI	-0.525	-0.729
TOLTI	-0.647	-0.977
VISITI	3.689	3.698

GEAR batch (Lab D alldata)
IND=148-1

	NEW	OLD
	18	89
ACVTI	1.343	1.352
ASLTI	0.582	0.628
PENTI	-0.477	-0.560
TOLTI	-0.540	-0.878
VISITI	3.695	3.708

GEAR batch (all data)
IND=151-2

	NEW	OLD
	21	241
ACVTI	1.358	1.583
ASLTI	0.568	0.487
PENTI	0.818	0.702
TOLTI	0.343	0.214
VISITI	3.612	3.613

GEAR batch (date >=20100101)
IND=151-2

	NEW	OLD
	21	68
ACVTI	1.358	1.554
ASLTI	0.568	0.422
PENTI	0.818	0.730
TOLTI	0.343	0.295
VISITI	3.612	3.620

GEAR batch (Lab D alldata)
IND=151-2

	NEW	OLD
	15	99
ACVTI	1.283	1.509
ASLTI	0.620	0.528
PENTI	0.896	0.782
TOLTI	0.457	0.194
VISITI	3.608	3.630

L-60-1 Gear Batch Comparisons
(April 2014 update)

Considering only more recent Lab D data.

GEAR batch (all data)
IND=148-1

	NEW	OLD
	23	200
ACVTI	1.317	1.282
ASLTI	0.635	0.658
PENTI	-0.525	-0.713
TOLTI	-0.647	-1.014
VISITI	3.689	3.704

GEAR batch (date >=20100101)
IND=148-1

	NEW	OLD
	23	66
ACVTI	1.317	1.304
ASLTI	0.635	0.614
PENTI	-0.525	-0.729
TOLTI	-0.647	-0.977
VISITI	3.689	3.698

GEAR batch (Lab D alldata)
IND=148-1

	NEW	OLD
	18	89
ACVTI	1.343	1.352
ASLTI	0.582	0.628
PENTI	-0.477	-0.560
TOLTI	-0.540	-0.878
VISITI	3.695	3.708

GEAR batch (Lab D >=20100101)
IND=148-1

	NEW	OLD
	18	27
ACVTI	1.343	1.421
ASLTI	0.582	0.587
PENTI	-0.477	-0.562
TOLTI	-0.540	-0.701
VISITI	3.695	3.696

GEAR batch (all data)
IND=151-2

	NEW	OLD
	21	241
ACVTI	1.358	1.583
ASLTI	0.568	0.487
PENTI	0.818	0.702
TOLTI	0.343	0.214
VISITI	3.612	3.613

GEAR batch (date >=20100101)
IND=151-2

	NEW	OLD
	21	68
ACVTI	1.358	1.554
ASLTI	0.568	0.422
PENTI	0.818	0.730
TOLTI	0.343	0.295
VISITI	3.612	3.620

GEAR batch (Lab D alldata)
IND=151-2

	NEW	OLD
	15	99
ACVTI	1.283	1.509
ASLTI	0.620	0.528
PENTI	0.896	0.782
TOLTI	0.457	0.194
VISITI	3.608	3.630

GEAR batch (Lab D >=20100101)
IND=151-2

	NEW	OLD
	15	26
ACVTI	1.283	1.481
ASLTI	0.620	0.522
PENTI	0.896	0.852
TOLTI	0.457	0.487
VISITI	3.608	3.616

L-60-1 Gear Batch Comparisons

(April 2014 update)

GEAR batch (all data)
IND=148-1

	NEW	OLD
	23	200
ACVTI	1.317	1.282
ASLTI	0.635	0.658
PENTI	-0.525	-0.713
TOLTI	-0.647	-1.014
VISITI	3.689	3.704

GEAR batch (date >=20100101)
IND=148-1

	NEW	OLD
	23	66
ACVTI	1.317	1.304
ASLTI	0.635	0.614
PENTI	-0.525	-0.729
TOLTI	-0.647	-0.977
VISITI	3.689	3.698

GEAR batch (Lab D alldata)
IND=148-1

	NEW	OLD
	18	89
ACVTI	1.343	1.352
ASLTI	0.582	0.628
PENTI	-0.477	-0.560
TOLTI	-0.540	-0.878
VISITI	3.695	3.708

GEAR batch (Lab D >=20100101)
IND=148-1

	NEW	OLD
	18	27
ACVTI	1.343	1.421
ASLTI	0.582	0.587
PENTI	-0.477	-0.562
TOLTI	-0.540	-0.701
VISITI	3.695	3.696

GEAR batch (all data)
IND=151-2

	NEW	OLD
	21	241
ACVTI	1.358	1.583
ASLTI	0.568	0.487
PENTI	0.818	0.702
TOLTI	0.343	0.214
VISITI	3.612	3.613

GEAR batch (date >=20100101)
IND=151-2

	NEW	OLD
	21	68
ACVTI	1.358	1.554
ASLTI	0.568	0.422
PENTI	0.818	0.730
TOLTI	0.343	0.295
VISITI	3.612	3.620

GEAR batch (Lab D alldata)
IND=151-2

	NEW	OLD
	15	99
ACVTI	1.283	1.509
ASLTI	0.620	0.528
PENTI	0.896	0.782
TOLTI	0.457	0.194
VISITI	3.608	3.630

GEAR batch (Lab D >=20100101)
IND=151-2

	NEW	OLD
	15	26
ACVTI	1.283	1.481
ASLTI	0.620	0.522
PENTI	0.896	0.852
TOLTI	0.457	0.487
VISITI	3.608	3.616

ORIGINAL UNITS Same analyses repeated for original units (no transformation)

GEAR batch (all data)
IND=148-1

	NEW	OLD
	23	200
ACV	7.883	7.805
ASL	9.465	9.476
PEN	0.600	0.516
TOL	0.539	0.386
VISI	40.217	40.685

GEAR batch (date >=20100101)
IND=148-1

	NEW	OLD
	23	66
ACV	7.883	7.836
ASL	9.465	9.453
PEN	0.600	0.495
TOL	0.539	0.400
VISI	40.217	40.424

GEAR batch (Lab D alldata)
IND=148-1

	NEW	OLD
	18	89
ACV	7.928	7.936
ASL	9.439	9.463
PEN	0.628	0.608
TOL	0.589	0.443
VISI	40.500	40.843

GEAR batch (Lab D >=20100101)
IND=148-1

	NEW	OLD
	18	27
ACV	7.928	8.048
ASL	9.439	9.441
PEN	0.628	0.582
TOL	0.589	0.507
VISI	40.500	40.296

GEAR batch (all data)
IND=151-2

	NEW	OLD
	21	241
ACV	7.938	8.238
ASL	9.429	9.377
PEN	2.310	2.049
TOL	1.495	1.300
VISI	37.190	37.166

GEAR batch (date >=20100101)
IND=151-2

	NEW	OLD
	21	68
ACV	7.938	8.204
ASL	9.429	9.337
PEN	2.310	2.118
TOL	1.495	1.399
VISI	37.190	37.382

GEAR batch (Lab D alldata)
IND=151-2

	NEW	OLD
	15	99
ACV	7.820	8.169
ASL	9.460	9.407
PEN	2.487	2.227
TOL	1.667	1.317
VISI	37.067	37.788

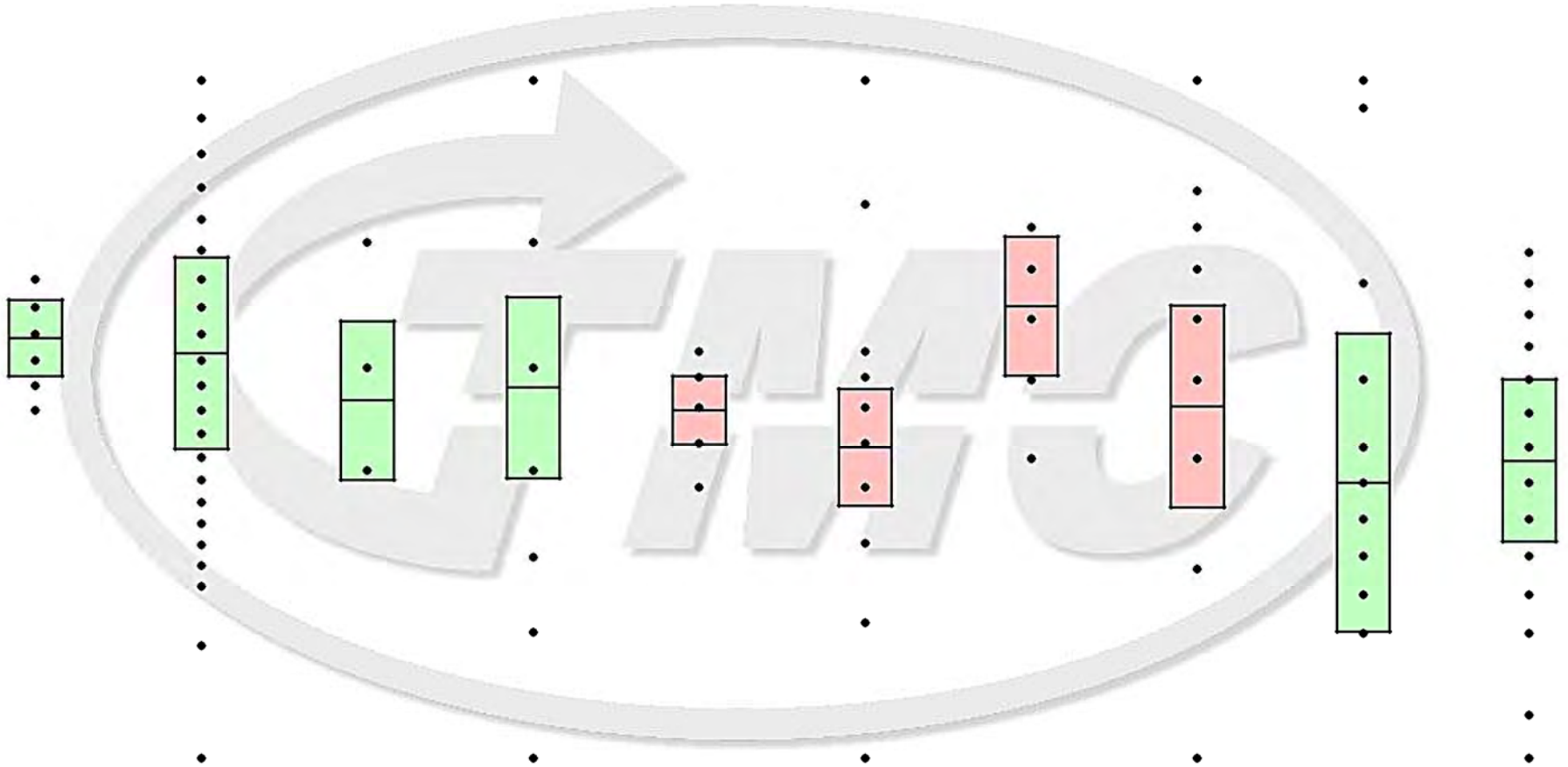
GEAR batch (Lab D >=20100101)
IND=151-2

	NEW	OLD
	15	26
ACV	7.820	8.127
ASL	9.460	9.404
PEN	2.487	2.415
TOL	1.667	1.689
VISI	37.067	37.281

L-60-1 New vs Old Gears

All Data

UNITS=TRANSFORMED IND=148-1



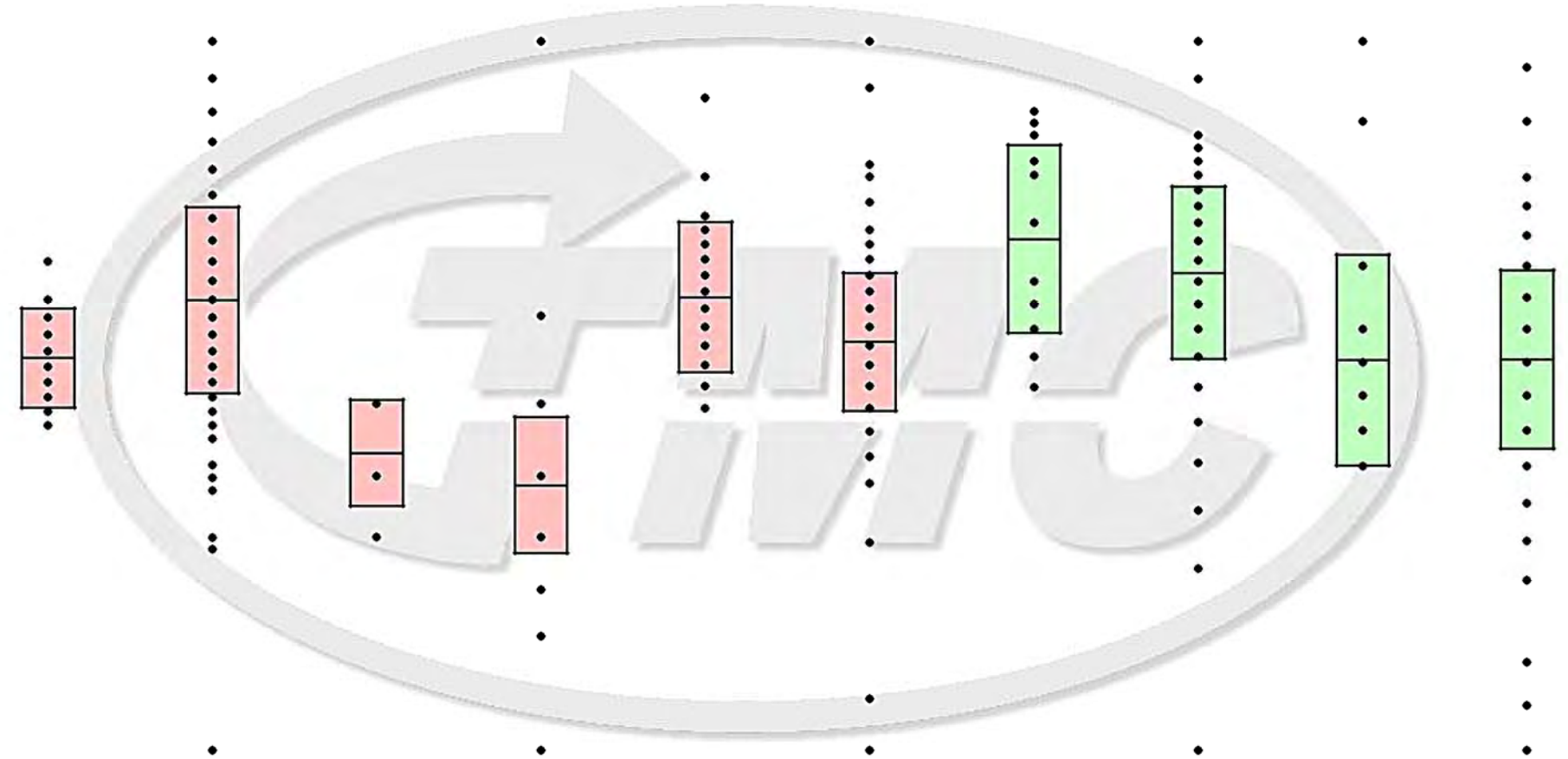
	ACVTI NEW	ACVTI OLD	ASLTI NEW	ASLTI OLD	PENTI NEW	PENTI OLD	TOLTI NEW	TOLTI OLD	VISITI NEW	VISITI OLD
N	23	200	23	200	23	200	23	200	23	200
Min	1.153	0.364	0.511	0	-0.92	-2.3	-1.2	-2.3	3.584	3.497
Max	1.45	1.901	0.916	1.204	-0.22	1.163	-0.36	0.182	3.97	3.85
Mean	1.317	1.282	0.635	0.658	-0.53	-0.71	-0.65	-1.01	3.689	3.704
Std	0.086	0.218	0.141	0.161	0.175	0.298	0.254	0.369	0.104	0.057

10:23:30 11APR2014

L-60-1 New vs Old Gears

All Data

UNITS=TRANSFORMED IND=151-2



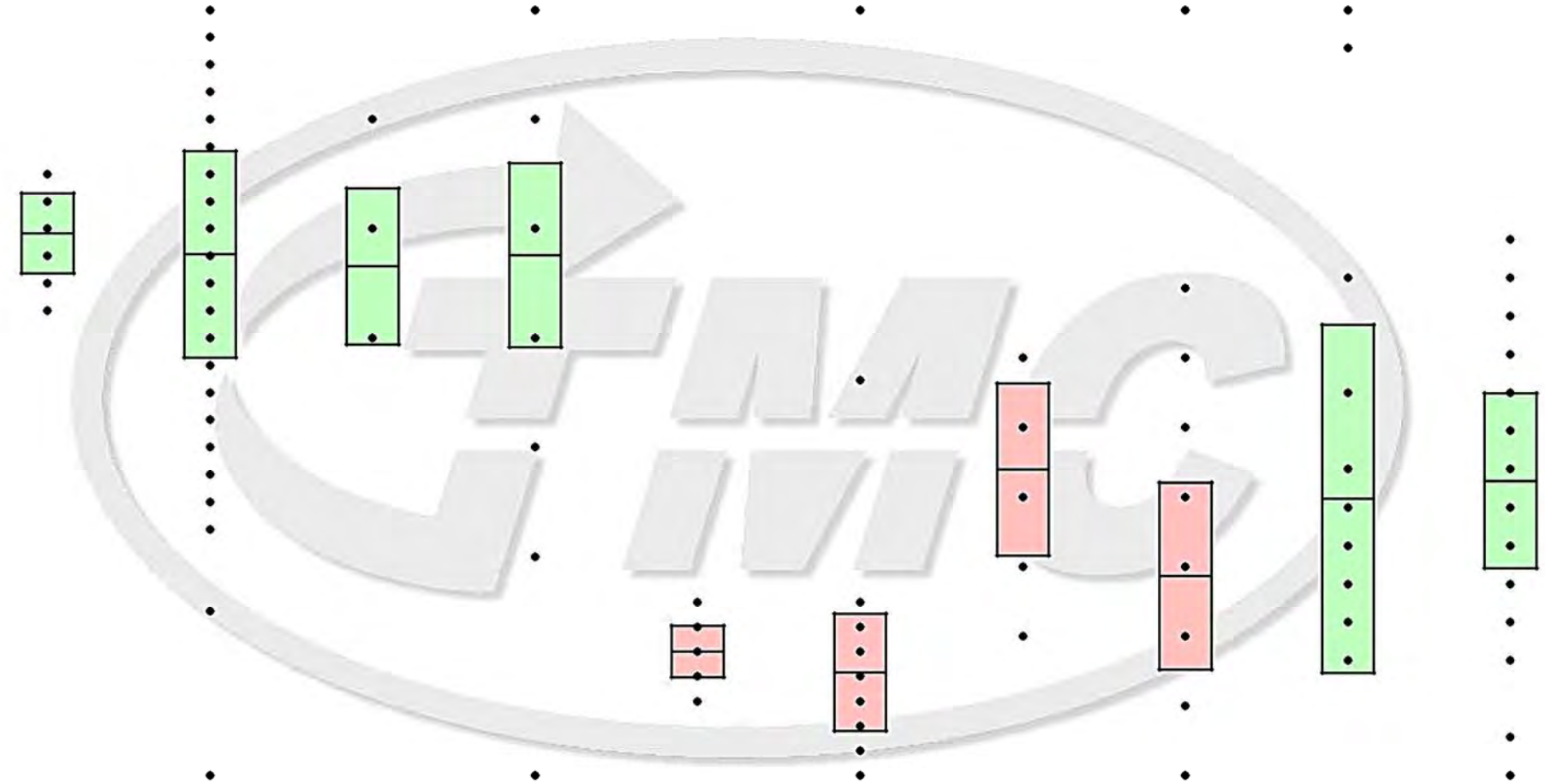
	ACVTI NEW	ACVTI OLD	ASLTI NEW	ASLTI OLD	PENTI NEW	PENTI OLD	TOLTI NEW	TOLTI OLD	VISITI NEW	VISITI OLD
N	21	241	21	241	21	241	21	241	21	241
Min	1.099	-0.16	0.357	-0.18	0.531	-0.36	-0.22	-1.61	3.526	3.296
Max	1.735	2.587	0.693	1.609	1.335	1.482	0.833	1.099	3.871	3.85
Mean	1.358	1.583	0.568	0.487	0.818	0.702	0.343	0.214	3.612	3.613
Std	0.193	0.362	0.134	0.172	0.195	0.179	0.359	0.33	0.086	0.073

10:23:30 11APR2014

L-60-1 New vs Old Gears

All Data

UNITS=ORIGINAL IND=148-1



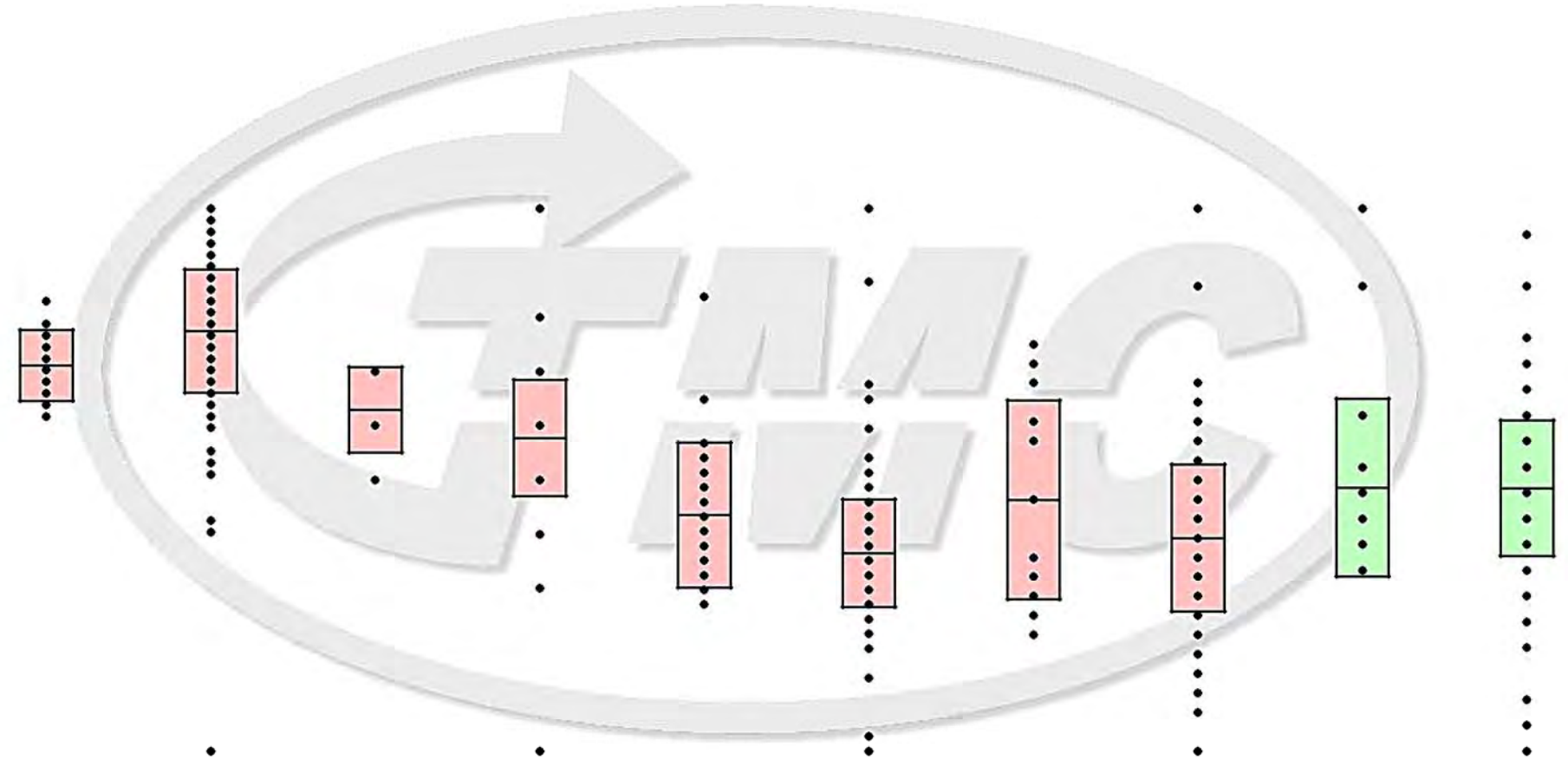
	ACV NEW	ACV OLD	ASL NEW	ASL OLD	PEN NEW	PEN OLD	TOL NEW	TOL OLD	VISI NEW	VISI OLD
N	23	200	23	200	23	200	23	200	23	200
Min	7.6	5.9	9.4	9	0.4	0.1	0.3	0.1	36	33
Max	8.1	8.7	9.6	9.7	0.8	3.2	0.7	1.2	53	47
Mean	7.883	7.805	9.465	9.476	0.6	0.516	0.539	0.386	40.22	40.69
Std	0.147	0.379	0.071	0.084	0.104	0.238	0.123	0.134	4.542	2.285

10:23:30 11APR2014

L-60-1 New vs Old Gears

All Data

UNITS=ORIGINAL IND=151-2



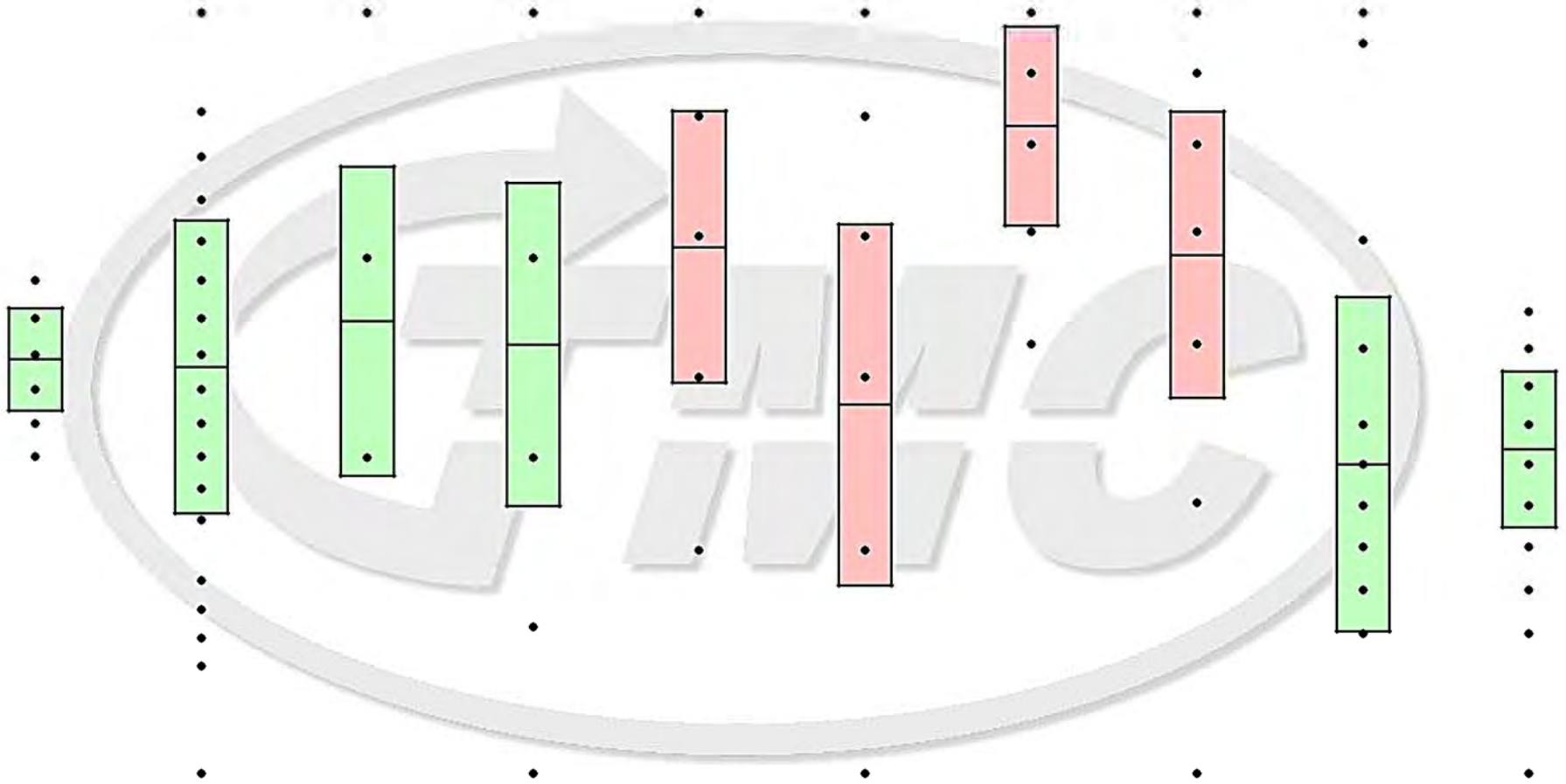
	ACV NEW	ACV OLD	ASL NEW	ASL OLD	PEN NEW	PEN OLD	TOL NEW	TOL OLD	VISI NEW	VISI OLD
N	21	241	21	241	21	241	21	241	21	241
Min	7.5	4.6	9.3	8.8	1.7	0.7	0.8	0.2	34	27
Max	8.5	9.3	9.5	9.8	3.8	4.4	2.3	3	48	47
Mean	7.938	8.238	9.429	9.377	2.31	2.049	1.495	1.3	37.19	37.17
Std	0.309	0.533	0.078	0.107	0.494	0.369	0.512	0.38	3.444	2.623

10:23:30 11APR2014

L-60-1 New vs Old Gears

Date >=20100101

UNITS=TRANSFORMED IND=148-1



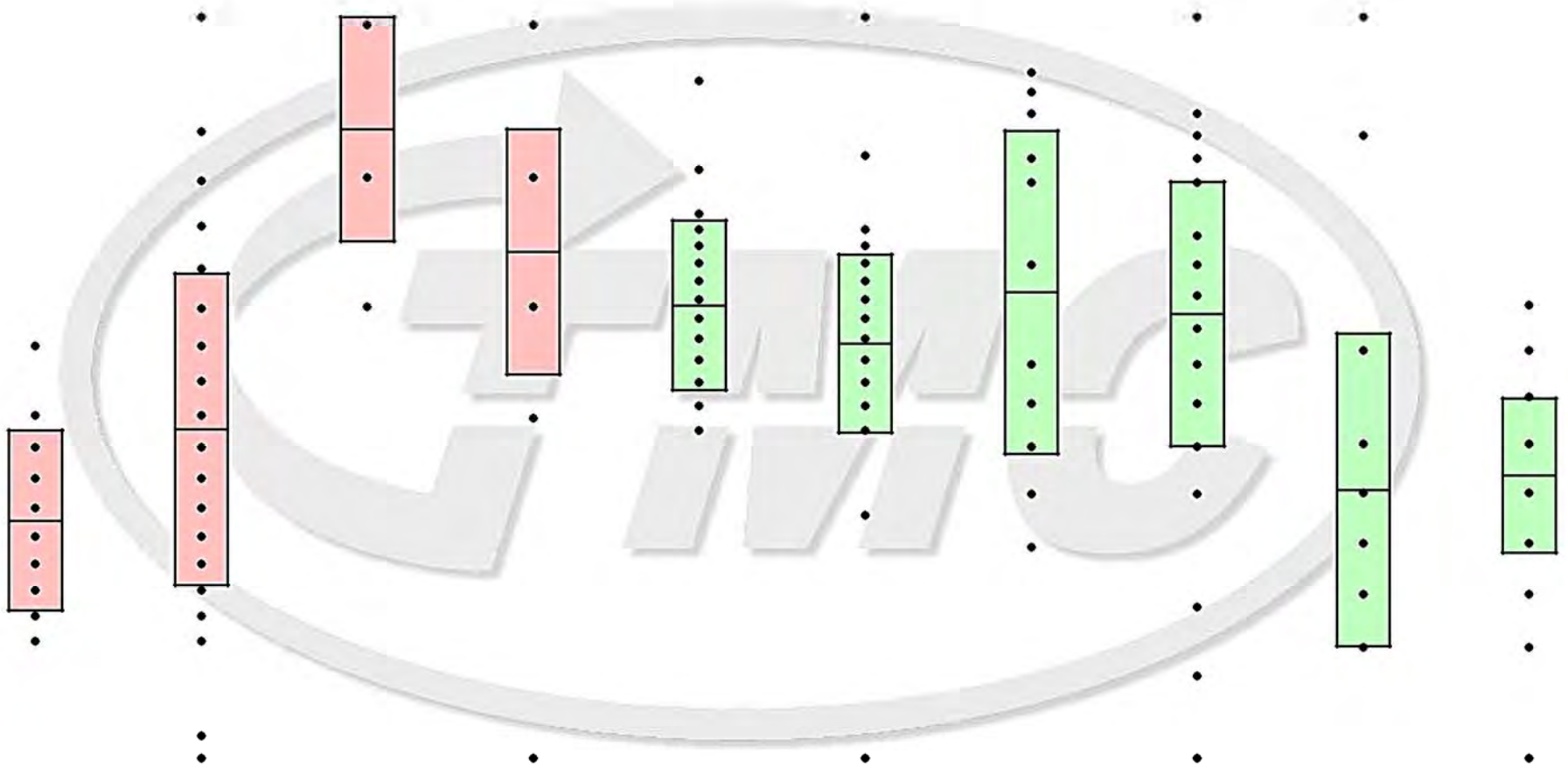
	ACVTI NEW	ACVTI OLD	ASLTI NEW	ASLTI OLD	PENTI NEW	PENTI OLD	TOLTI NEW	TOLTI OLD	VISITI NEW	VISITI OLD
N	23	66	23	66	23	66	23	66	23	66
Min	1.153	0.619	0.511	0.223	-0.92	-1.2	-1.2	-2.3	3.584	3.497
Max	1.45	1.901	0.916	0.916	-0.22	-0.22	-0.36	-0.36	3.97	3.784
Mean	1.317	1.304	0.635	0.614	-0.53	-0.73	-0.65	-0.98	3.689	3.698
Std	0.086	0.247	0.141	0.147	0.175	0.233	0.254	0.366	0.104	0.049

10:19:25 11APR2014

L-60-1 New vs Old Gears

Date >=20100101

UNITS=TRANSFORMED IND=151-2



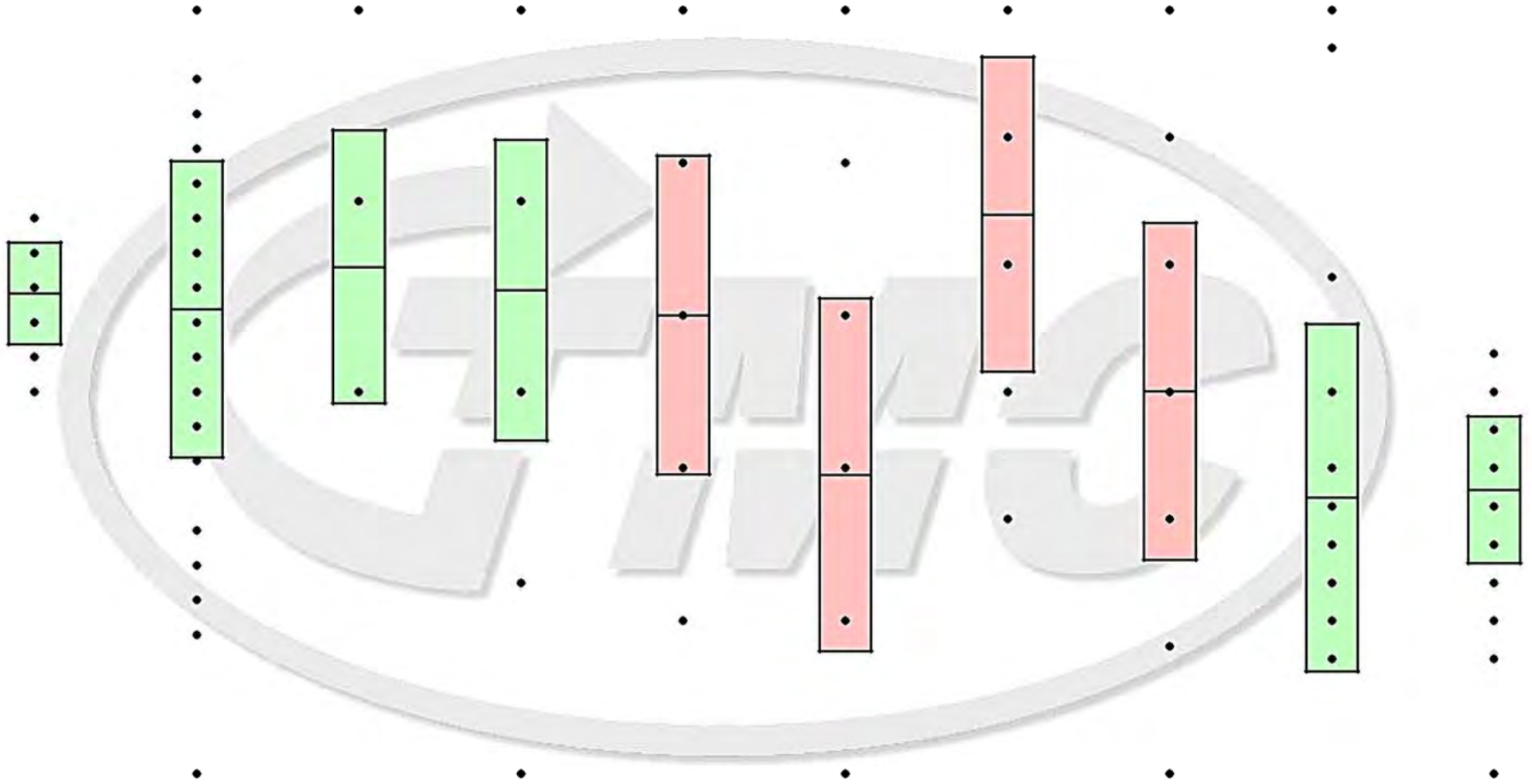
	ACVTI NEW	ACVTI OLD	ASLTI NEW	ASLTI OLD	PENTI NEW	PENTI OLD	TOLTI NEW	TOLTI OLD	VISITI NEW	VISITI OLD
N	21	68	21	68	21	68	21	68	21	68
Min	1.099	0.847	0.357	-0.18	0.531	-0.22	-0.22	-0.69	3.526	3.466
Max	1.735	2.442	0.693	0.693	1.335	1.482	0.833	0.956	3.871	3.714
Mean	1.358	1.554	0.568	0.422	0.818	0.73	0.343	0.295	3.612	3.62
Std	0.193	0.335	0.134	0.146	0.195	0.205	0.359	0.294	0.086	0.042

10:19:25 11APR2014

L-60-1 New vs Old Gears

Date >=20100101

UNITS=ORIGINAL IND=148-1



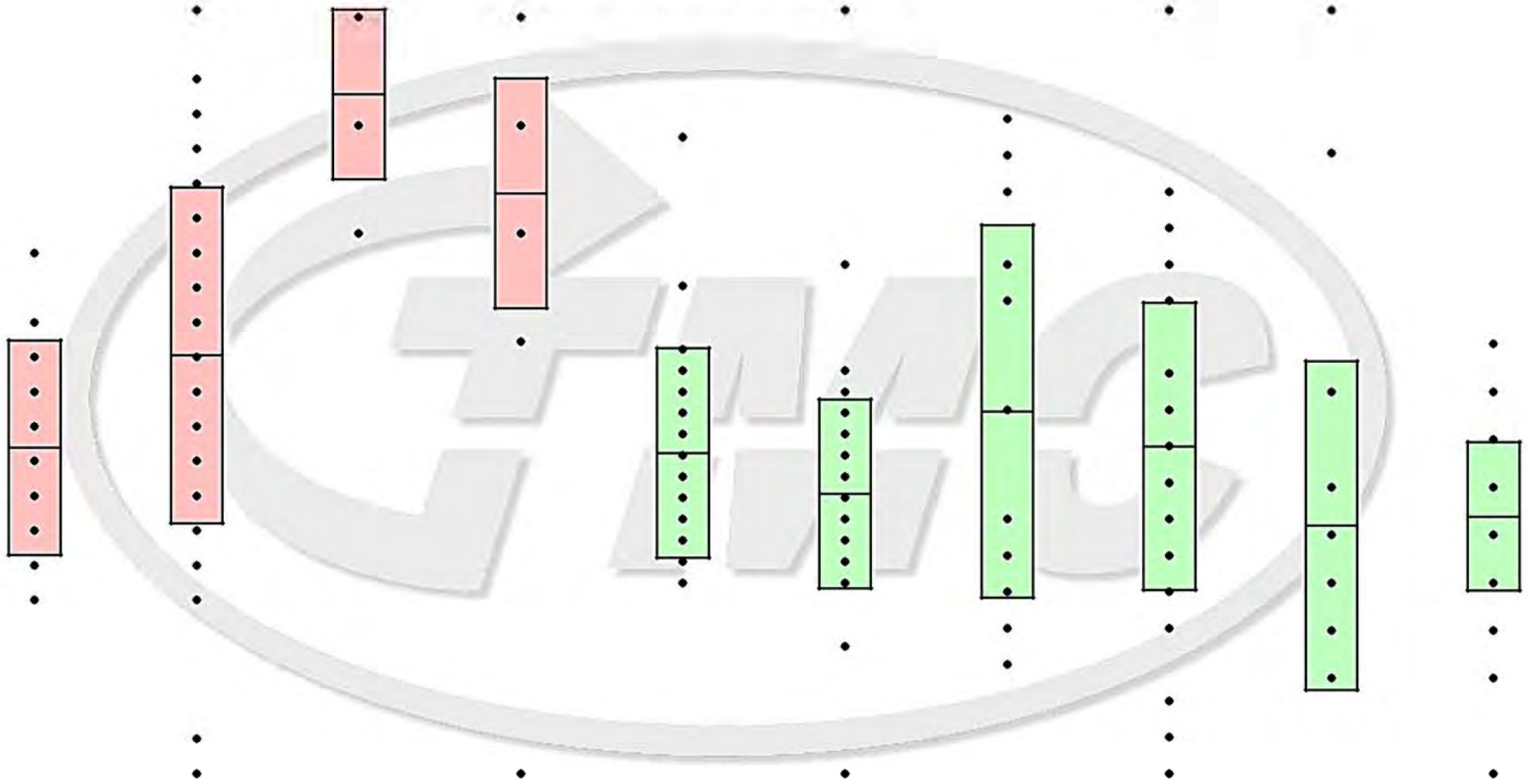
	ACV NEW	ACV OLD	ASL NEW	ASL OLD	PEN NEW	PEN OLD	TOL NEW	TOL OLD	VISI NEW	VISI OLD
N	23	66	23	66	23	66	23	66	23	66
Min	7.6	6.5	9.4	9.2	0.4	0.3	0.3	0.1	36	33
Max	8.1	8.7	9.6	9.6	0.8	0.8	0.7	0.7	53	44
Mean	7.883	7.836	9.465	9.453	0.6	0.495	0.539	0.4	40.22	40.42
Std	0.147	0.427	0.071	0.079	0.104	0.116	0.123	0.132	4.542	1.914

10:19:25 11APR2014

L-60-1 New vs Old Gears

Date >=20100101

UNITS=ORIGINAL IND=151-2



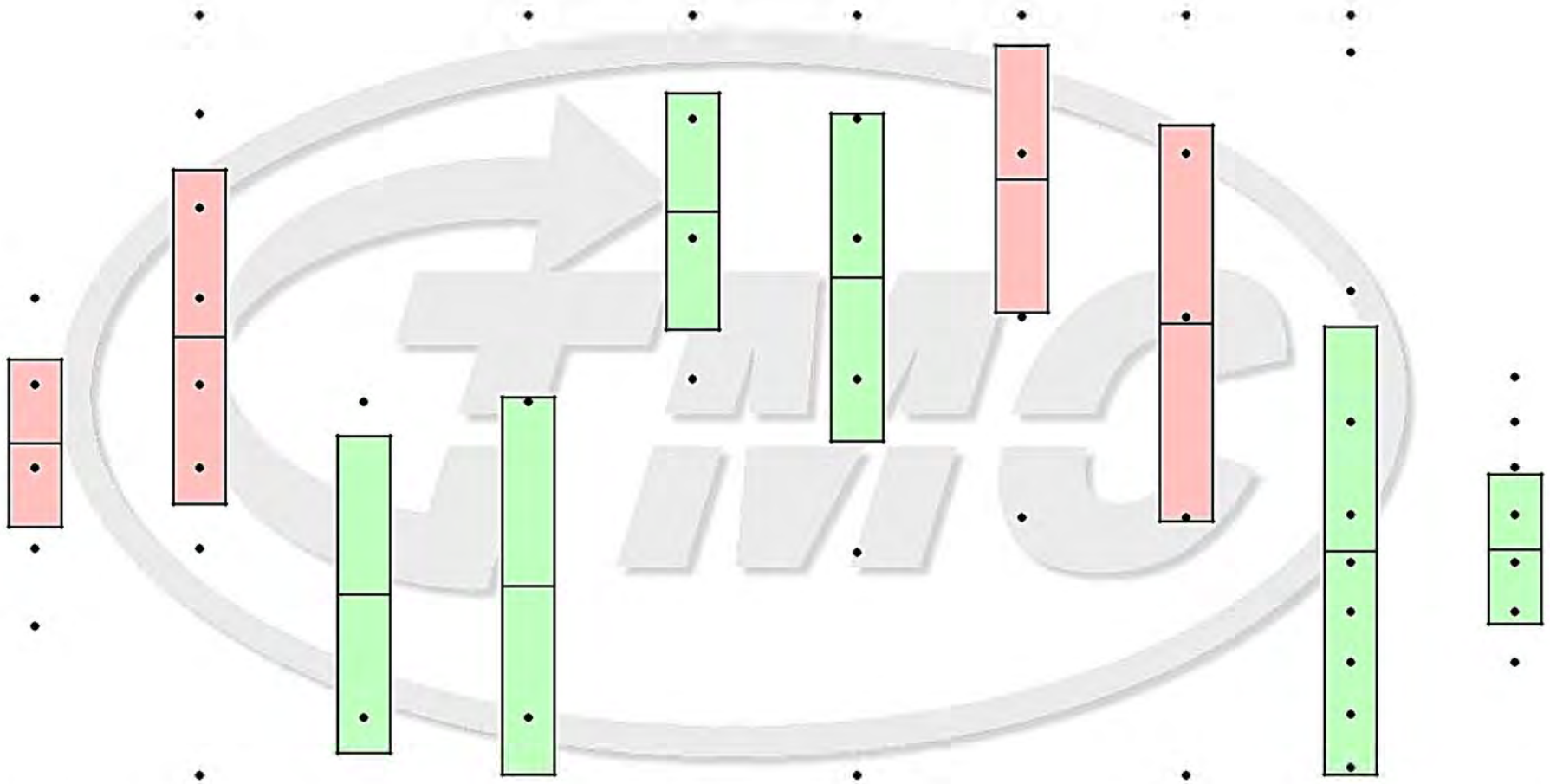
	ACV NEW	ACV OLD	ASL NEW	ASL OLD	PEN NEW	PEN OLD	TOL NEW	TOL OLD	VISI NEW	VISI OLD
N	21	68	21	68	21	68	21	68	21	68
Min	7.5	7	9.3	8.8	1.7	0.8	0.8	0.5	34	32
Max	8.5	9.2	9.5	9.5	3.8	4.4	2.3	2.6	48	41
Mean	7.938	8.204	9.429	9.337	2.31	2.118	1.495	1.399	37.19	37.38
Std	0.309	0.484	0.078	0.106	0.494	0.446	0.512	0.395	3.444	1.555

10:19:25 11APR2014

L-60-1 New vs Old Gears

Lab D Date >=20100101

UNITS=TRANSFORMED IND=148-1



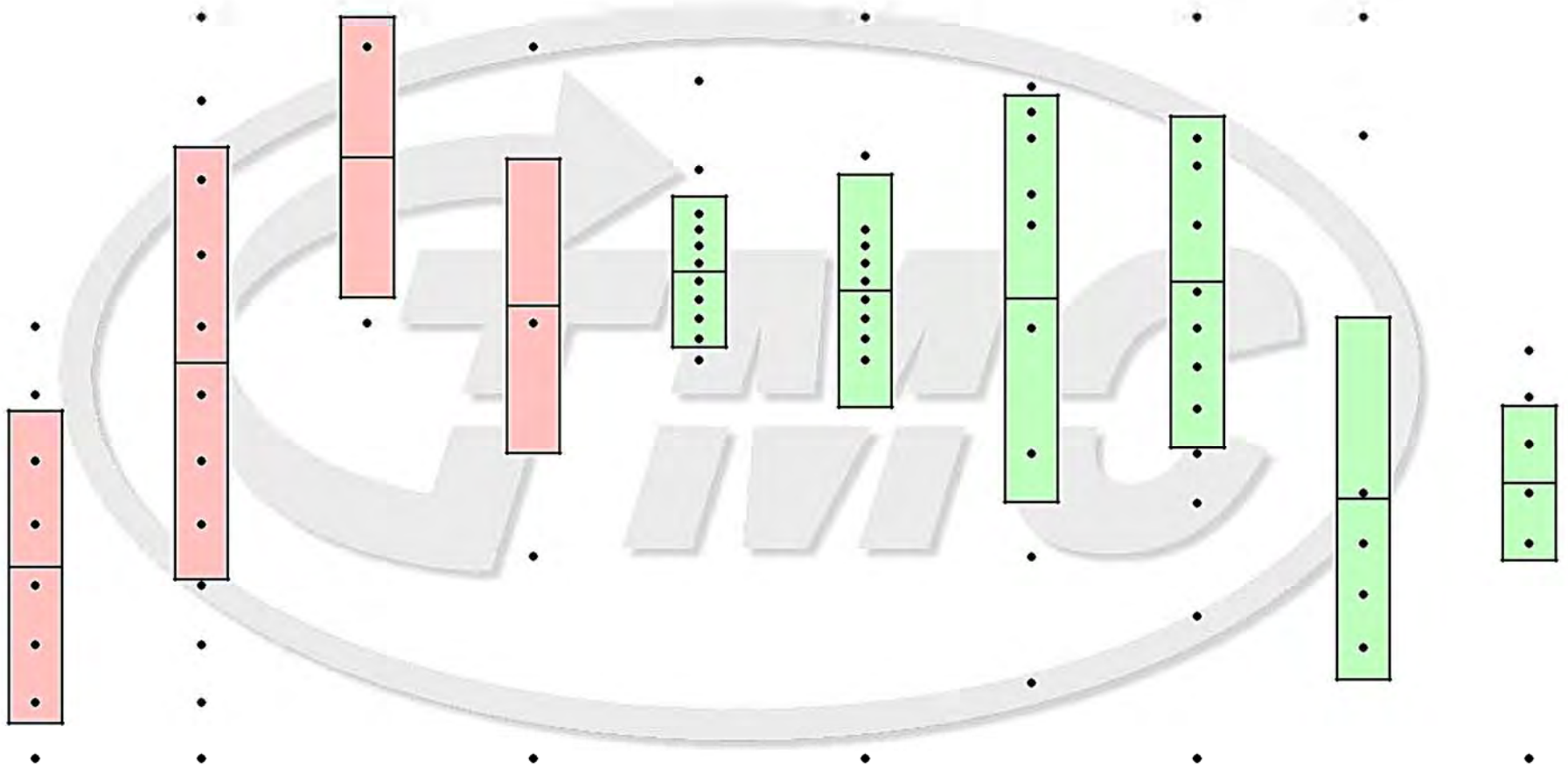
	ACVTI NEW	ACVTI OLD	ASLTI NEW	ASLTI OLD	PENTI NEW	PENTI OLD	TOLTI NEW	TOLTI OLD	VISITI NEW	VISITI OLD
N	18	27	18	27	18	27	18	27	18	27
Min	1.208	1.099	0.511	0.511	-0.69	-1.2	-0.92	-1.2	3.584	3.638
Max	1.45	1.658	0.693	0.916	-0.22	-0.22	-0.36	-0.36	3.97	3.784
Mean	1.343	1.421	0.582	0.587	-0.48	-0.56	-0.54	-0.7	3.695	3.696
Std	0.061	0.123	0.091	0.109	0.153	0.211	0.149	0.221	0.115	0.038

10:08:21 11APR2014

L-60-1 New vs Old Gears

Lab D Date >=20100101

UNITS=TRANSFORMED IND=151-2



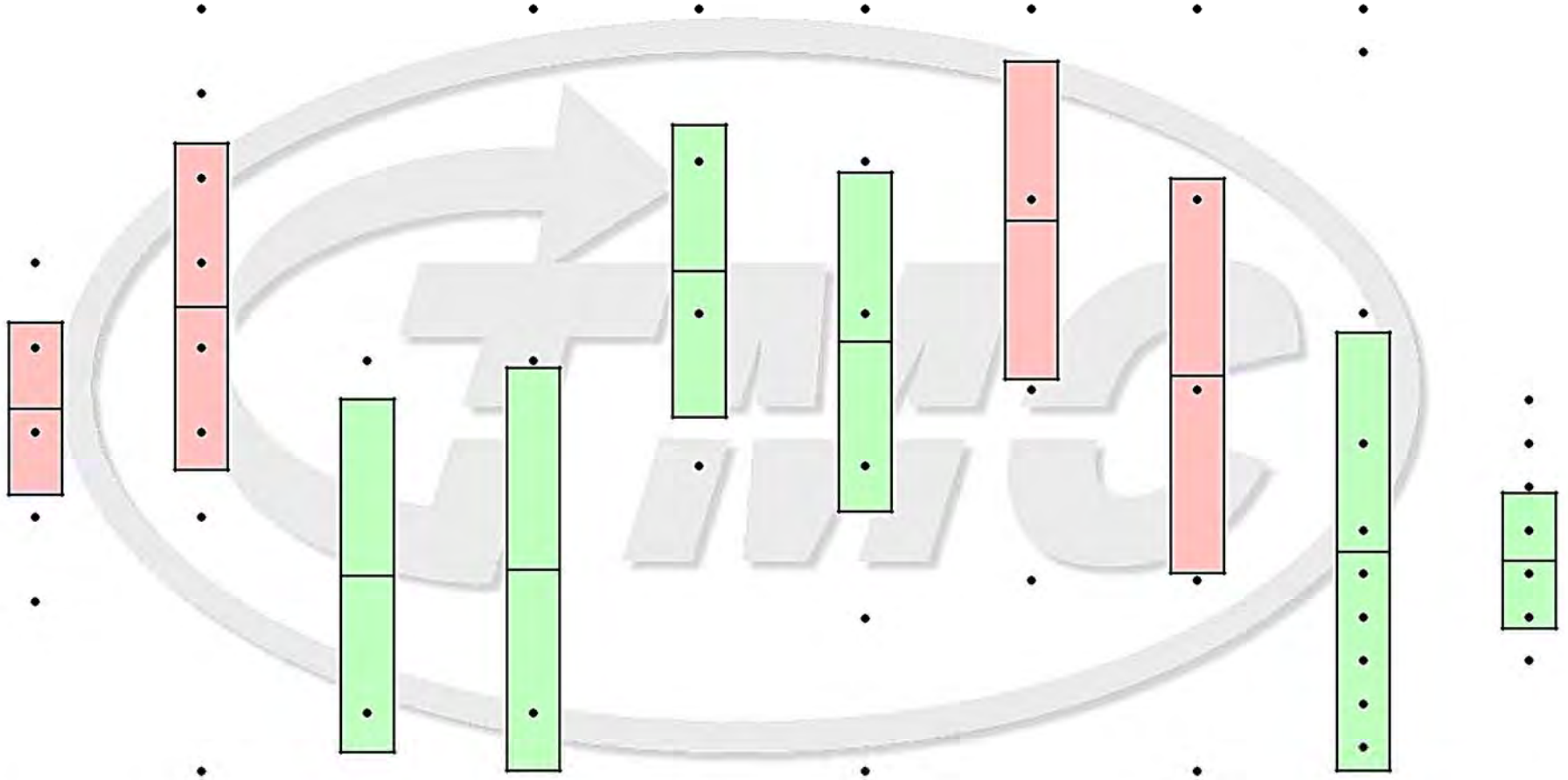
	ACVTI NEW	ACVTI OLD	ASLTI NEW	ASLTI OLD	PENTI NEW	PENTI OLD	TOLTI NEW	TOLTI OLD	VISITI NEW	VISITI OLD
N	15	26	15	26	15	26	15	26	15	26
Min	1.099	1.099	0.511	0.223	0.693	-0.22	-0.22	-0.36	3.526	3.466
Max	1.516	1.815	0.693	0.693	1.335	1.482	0.833	0.956	3.871	3.689
Mean	1.283	1.481	0.62	0.522	0.896	0.852	0.457	0.487	3.608	3.616
Std	0.151	0.209	0.092	0.097	0.173	0.268	0.36	0.293	0.099	0.042

10:08:21 11APR2014

L-60-1 New vs Old Gears

Lab D Date >=20100101

UNITS=ORIGINAL IND=148-1



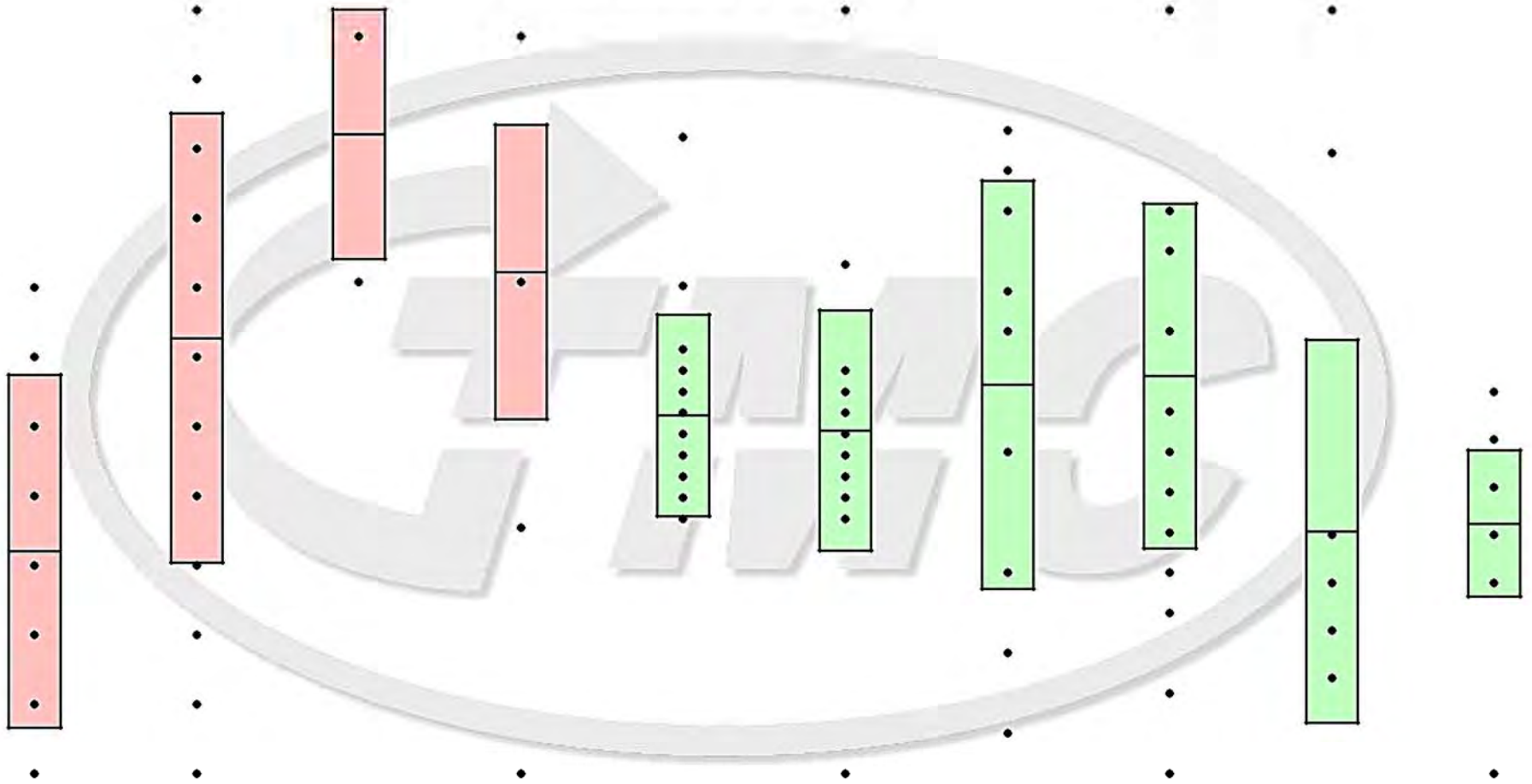
	ACV NEW	ACV OLD	ASL NEW	ASL OLD	PEN NEW	PEN OLD	TOL NEW	TOL OLD	VISI NEW	VISI OLD
N	18	27	18	27	18	27	18	27	18	27
Min	7.7	7.5	9.4	9.4	0.5	0.3	0.4	0.3	36	38
Max	8.1	8.4	9.5	9.6	0.8	0.8	0.7	0.7	53	44
Mean	7.928	8.048	9.439	9.441	0.628	0.581	0.589	0.507	40.5	40.3
Std	0.102	0.193	0.05	0.057	0.096	0.111	0.083	0.104	5.044	1.564

10:08:21 11APR2014

L-60-1 New vs Old Gears

Lab D Date >=20100101

UNITS=ORIGINAL IND=151-2

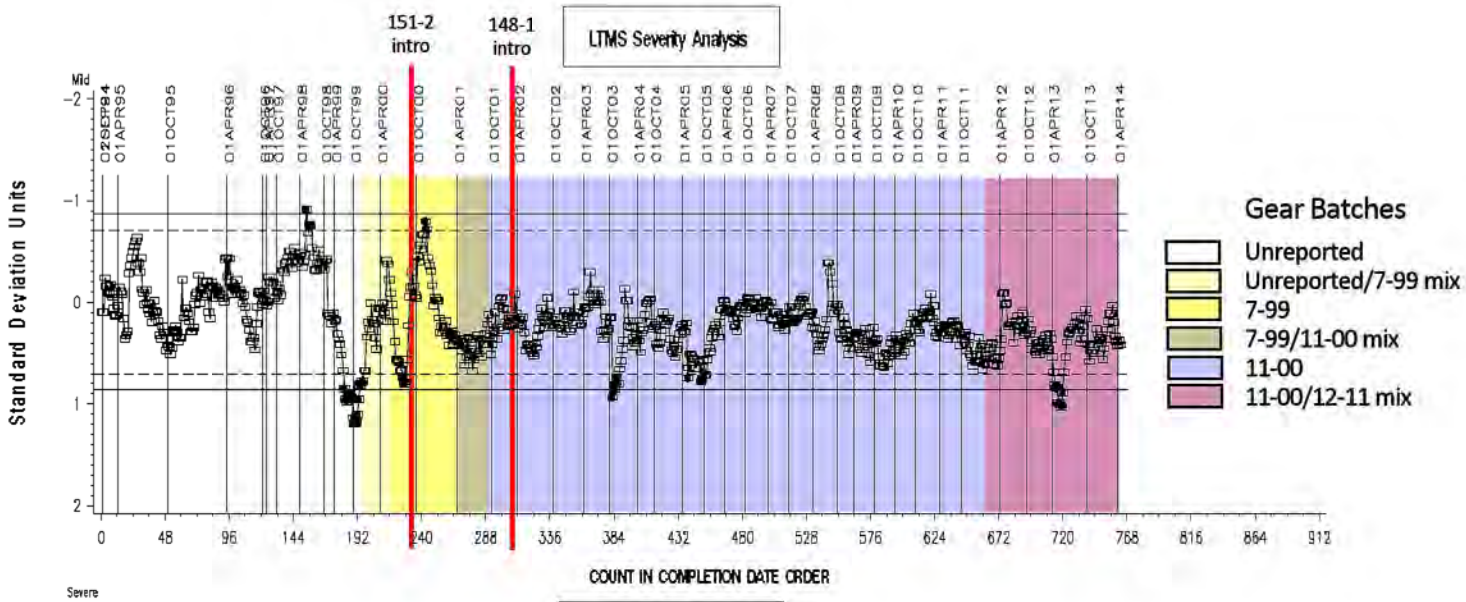


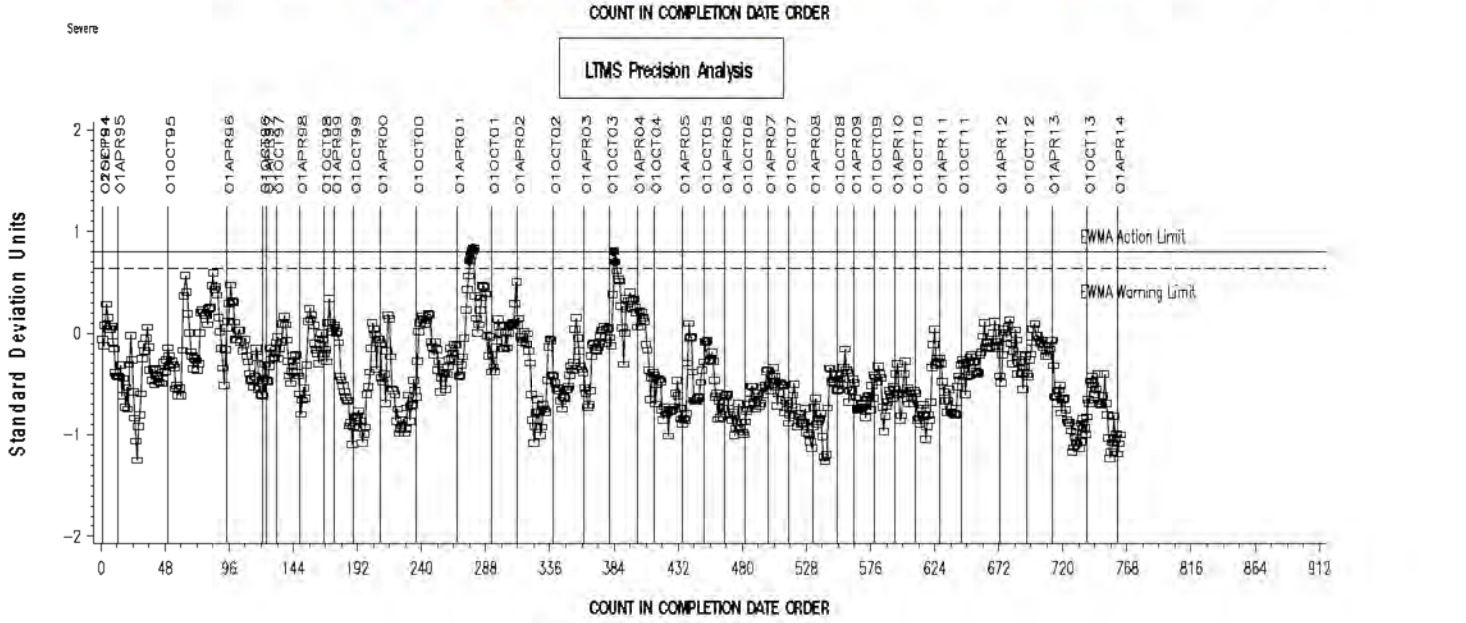
	ACV NEW	ACV OLD	ASL NEW	ASL OLD	PEN NEW	PEN OLD	TOL NEW	TOL OLD	VISI NEW	VISI OLD
N	15	26	15	26	15	26	15	26	15	26
Min	7.5	7.5	9.4	9.2	2	0.8	0.8	0.7	34	32
Max	8.2	8.6	9.5	9.5	3.8	4.4	2.3	2.6	48	40
Mean	7.82	8.127	9.46	9.404	2.487	2.415	1.667	1.688	37.07	37.23
Std	0.254	0.323	0.051	0.06	0.475	0.566	0.508	0.428	4.008	1.531

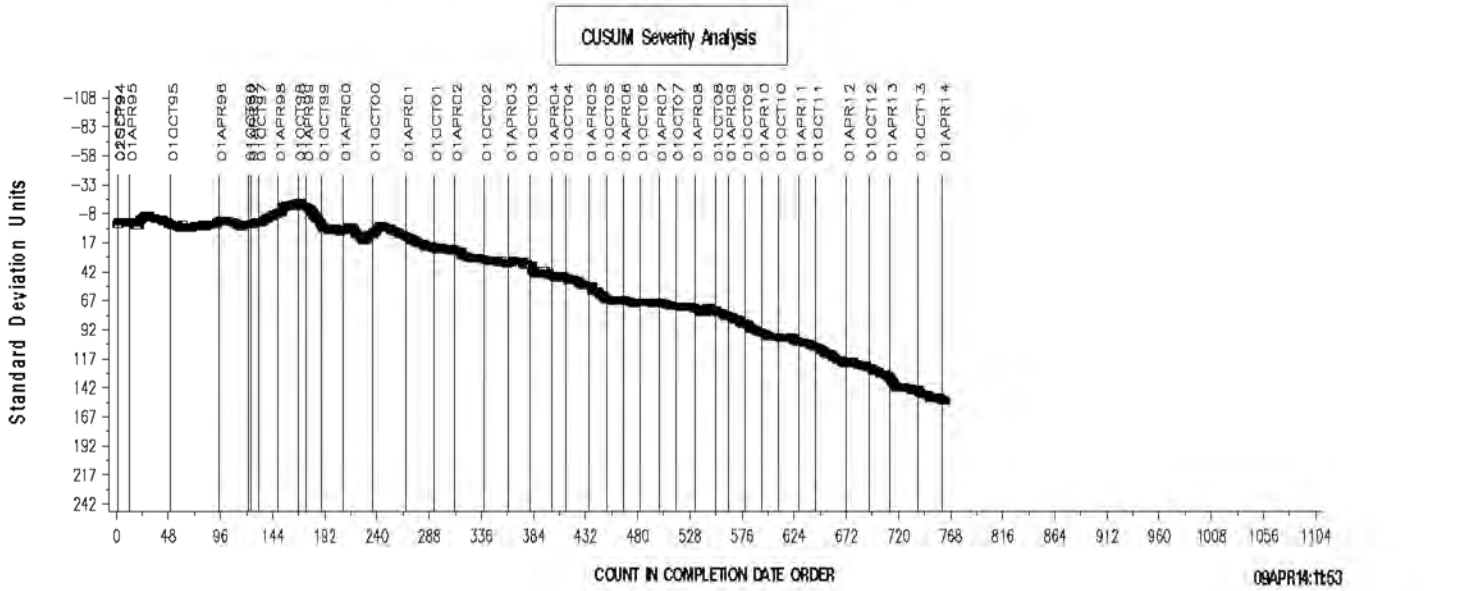
10:08:21 11APR2014

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

REF. FINAL PENTANE INSOLUBLES







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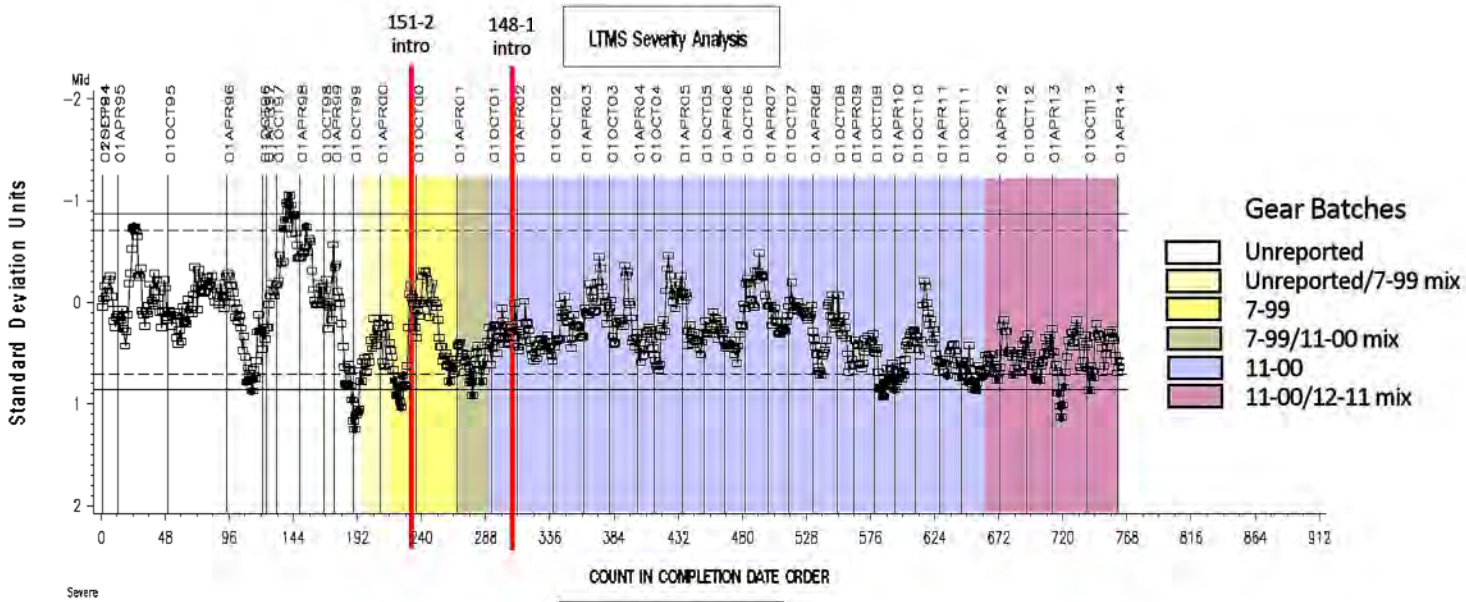

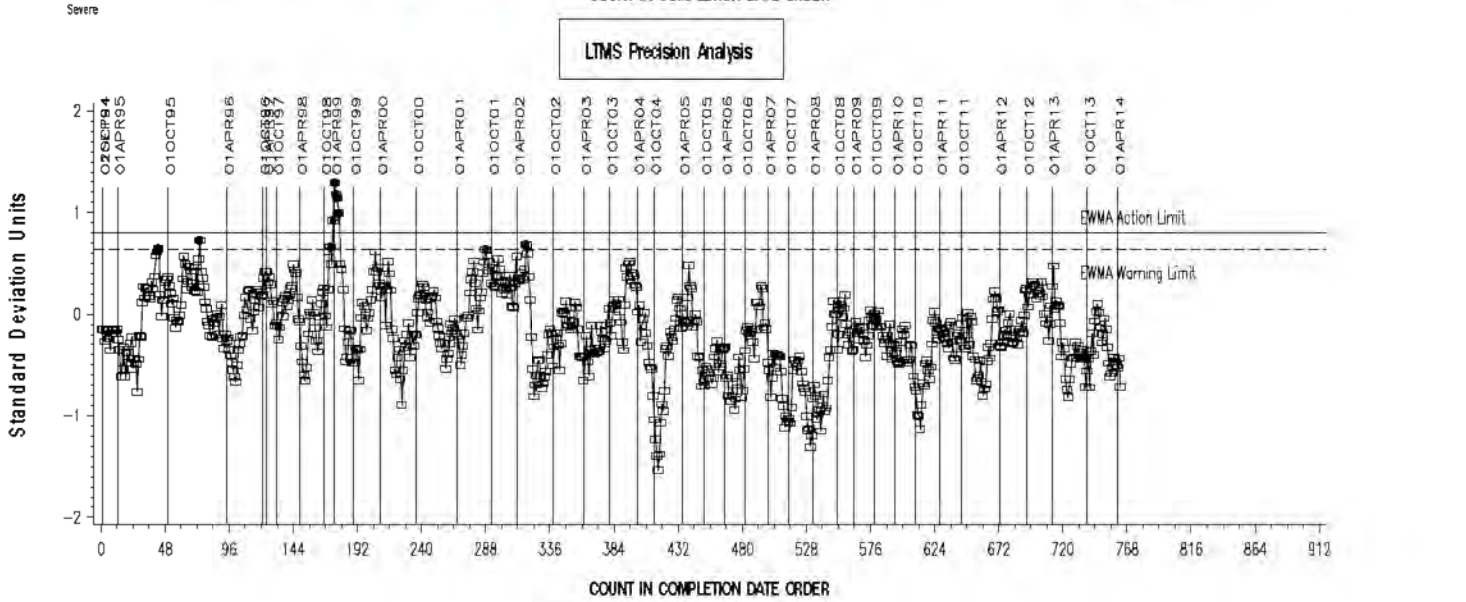

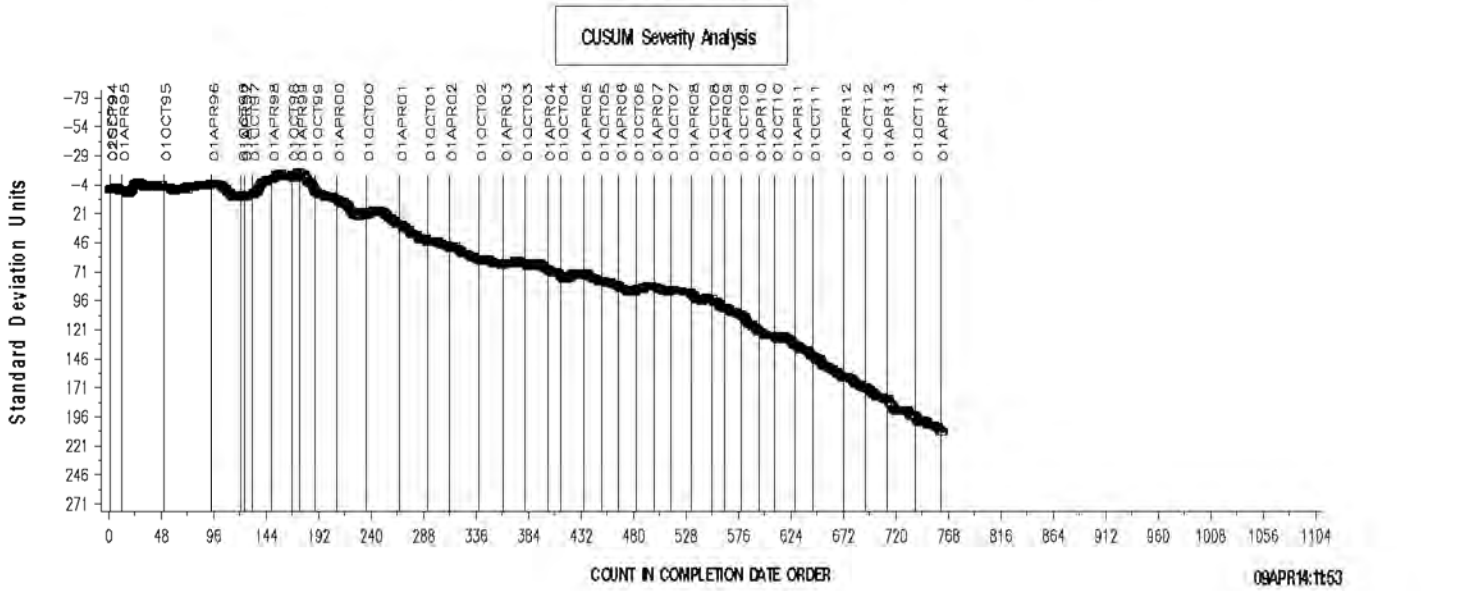

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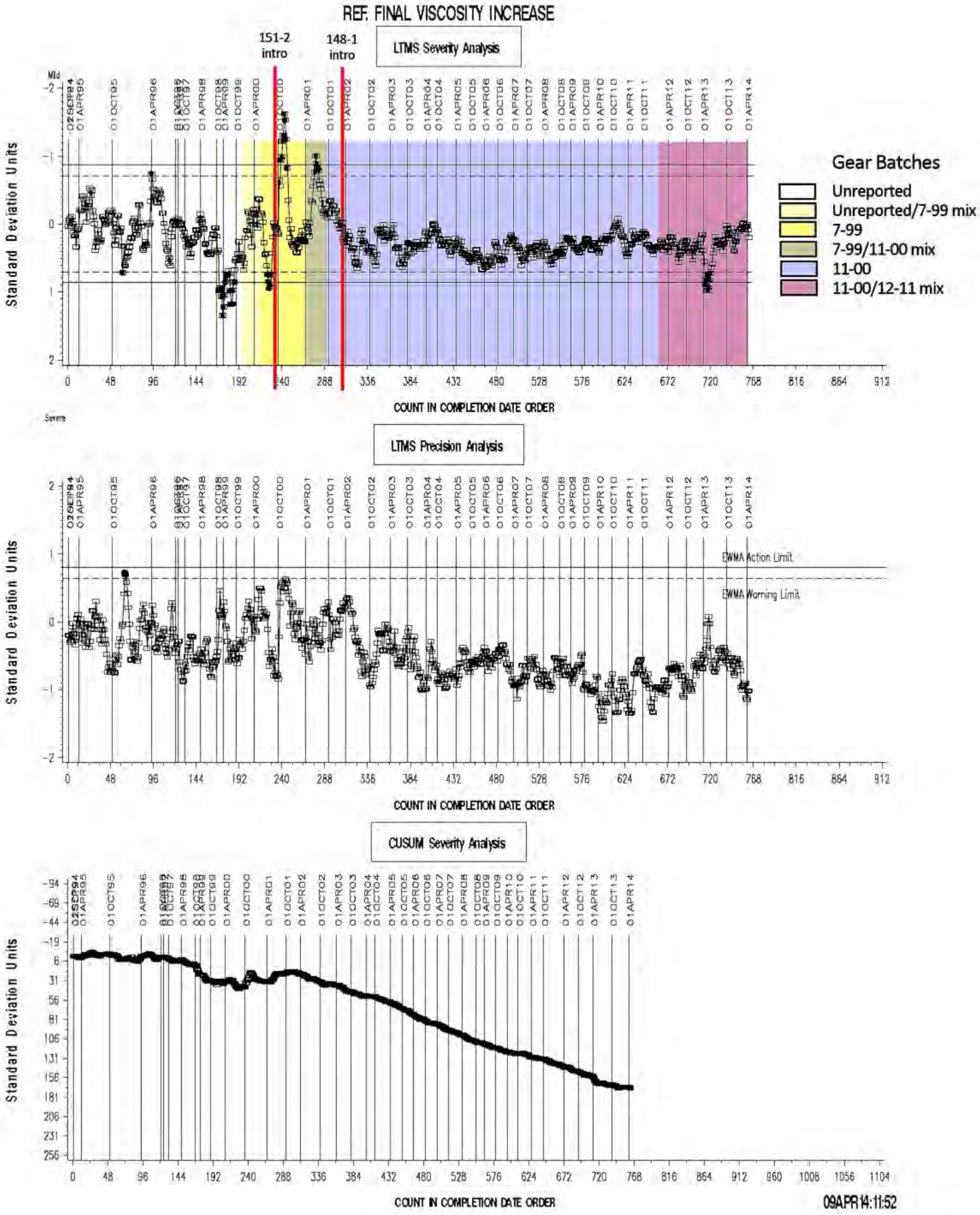
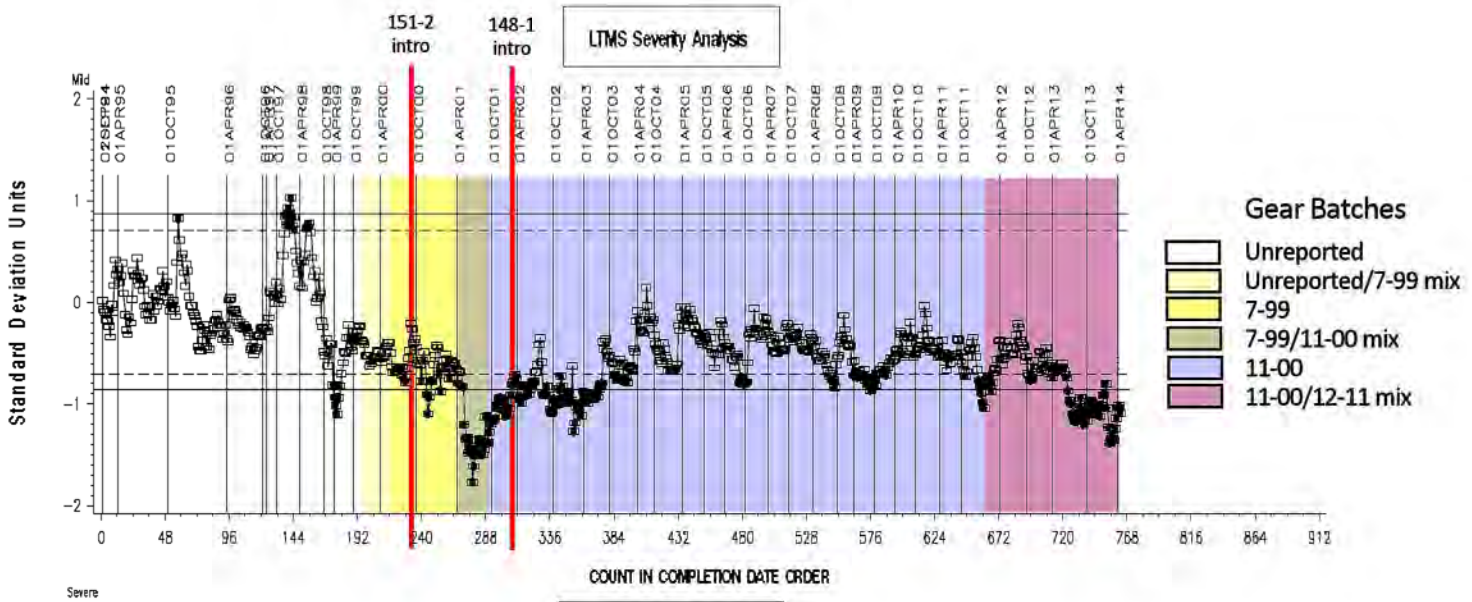
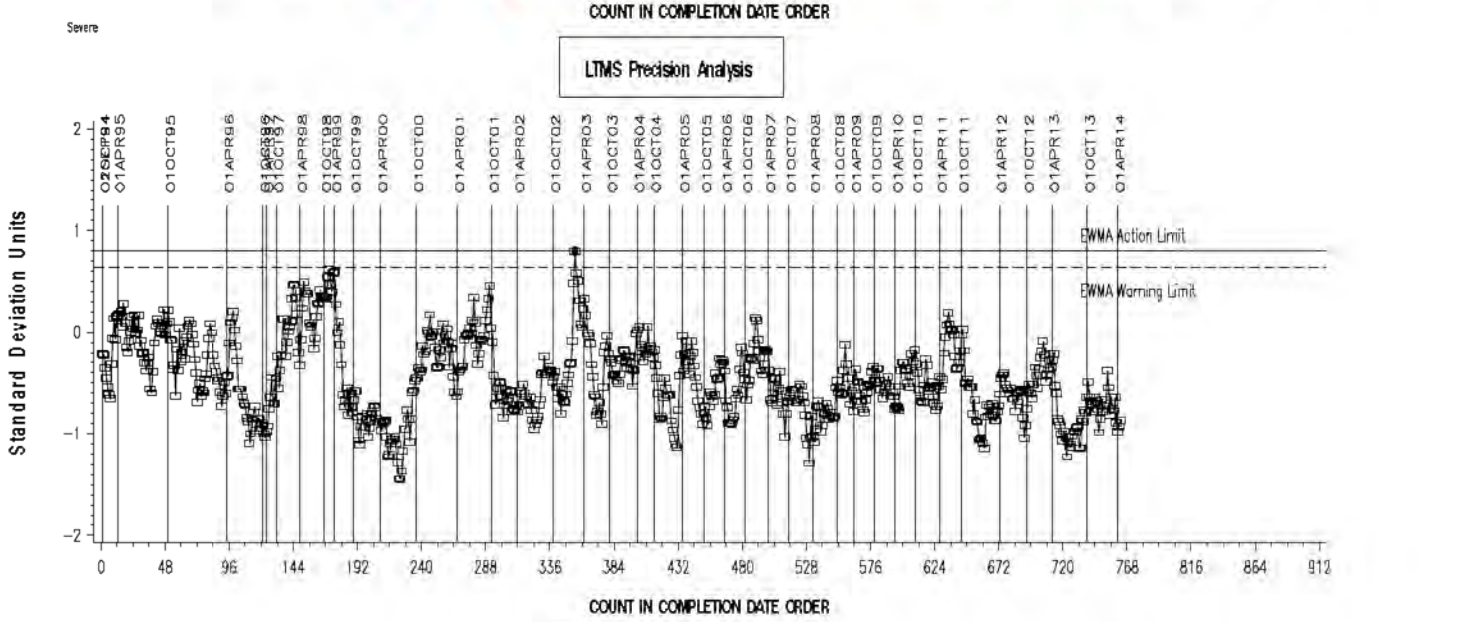
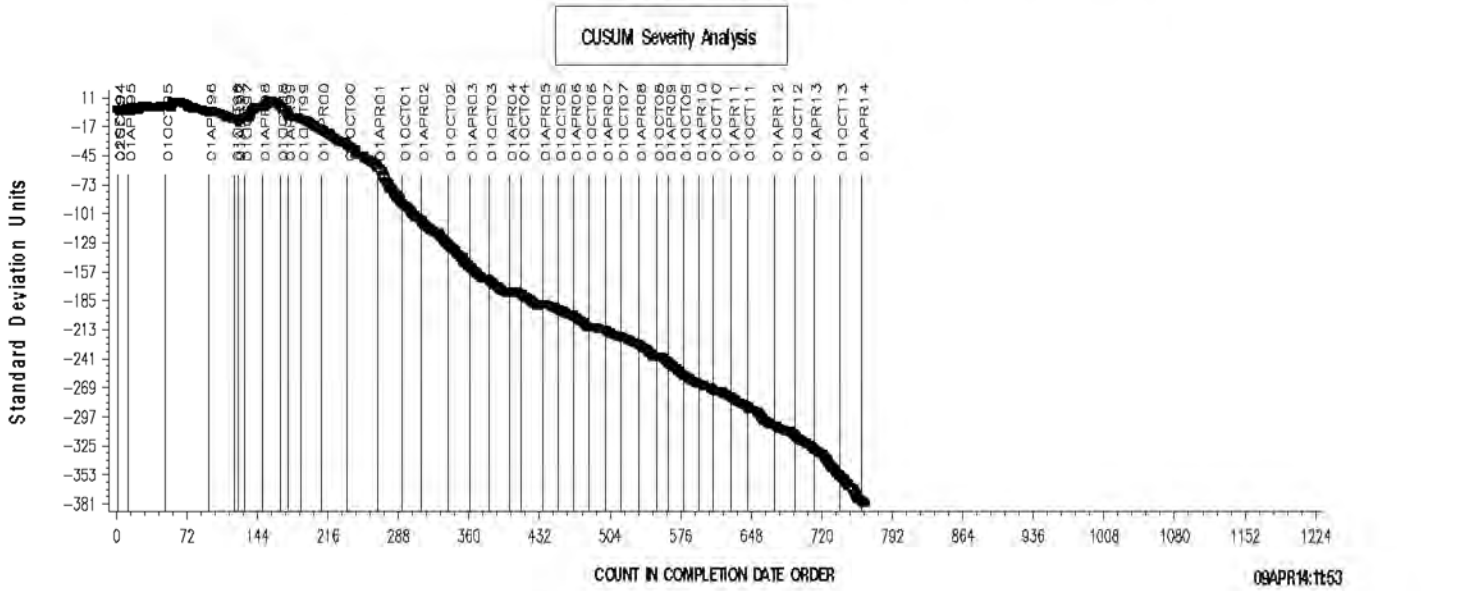


L-60-1 INDUSTRY OPERATIONALLY VALID DATA

REF. FINAL AVERAGE CARBON/ VARNISH

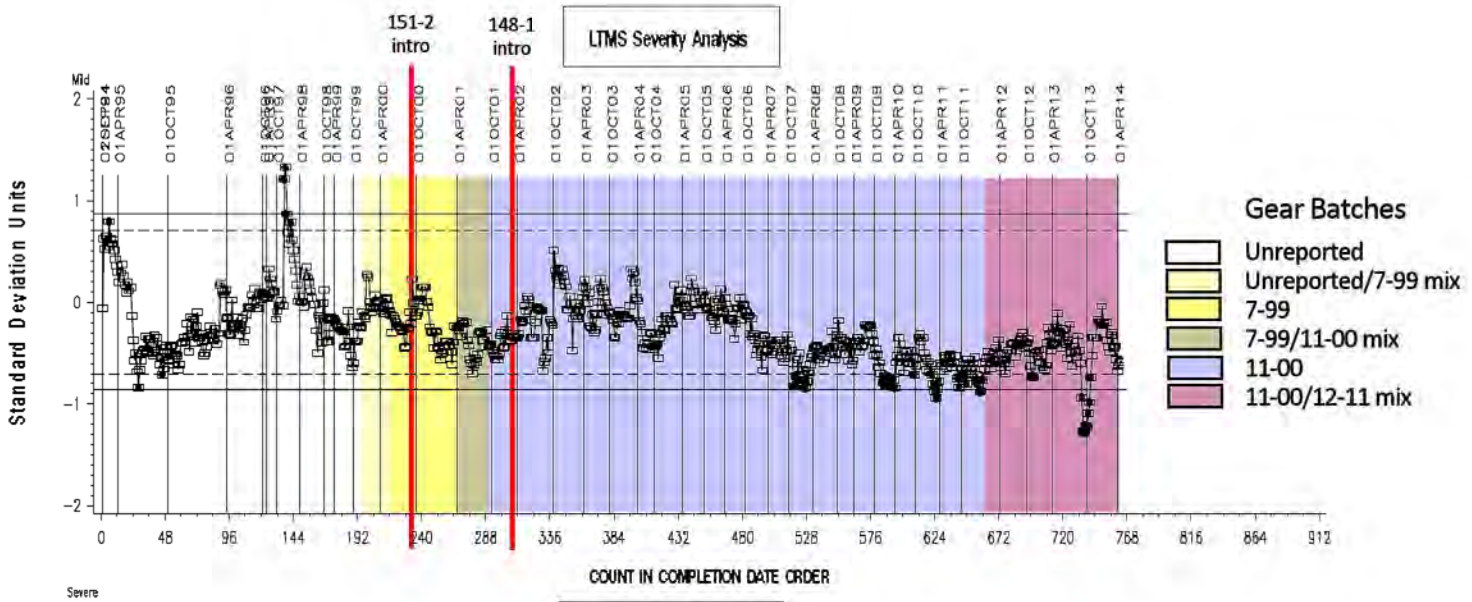


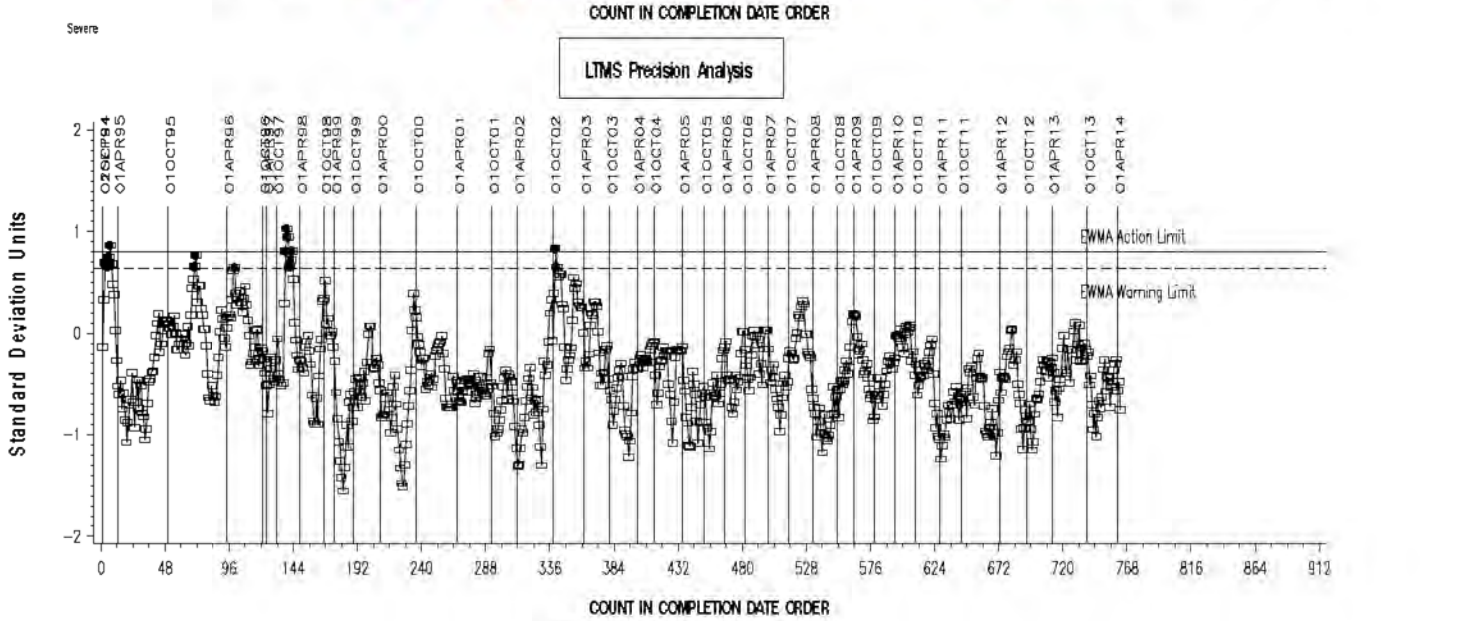


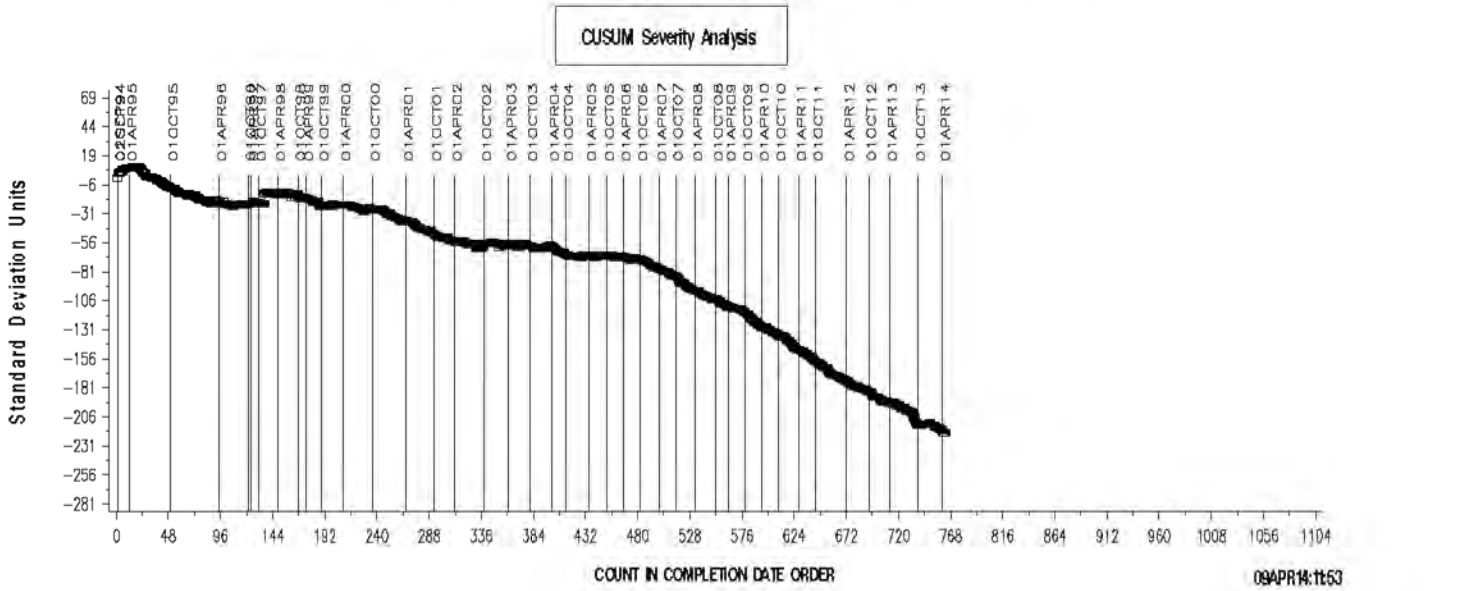


L-60-1 INDUSTRY OPERATIONALLY VALID DATA

REF. FINAL AVERAGE SLUDGE







		VISI	PEN	TOL	ACV	ASL	VISIti	PENti	TOLti	ACVti	ASLti	VISIyi	PENyi	TOLyi	ACVyi	ASLyi
target 148-1	mean						3.61	-0.95	-1.36	1.59	0.76					
(30 148 tests, ca. 1994)	std						0.15	0.39	0.49	0.47	0.19					
first 30 148	mean	38.27	0.45	0.30	8.15	9.49	3.64	-0.88	-1.29	1.53	0.70	0.19	0.17	0.14	-0.12	-0.32
09-1994 to 03-1996	std	4.38	0.15	0.12	0.61	0.09	0.11	0.45	0.49	0.41	0.21	0.73	1.16	1.00	0.88	1.13
first 30 148-1	mean	40.97	0.50	0.35	7.53	9.50	3.71	-0.73	-1.12	1.12	0.71	0.66	0.57	0.49	-0.99	-0.28
03-2002 to 08-2003	std	3.43	0.13	0.12	0.43	0.12	0.08	0.28	0.46	0.21	0.20	0.56	0.72	0.94	0.46	1.04
last 30 148-1	mean	41.50	0.54	0.45	7.90	9.46	3.72	-0.65	-0.86	1.34	0.62	0.75	0.76	1.02	-0.54	-0.73
03-2012 to 07-2013	std	3.81	0.13	0.15	0.33	0.08	0.09	0.25	0.37	0.20	0.15	0.58	0.65	0.75	0.42	0.79
target 151-2	mean						3.62	0.75	0.26	1.81	0.54					
(9 tests, ca. 2000)	std						0.15	0.37	0.50	0.40	0.23					
first 30 151-2	mean	35.07	1.95	1.35	7.98	9.36	3.55	0.66	0.27	1.41	0.46	-0.46	-0.24	0.03	-1.00	-0.35
10-2000 to 10-2001	std	3.68	0.22	0.29	0.61	0.09	0.11	0.12	0.23	0.38	0.14	0.72	0.32	0.45	0.94	0.59
last 30 151-2	mean	37.70	2.15	1.37	8.14	9.39	3.63	0.74	0.26	1.50	0.50	0.05	-0.04	0.01	-0.77	-0.18
03-2012 to 08-2013	std	2.97	0.51	0.43	0.42	0.09	0.07	0.25	0.32	0.30	0.15	0.50	0.69	0.63	0.74	0.63

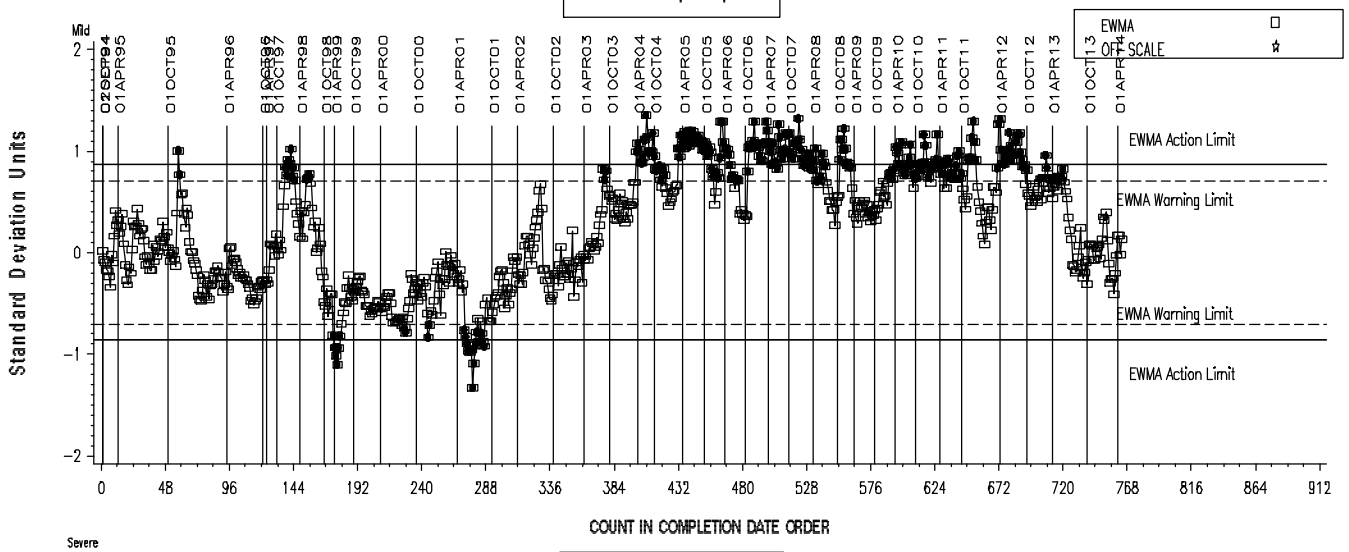
L-60-1 INDUSTRY OPERATIONALLY VALID DATA

USING FIXED (UPDATED) TARGETS

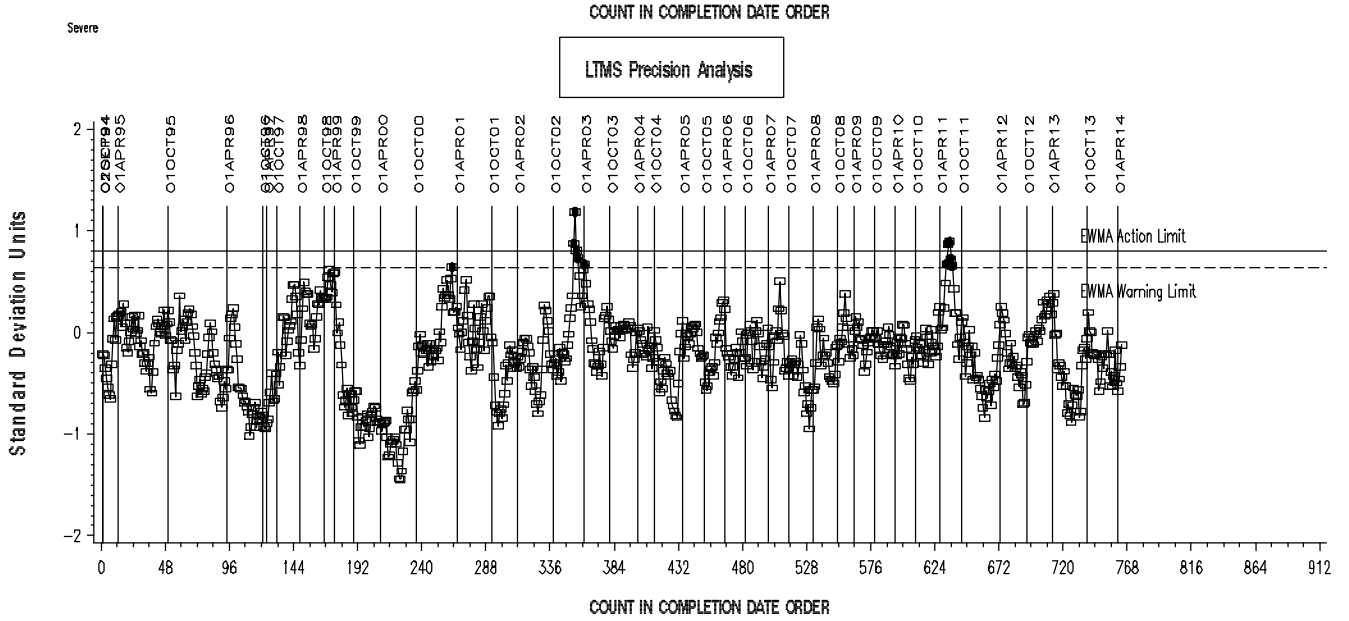
REF. FINAL AVERAGE CARBON/ VARNISH

A Program of ASTM International

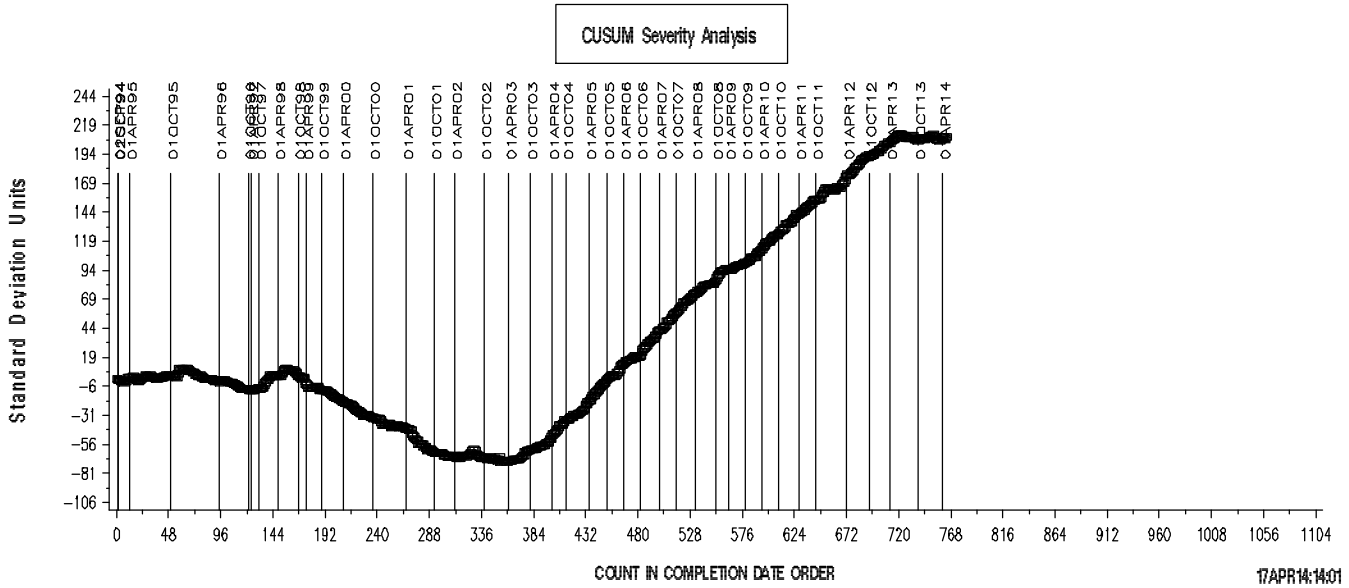
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



17APR14:14:01

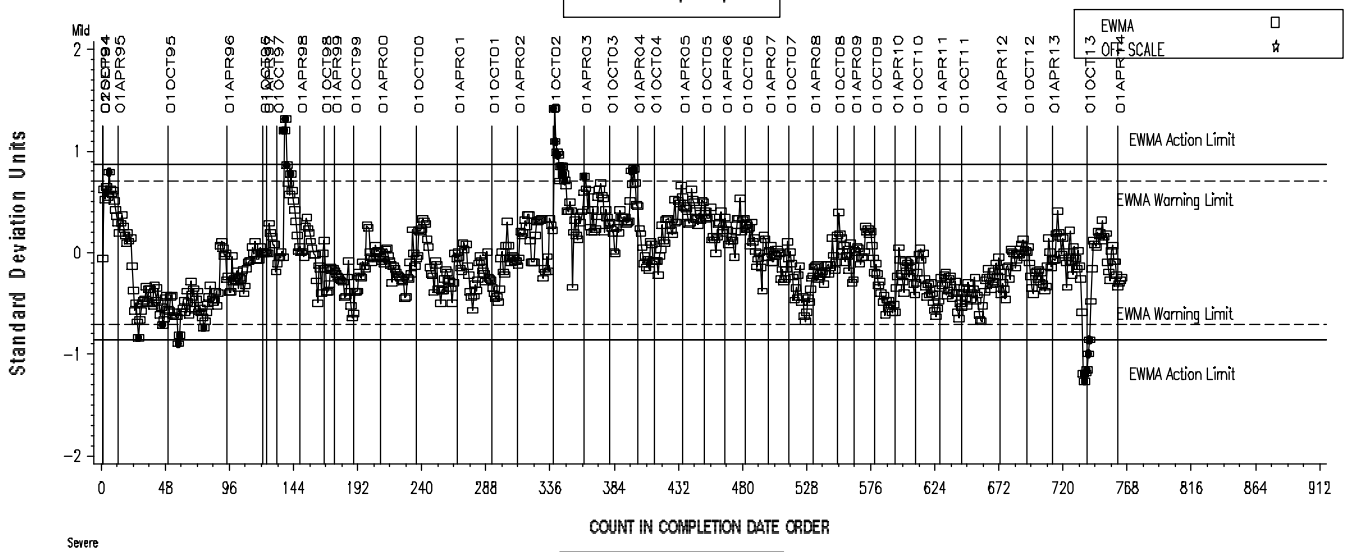
L-60-1 INDUSTRY OPERATIONALLY VALID DATA

USING FIXED (UPDATED) TARGETS

REF. FINAL AVERAGE SLUDGE

A Program of ASTM International

LTMS Severity Analysis



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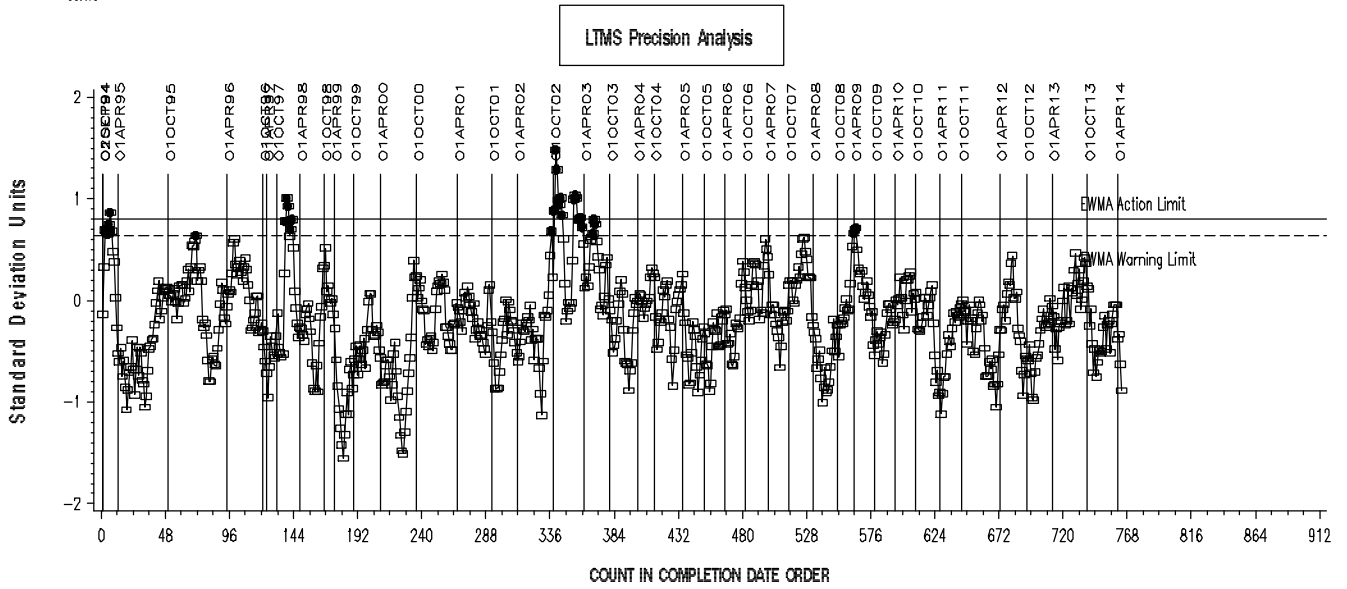
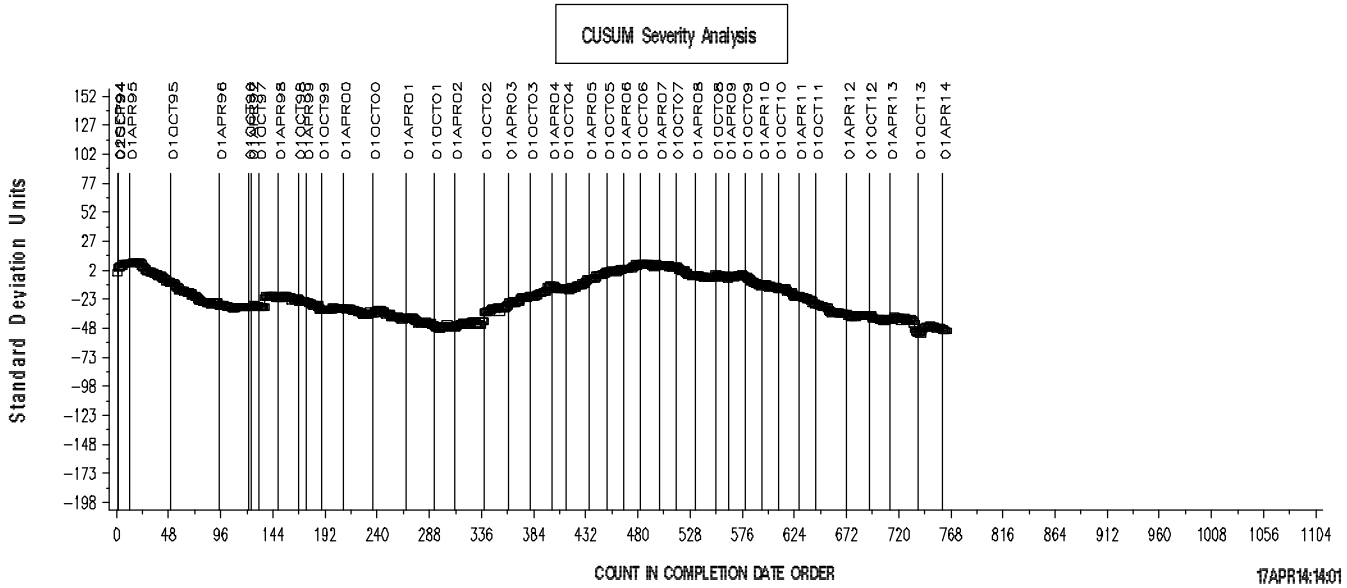


CUSUM Severity Analysis



17APR14:14:01

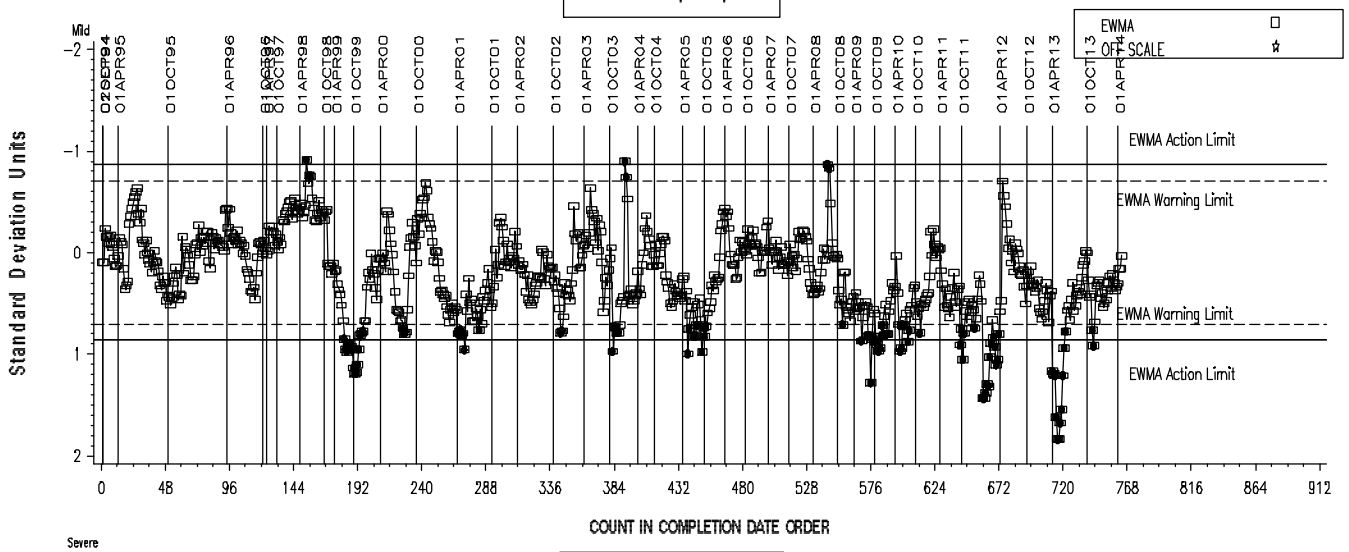
L-60-1 INDUSTRY OPERATIONALLY VALID DATA

USING FIXED (UPDATED) TARGETS

REF. FINAL PENTANE INSOLUBLES

A Program of ASTM International

LTMS Severity Analysis



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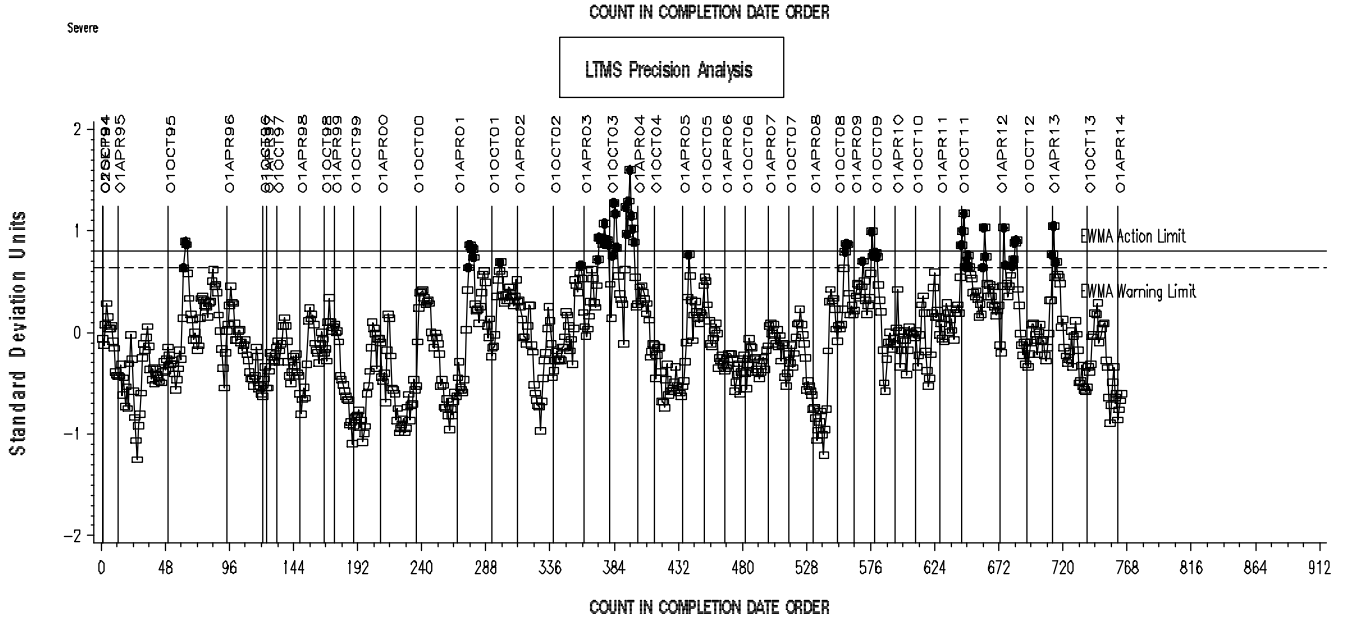
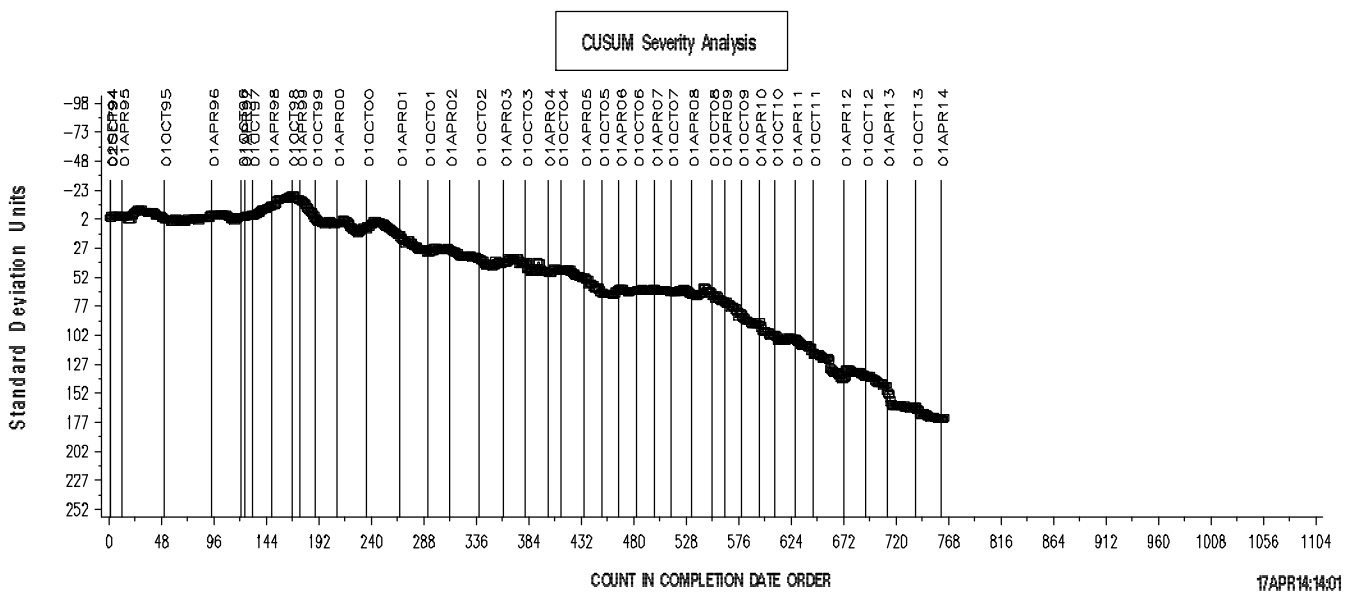


CUSUM Severity Analysis



17APR14:14:01

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

USING FIXED (UPDATED) TARGETS

REF. FINAL TOLUENE INSOLUBLES

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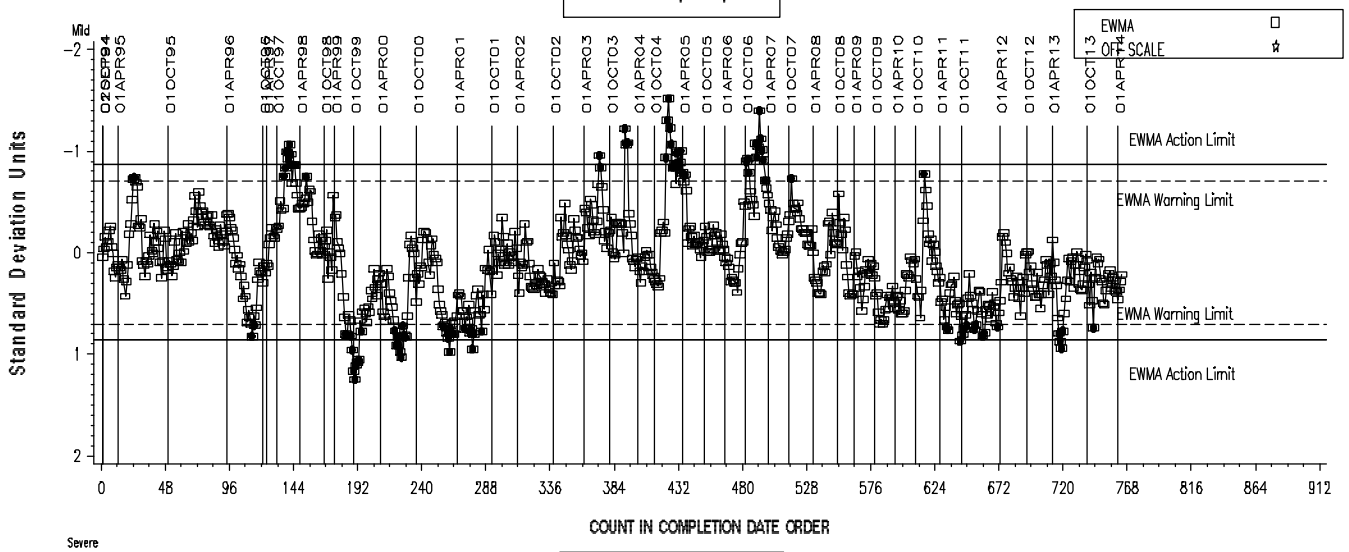
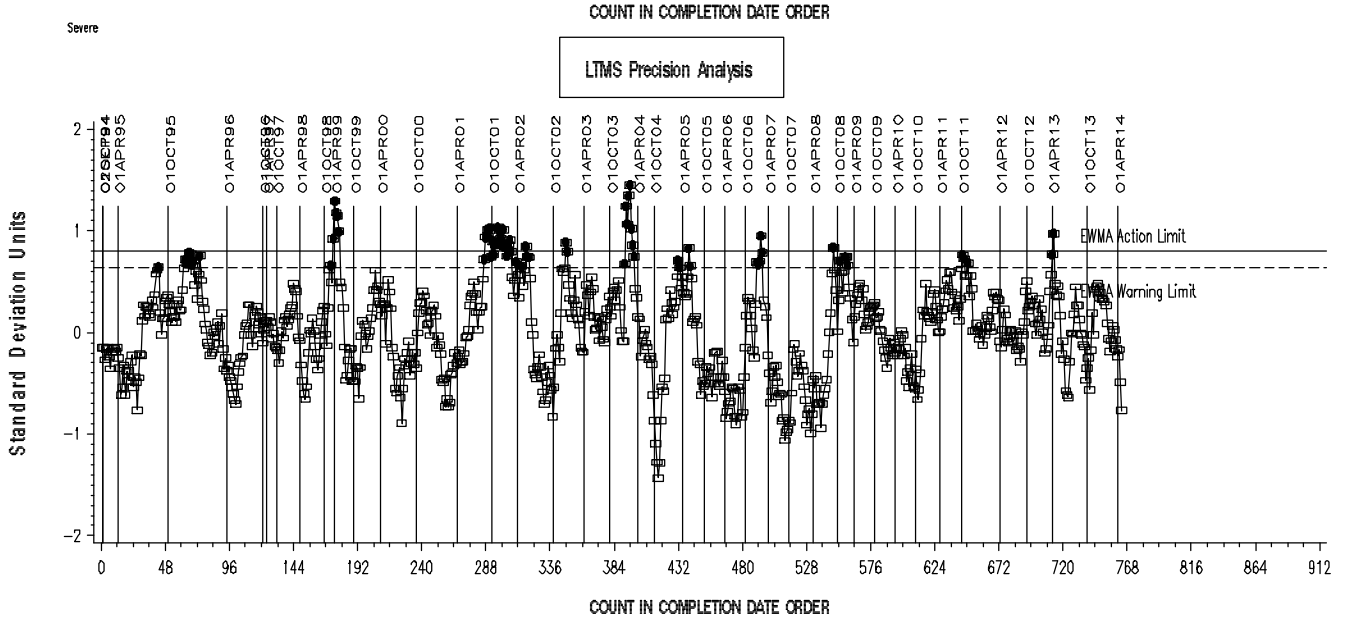
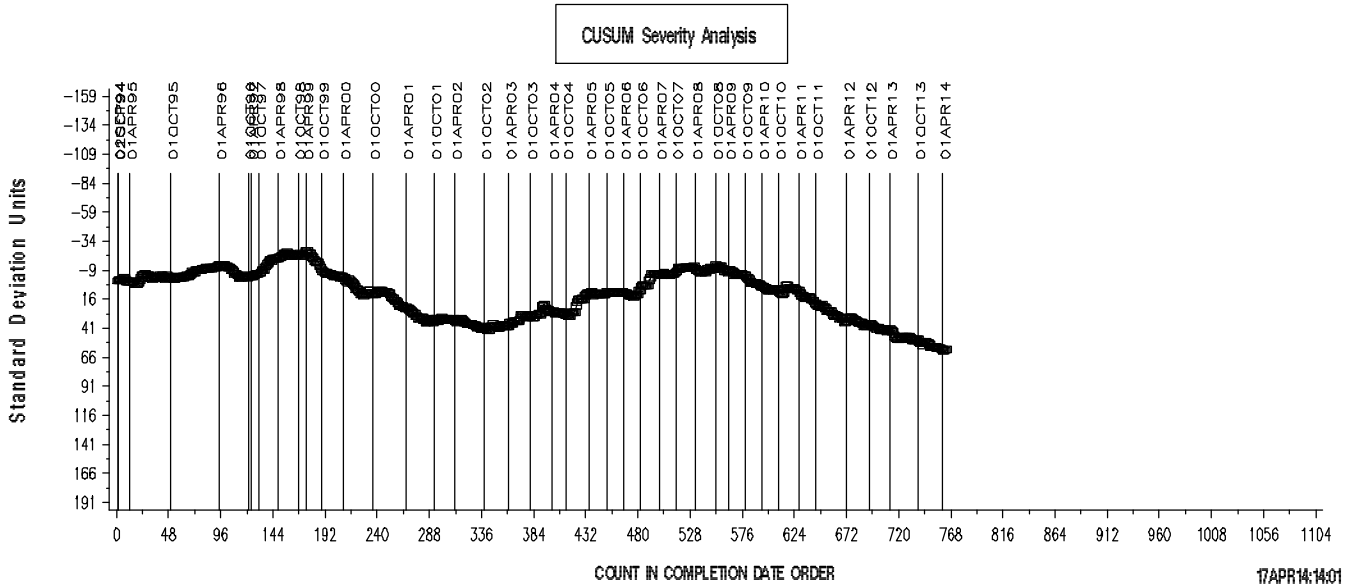
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



17APR14:14:01

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

USING FIXED (UPDATED) TARGETS

REF. FINAL VISCOSITY INCREASE

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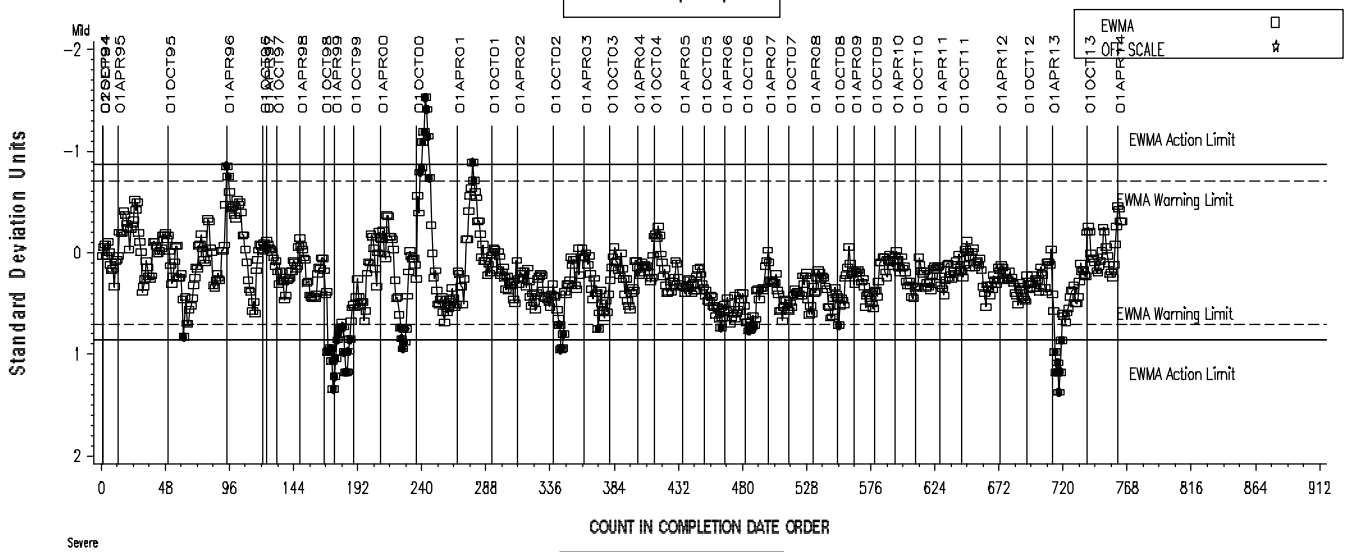
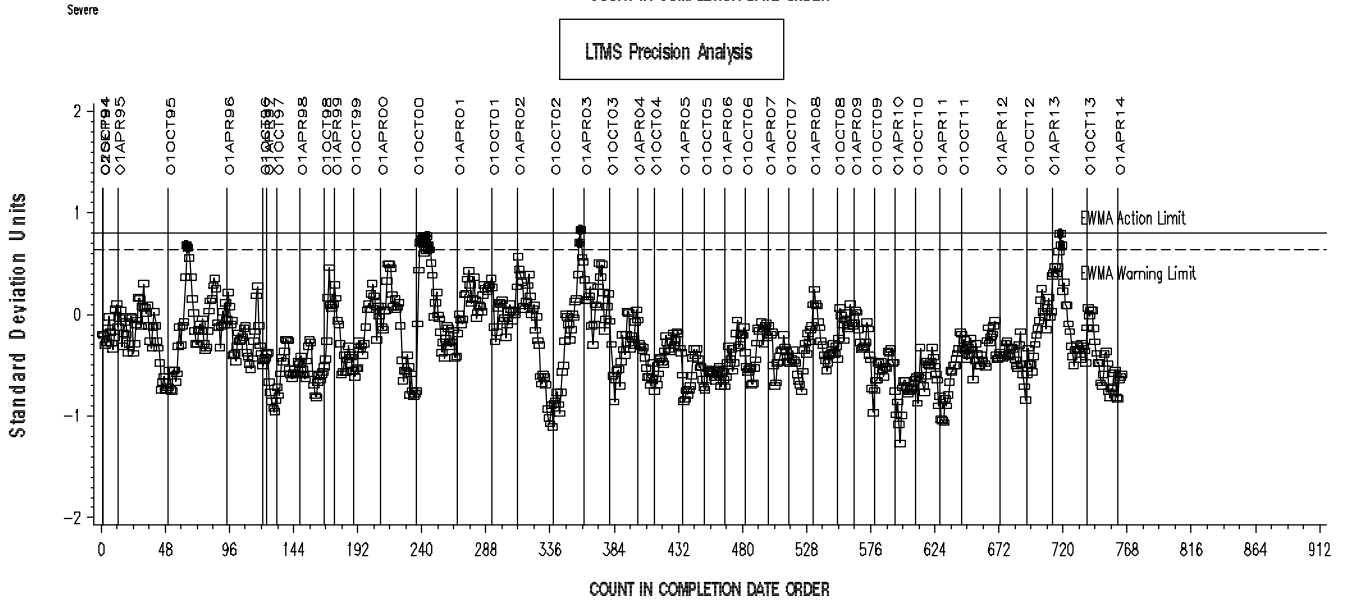
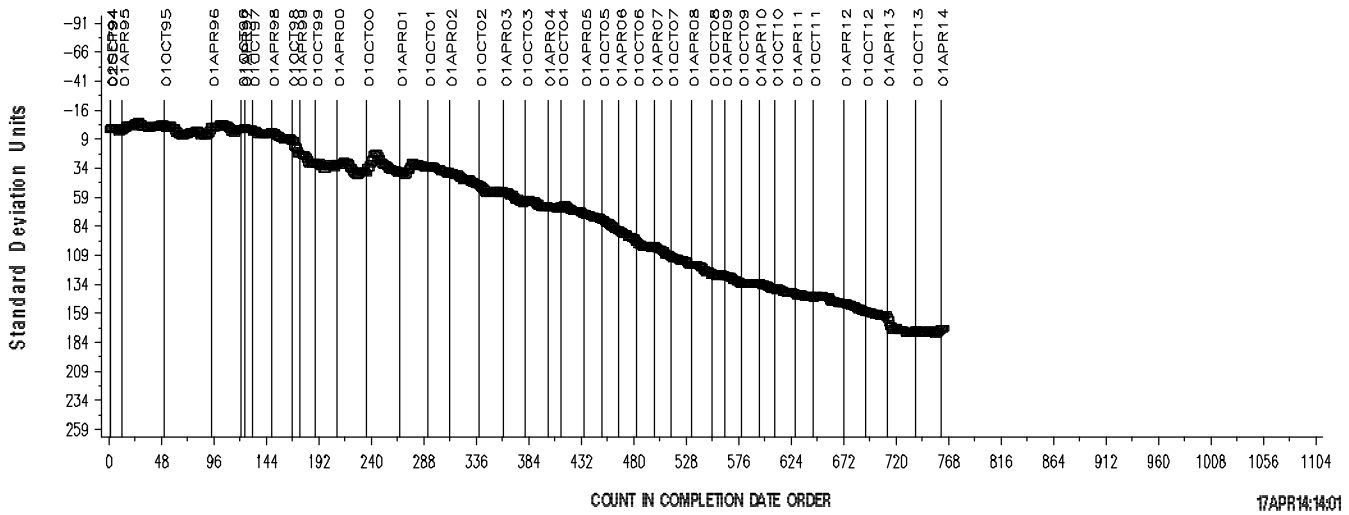
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



17APR14:14:01

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '148-1' (and updated targets)

REF. FINAL AVERAGE CARBON/ VARNISH

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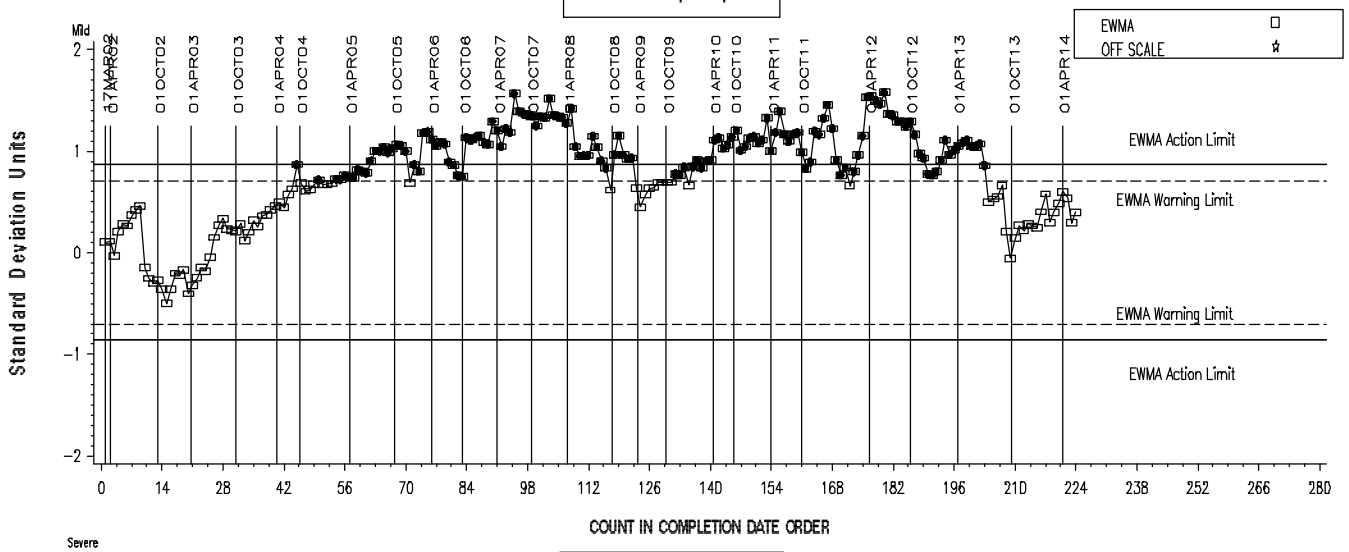
LTMS Severity Analysis



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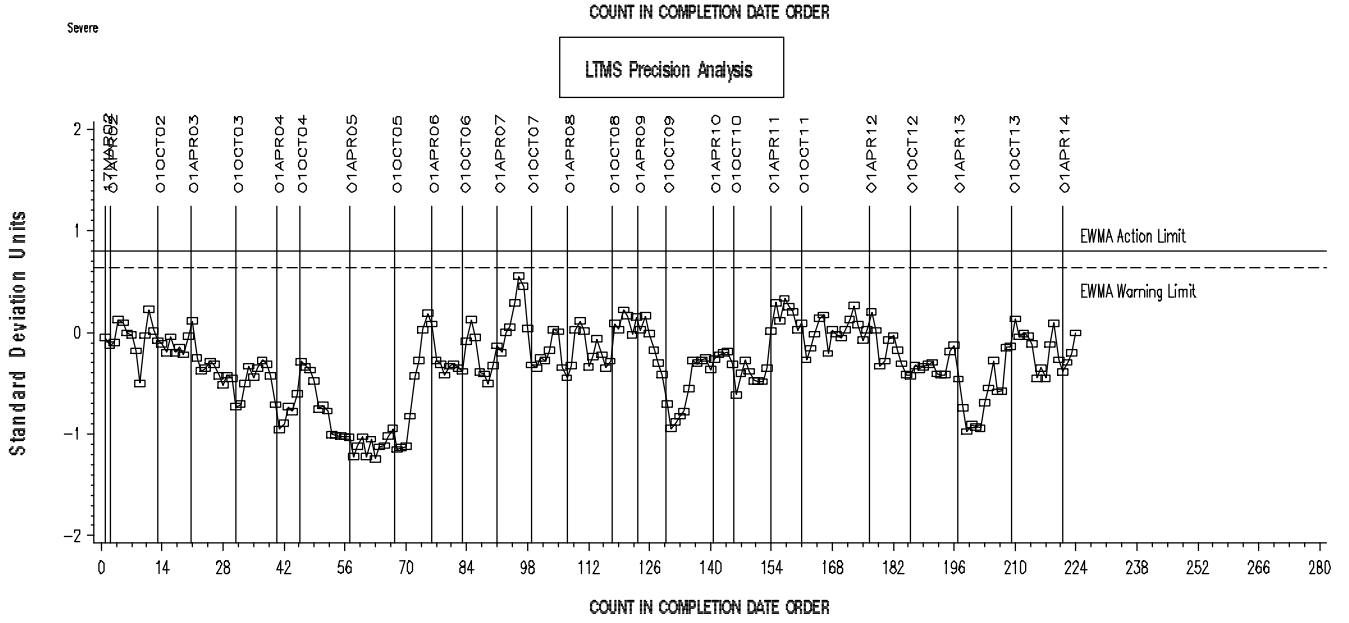

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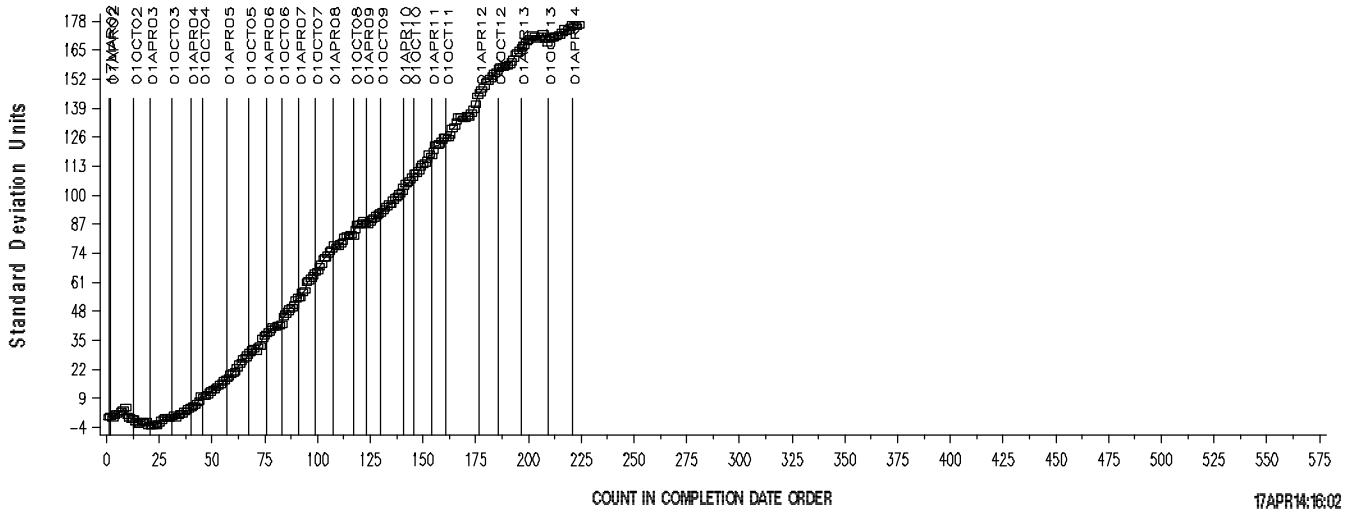

17APR14:16:02

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '148-1' (and updated targets)

REF. FINAL AVERAGE SLUDGE

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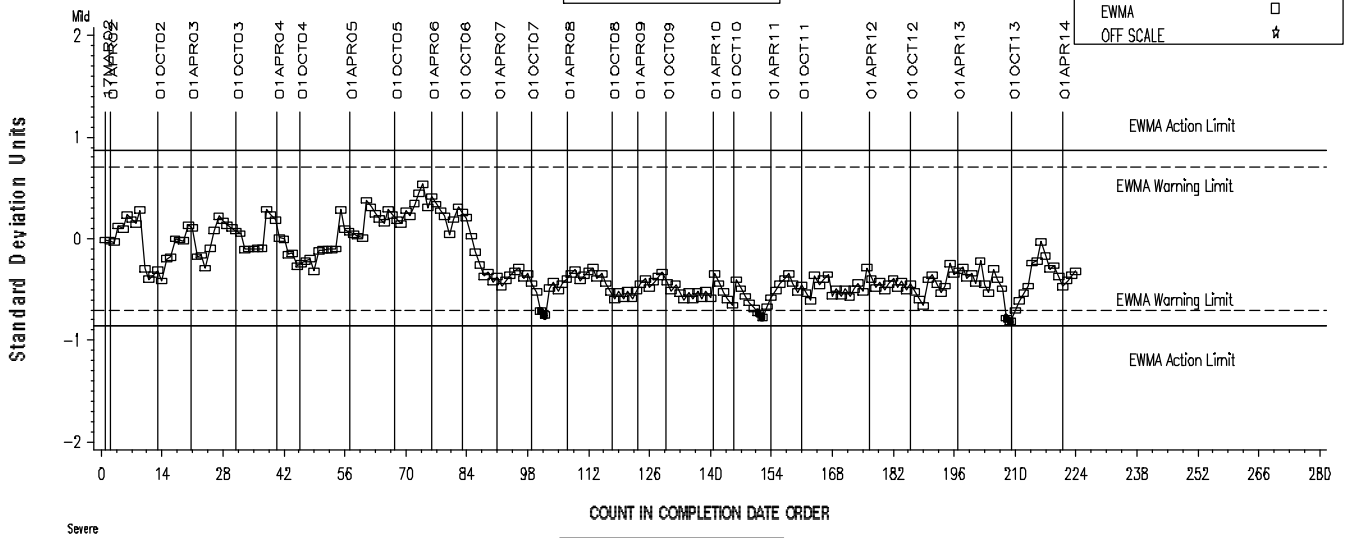
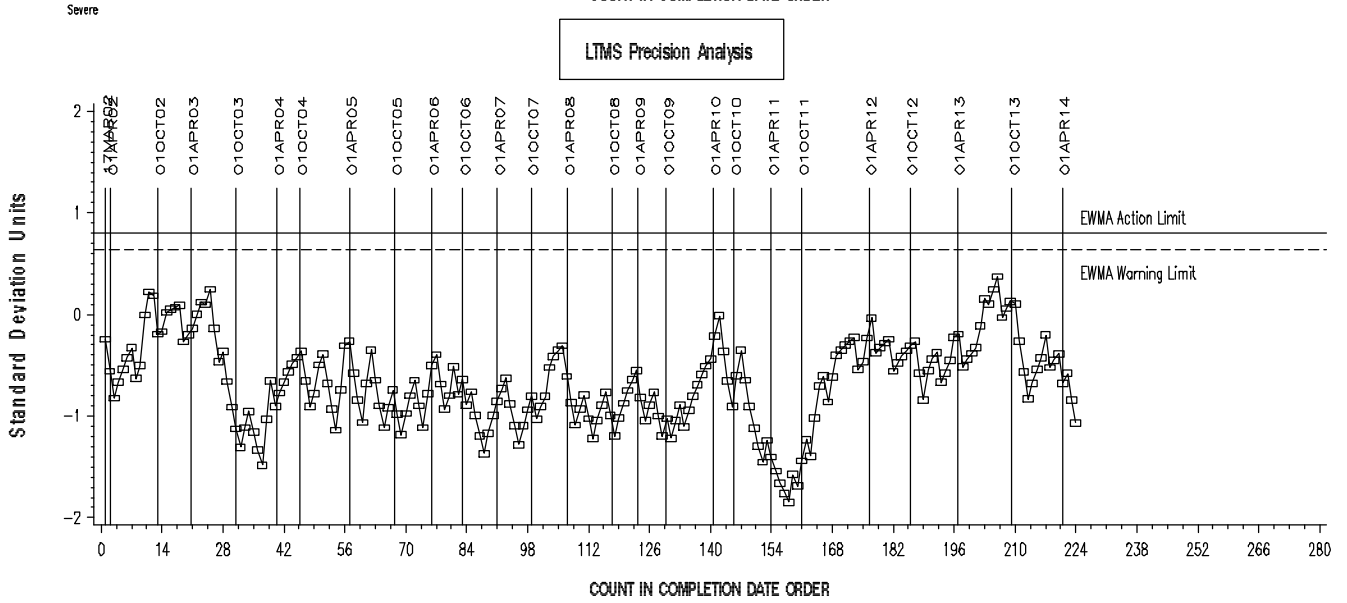
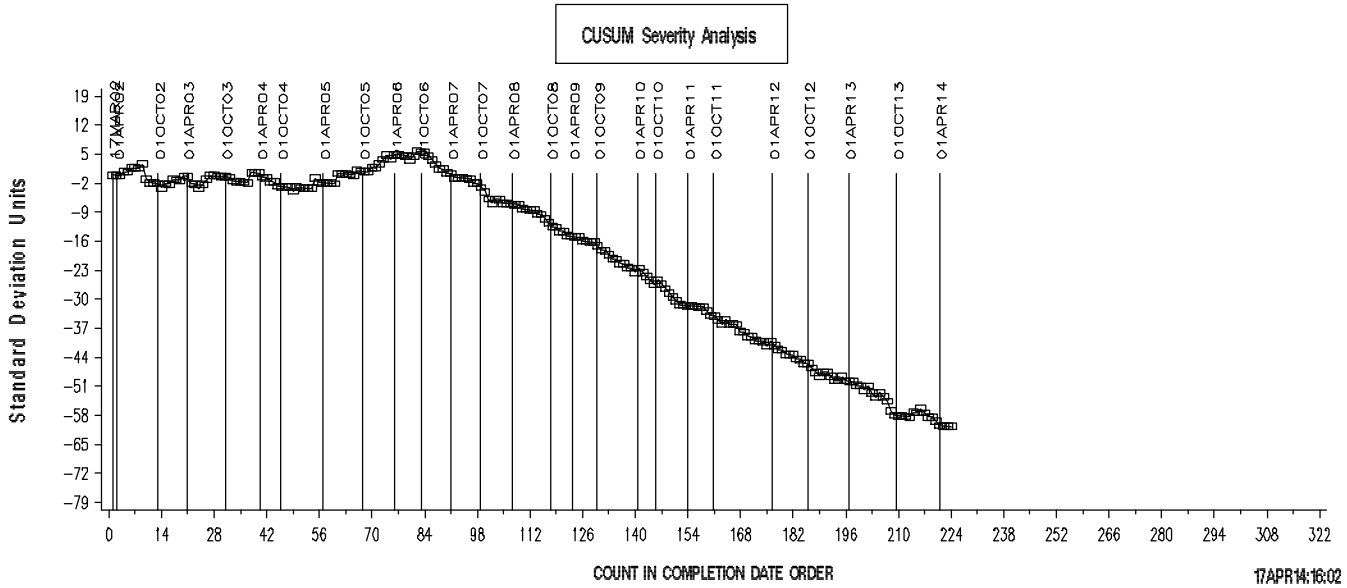
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



17APR14:16:02

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '148-1' (and updated targets)

REF. FINAL PENTANE INSOLUBLES

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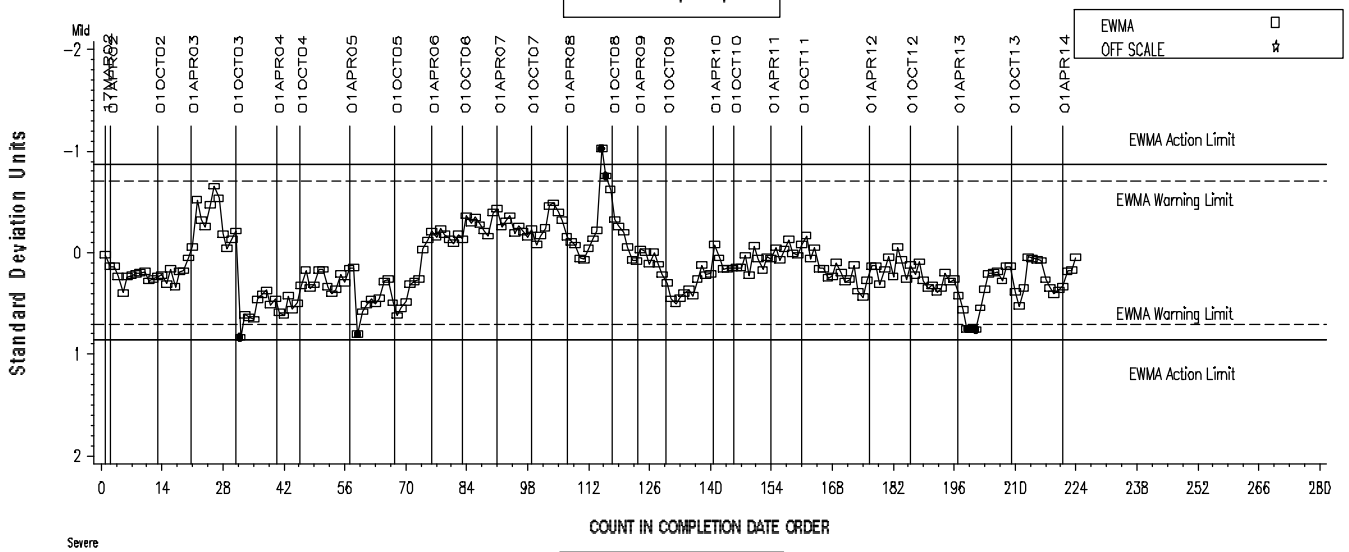
LTMS Severity Analysis



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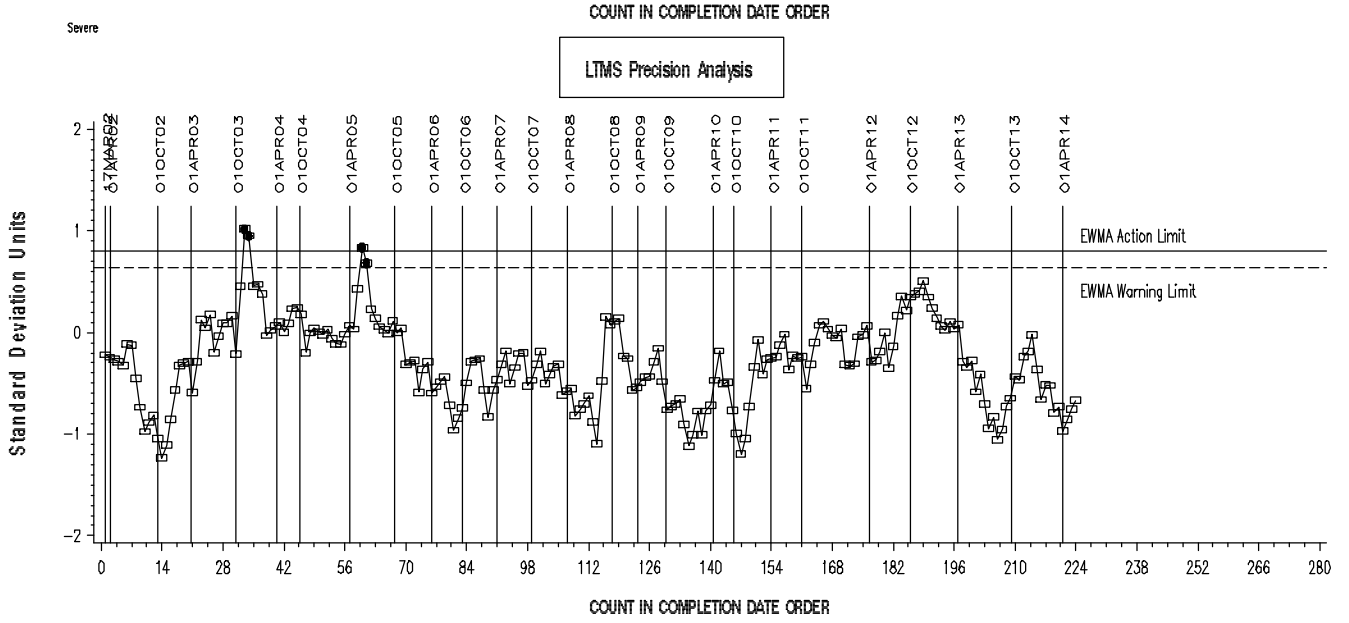
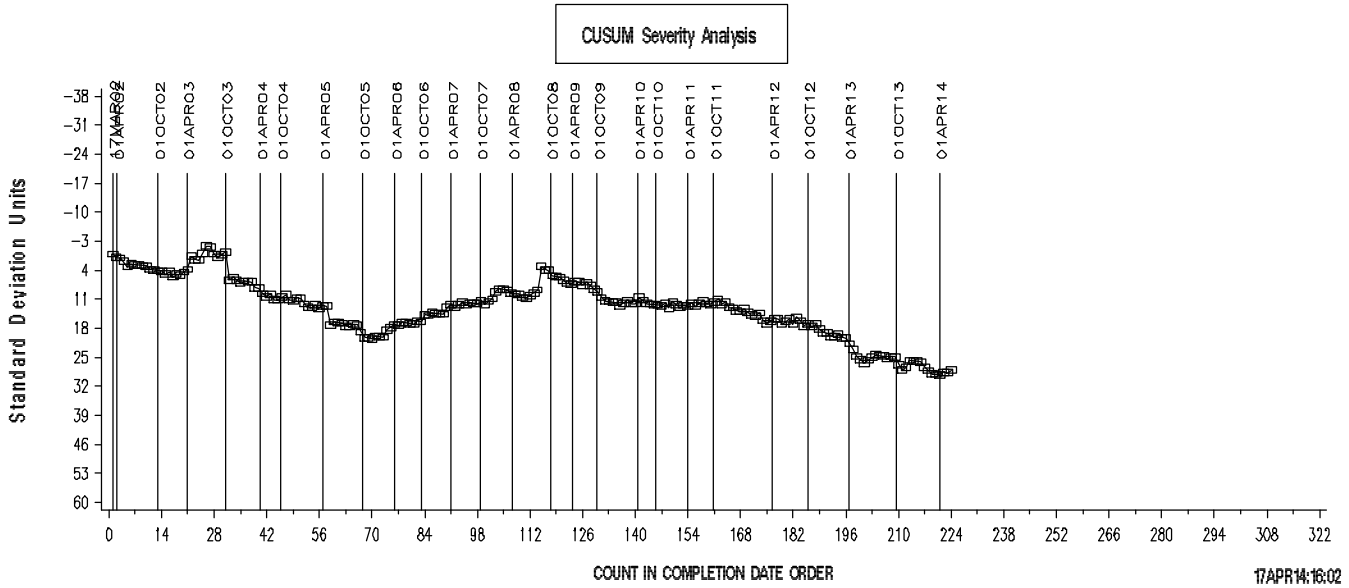


CUSUM Severity Analysis



17APR14:16:02

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '148-1' (and updated targets)

REF. FINAL TOLUENE INSOLUBLES

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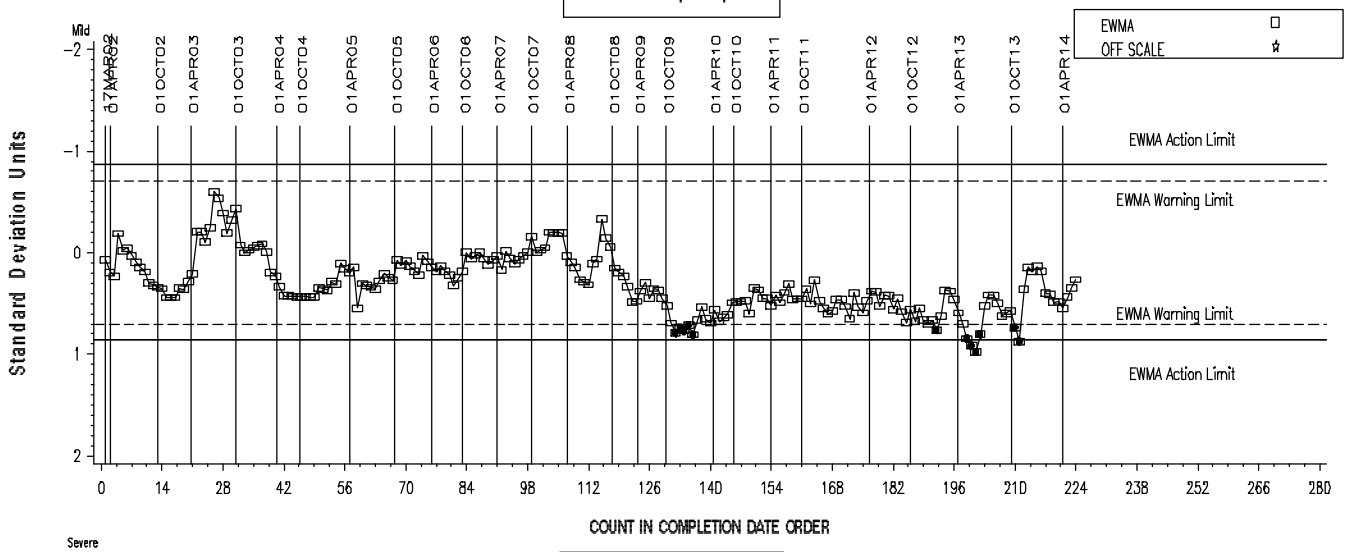
LTMS Severity Analysis



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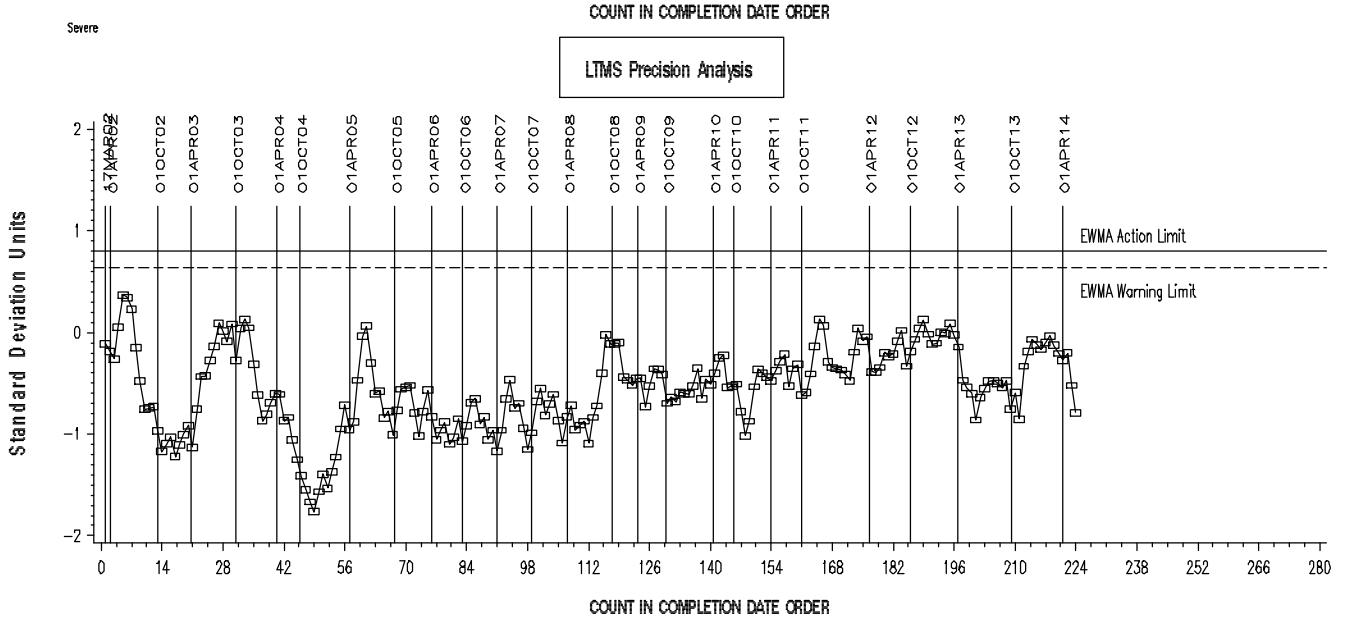
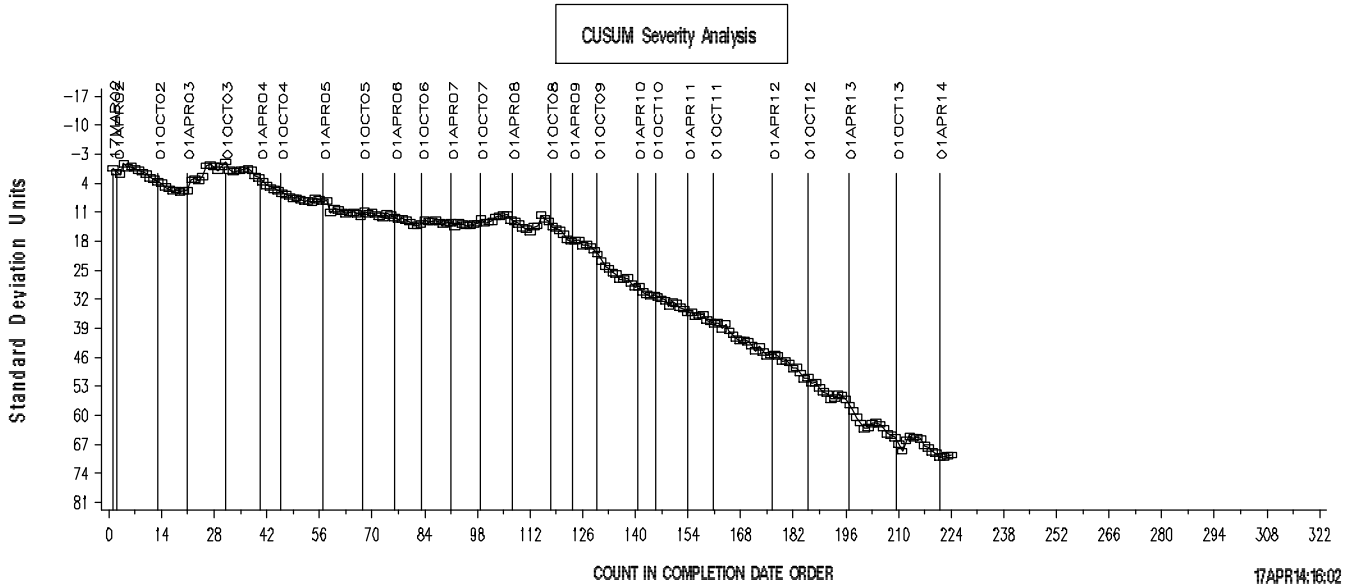


CUSUM Severity Analysis

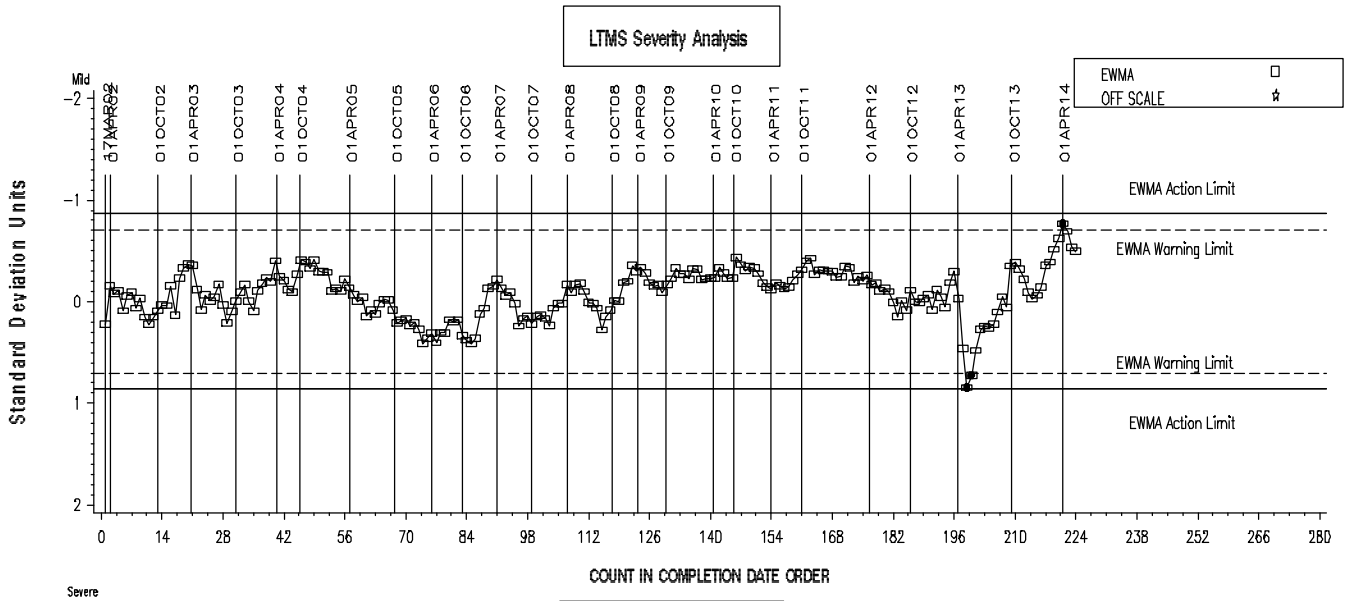


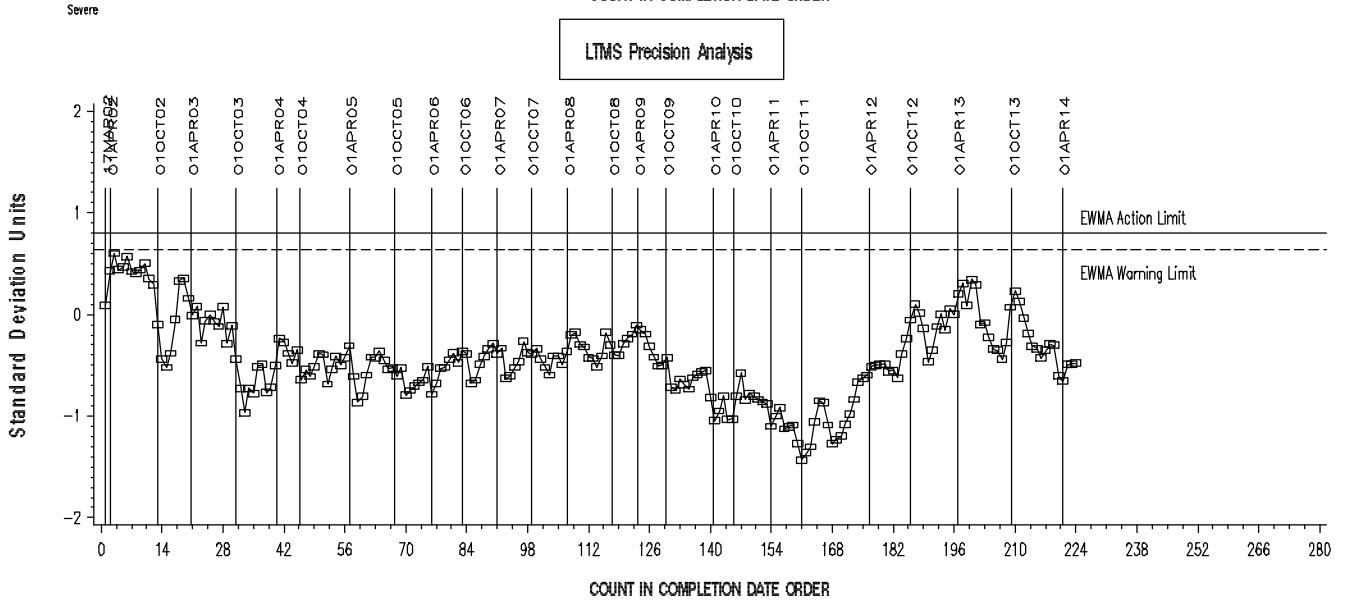
17APR14:16:02

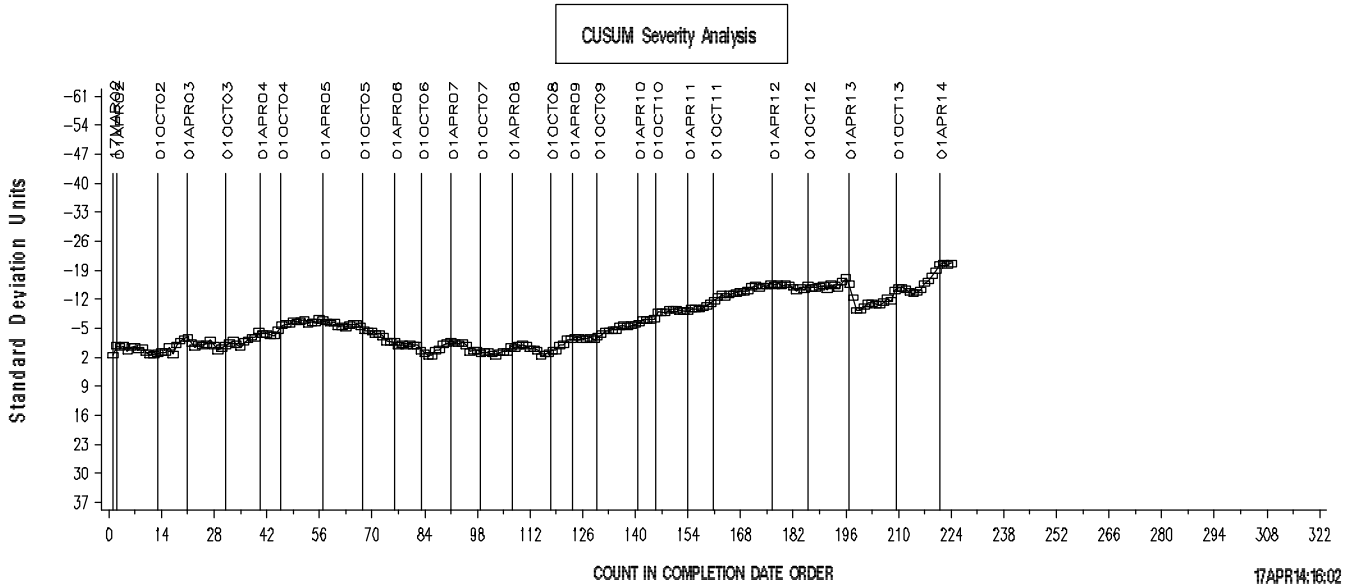
L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '148-1' (and updated targets)

REF. FINAL VISCOSITY INCREASE







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L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '161-2' (and updated targets)

REF. FINAL AVERAGE CARBON/ VARNISH

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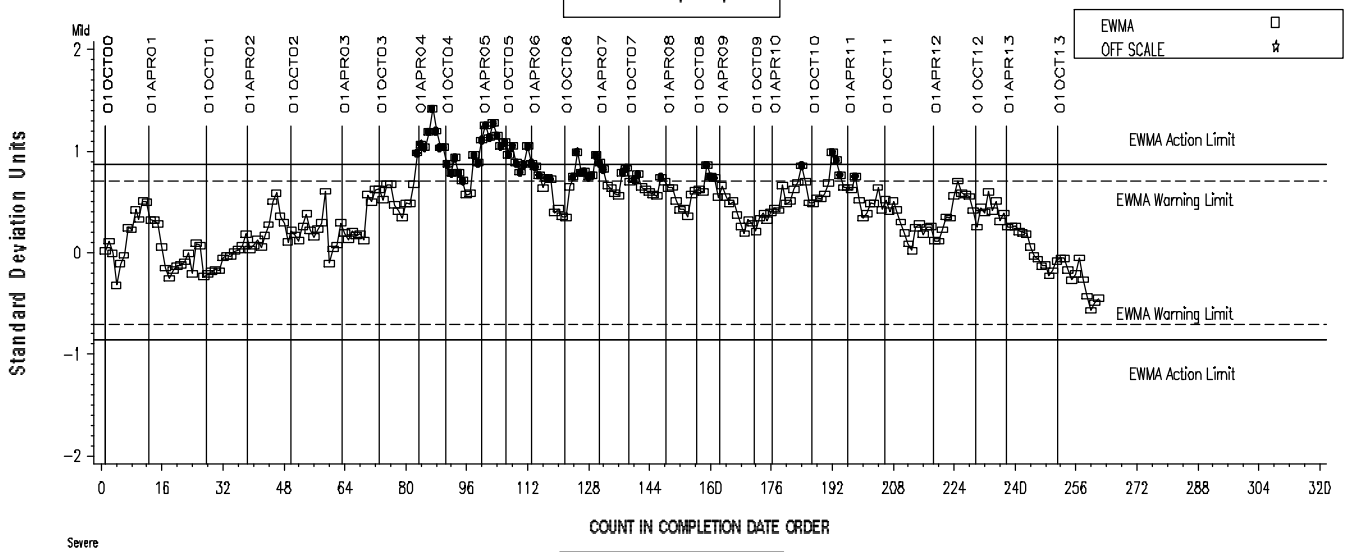
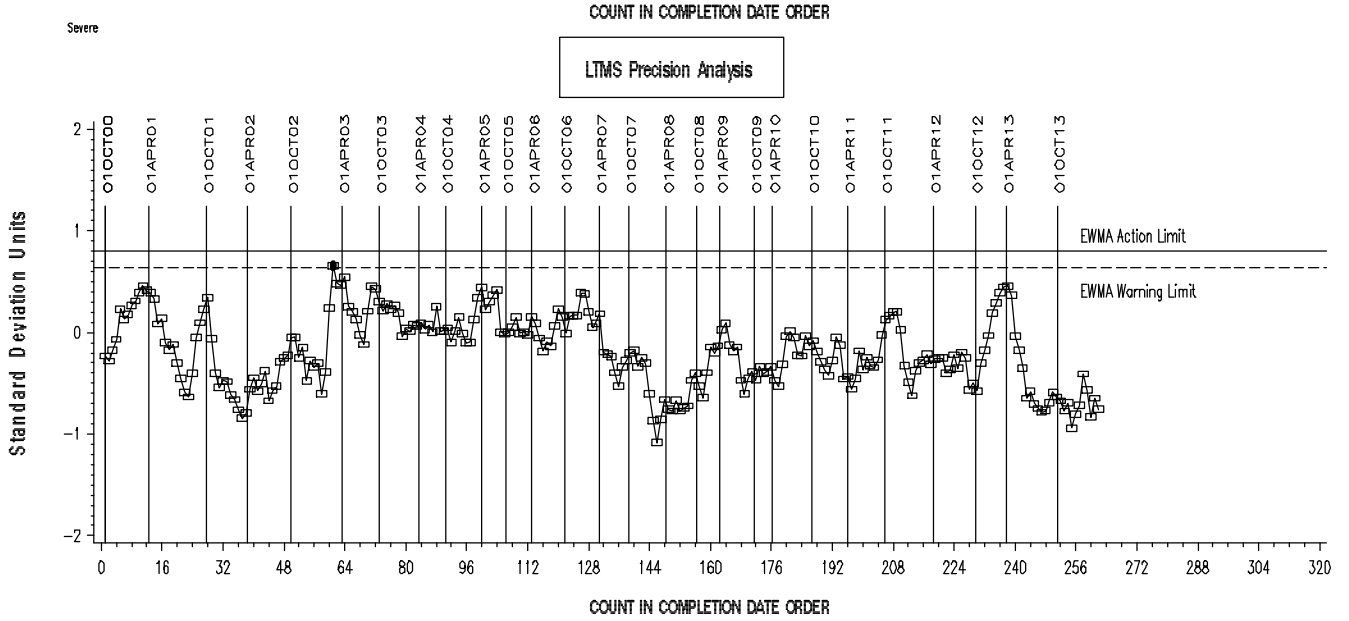
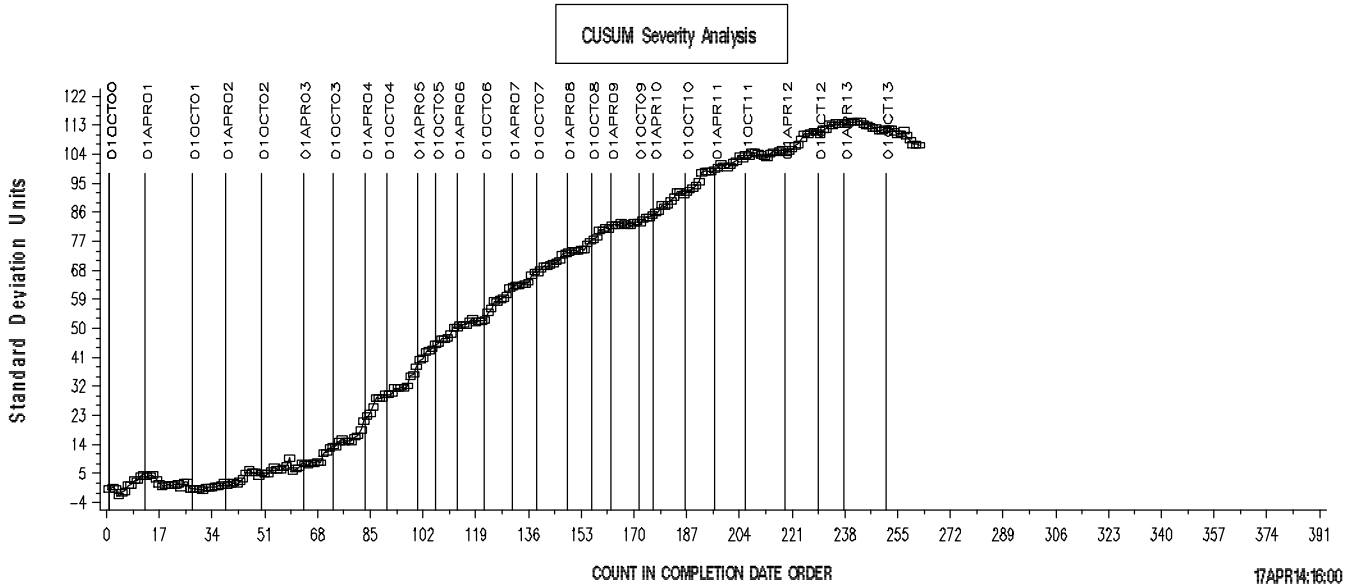
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



17APR14:16:00

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '151-2' (and updated targets)

REF. FINAL AVERAGE SLUDGE

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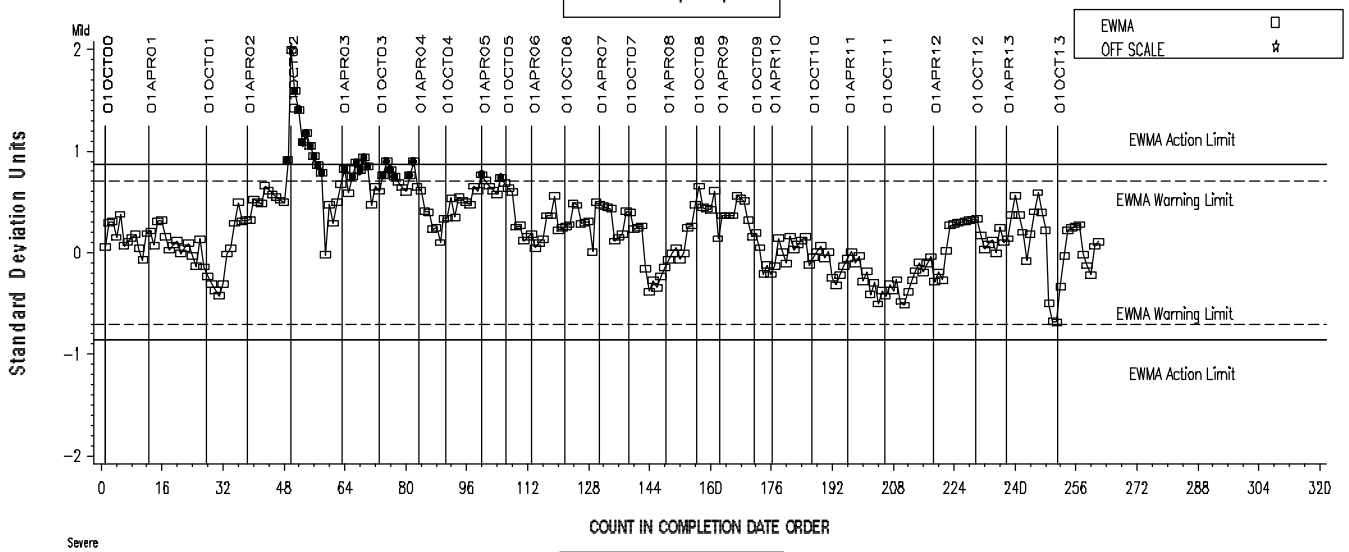
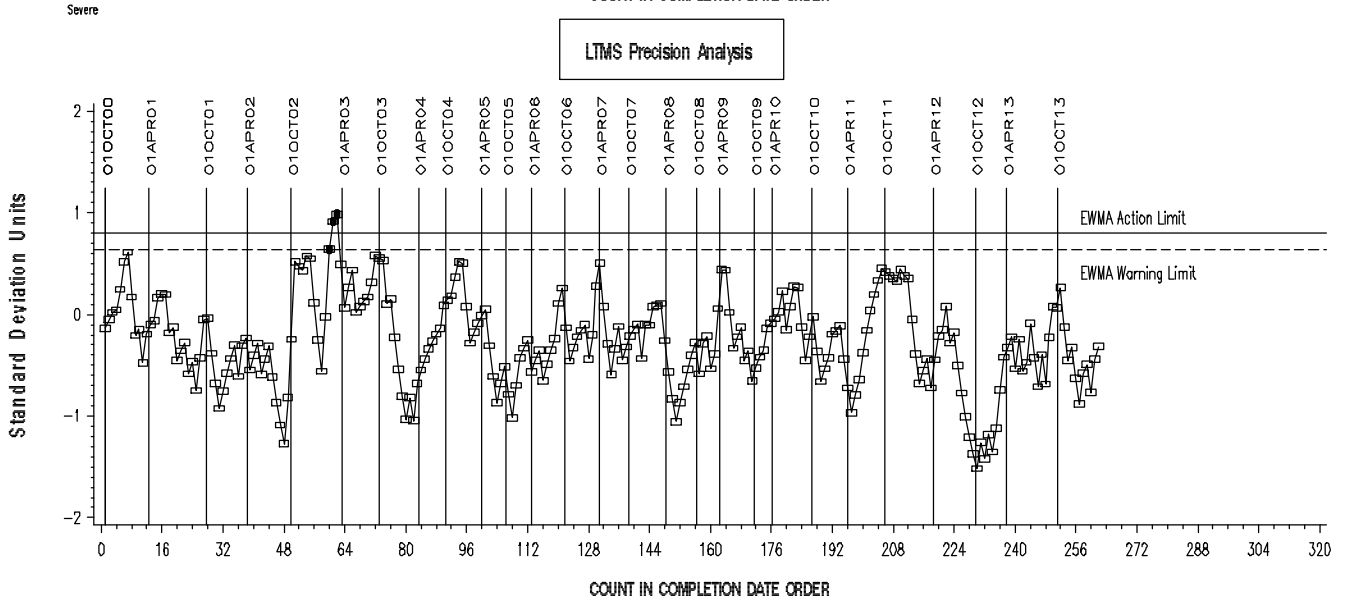
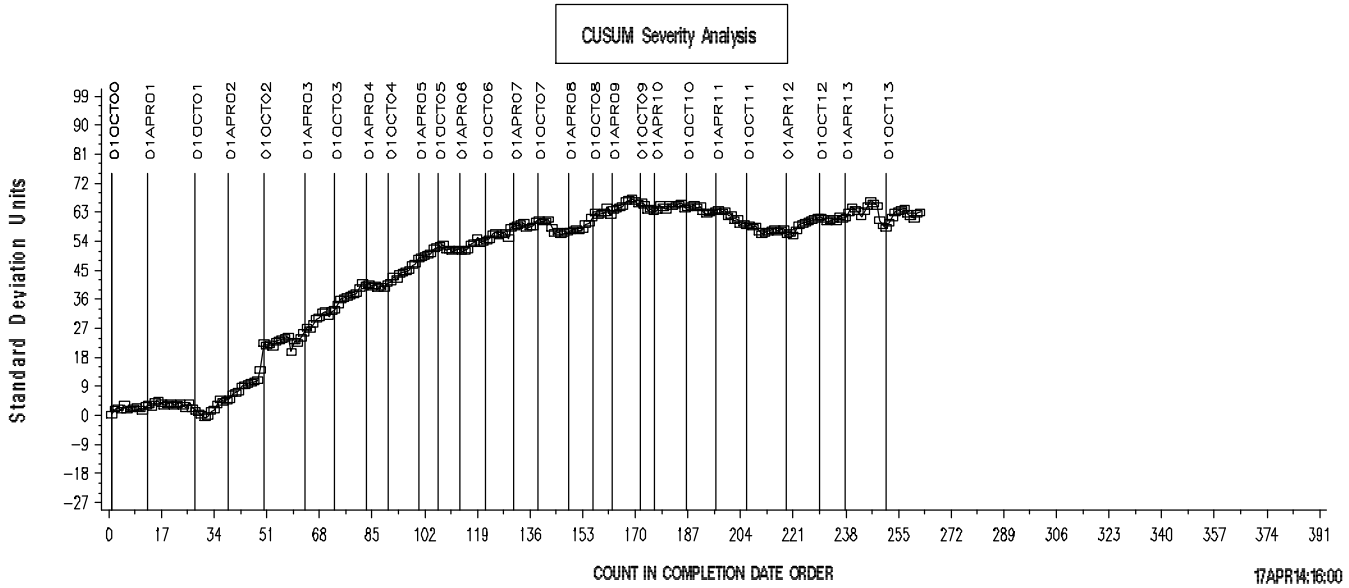
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



17APR14:16:00

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '151-2' (and updated targets)

REF. FINAL PENTANE INSOLUBLES

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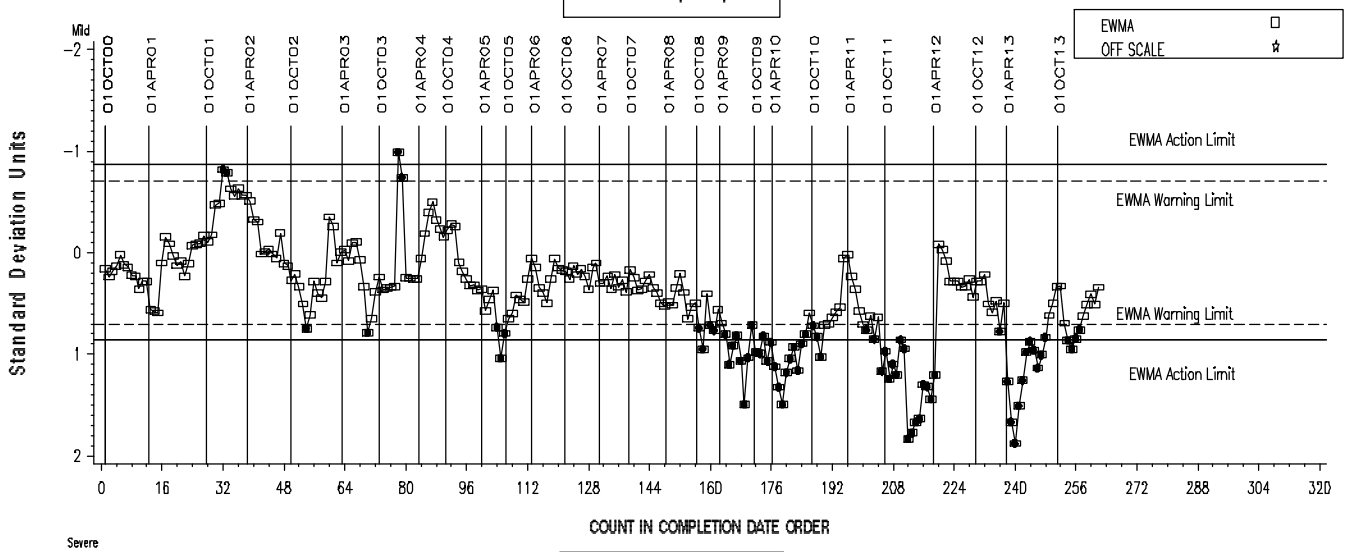
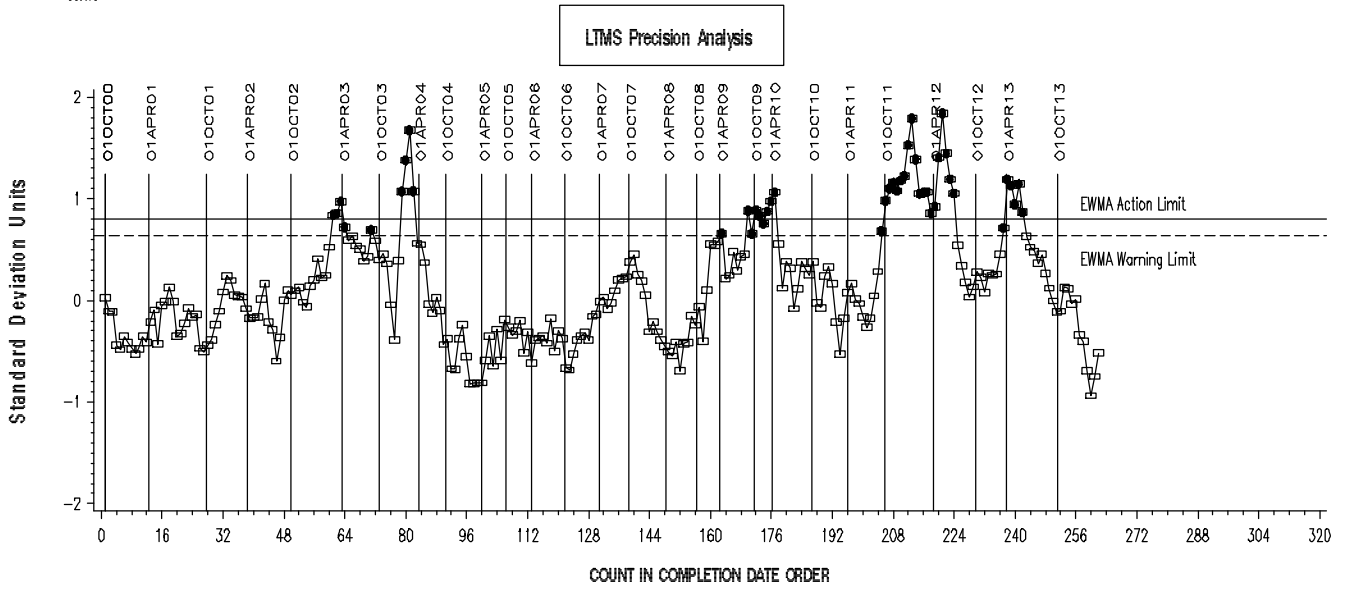
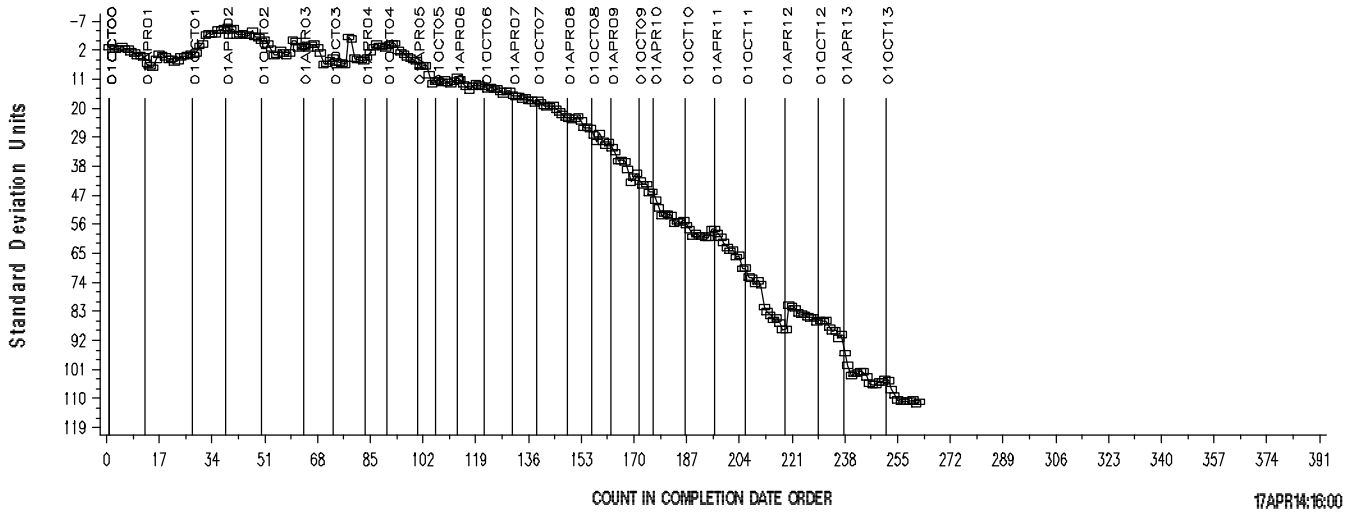
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



17APR14:16:00

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '151-2' (and updated targets)

REF. FINAL TOLUENE INSOLUBLES

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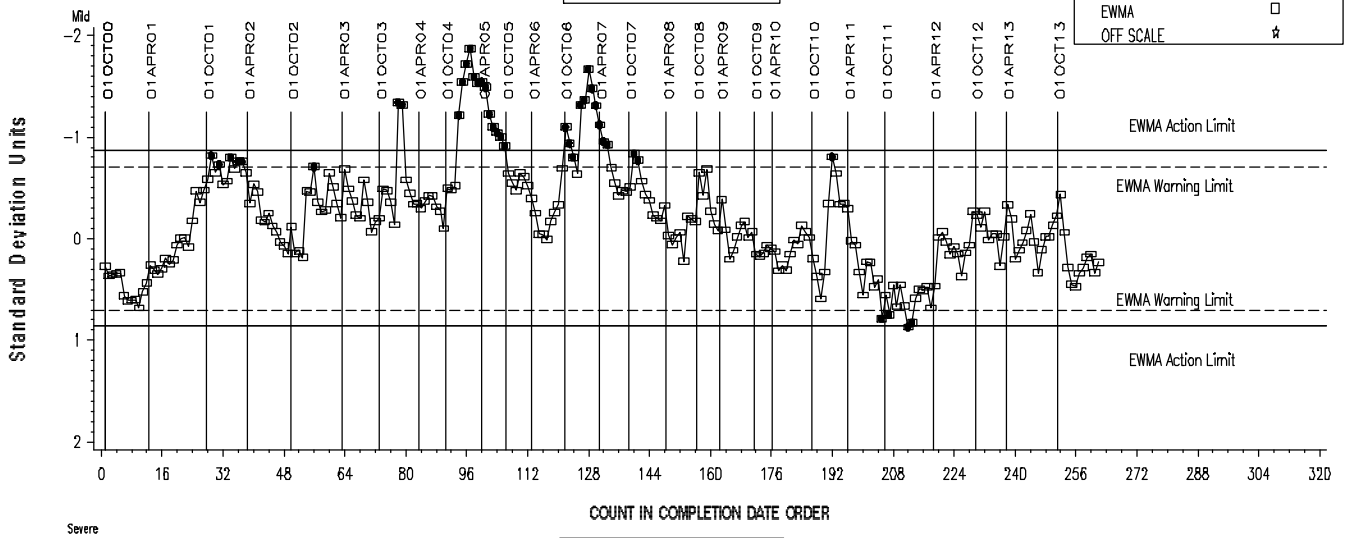
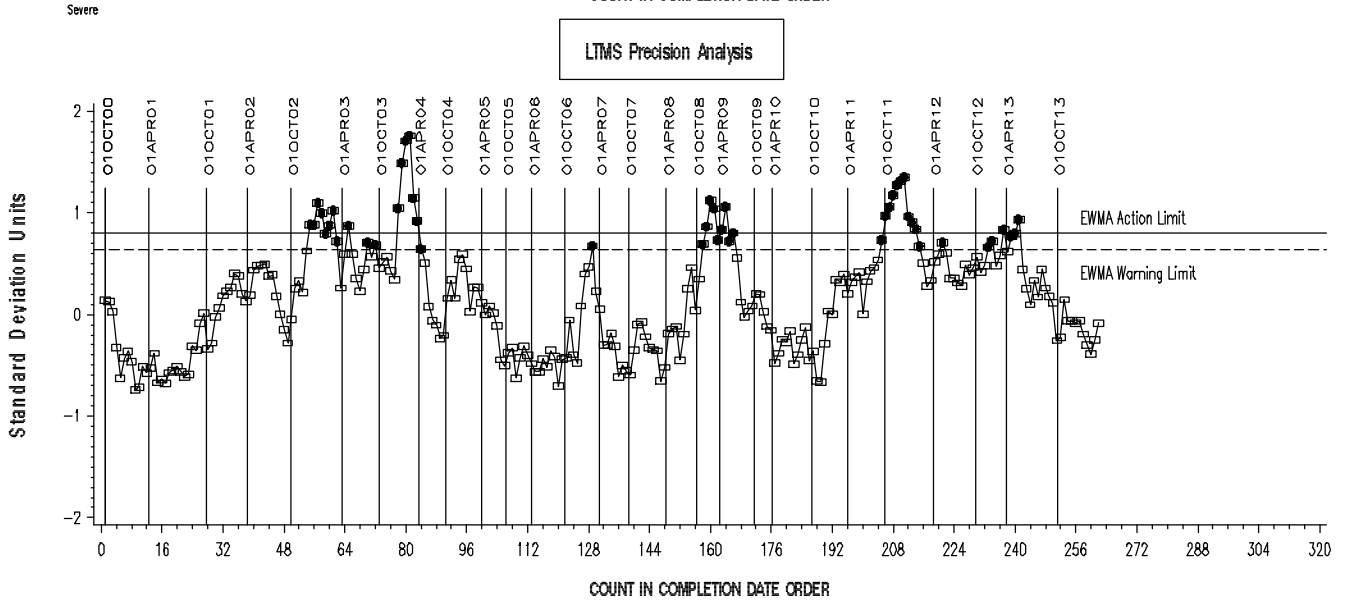
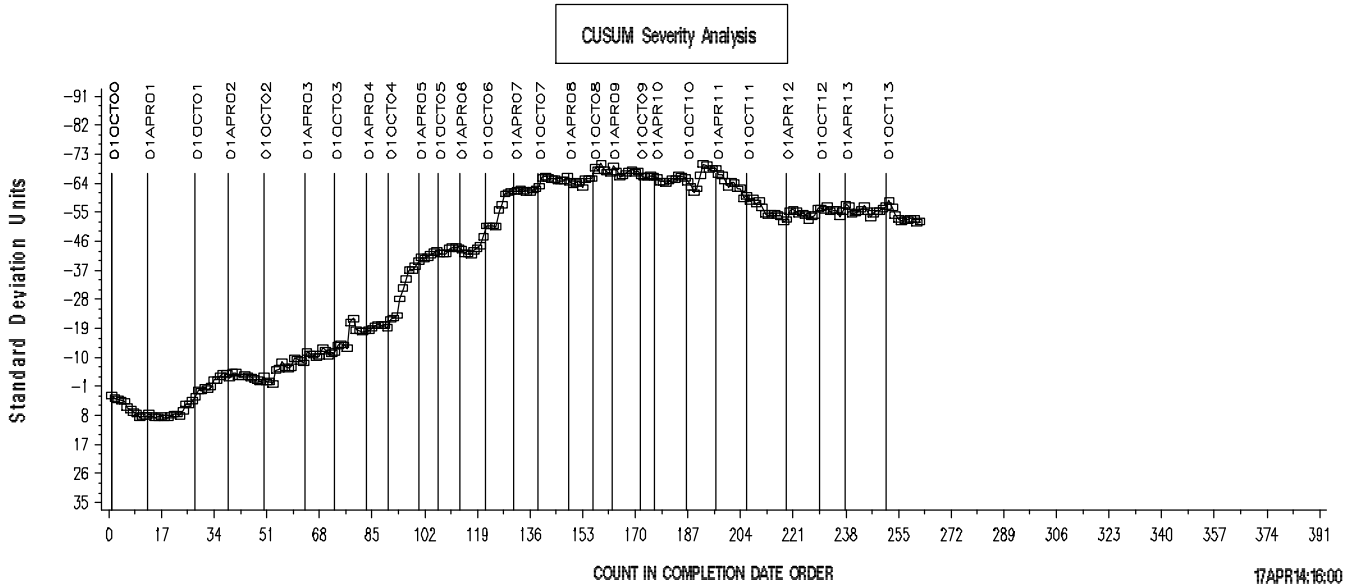
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



17APR14:16:00

L-60-1 INDUSTRY OPERATIONALLY VALID DATA

IND = '151-2' (and updated targets)

REF. FINAL VISCOSITY INCREASE

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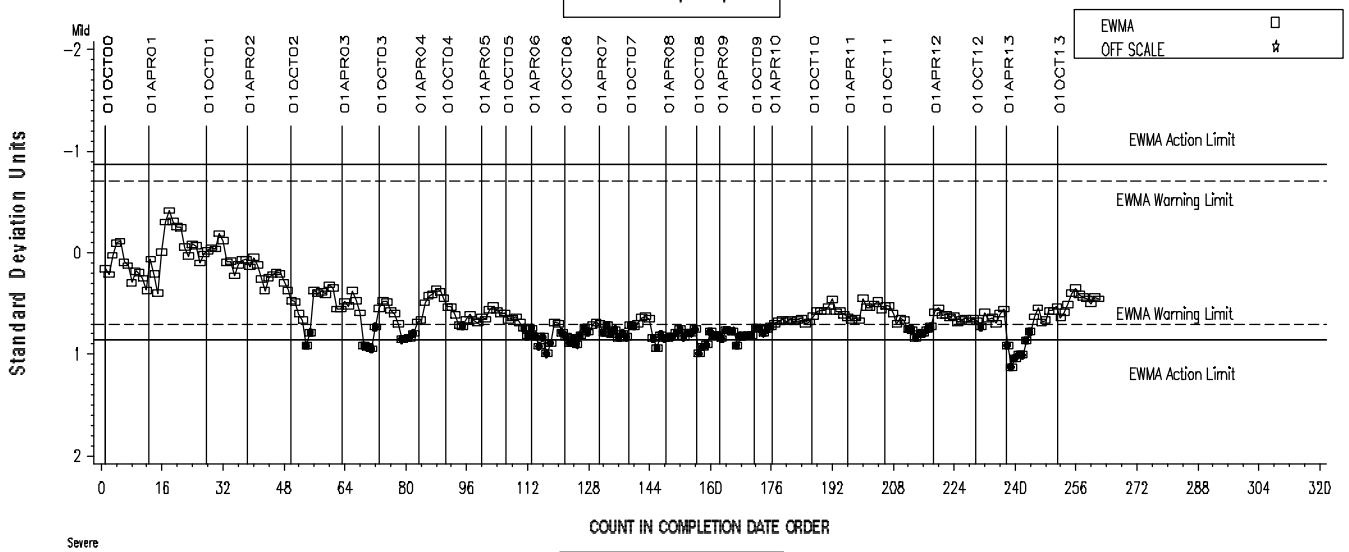
LTMS Severity Analysis



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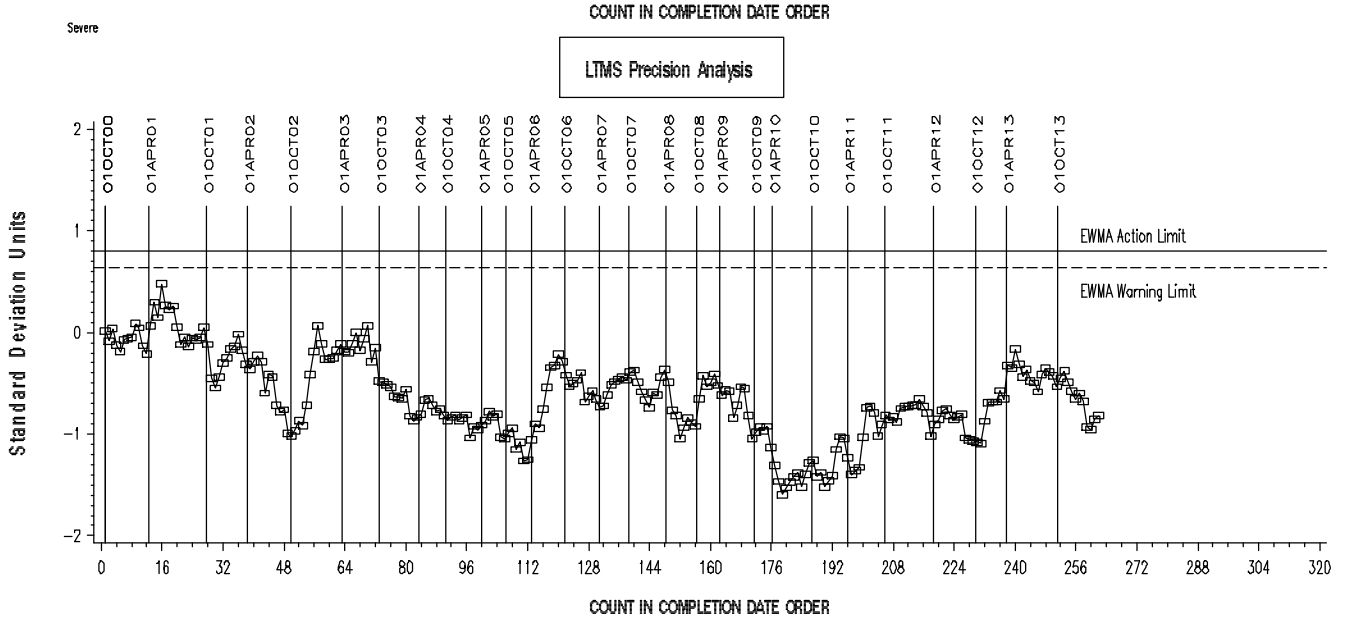
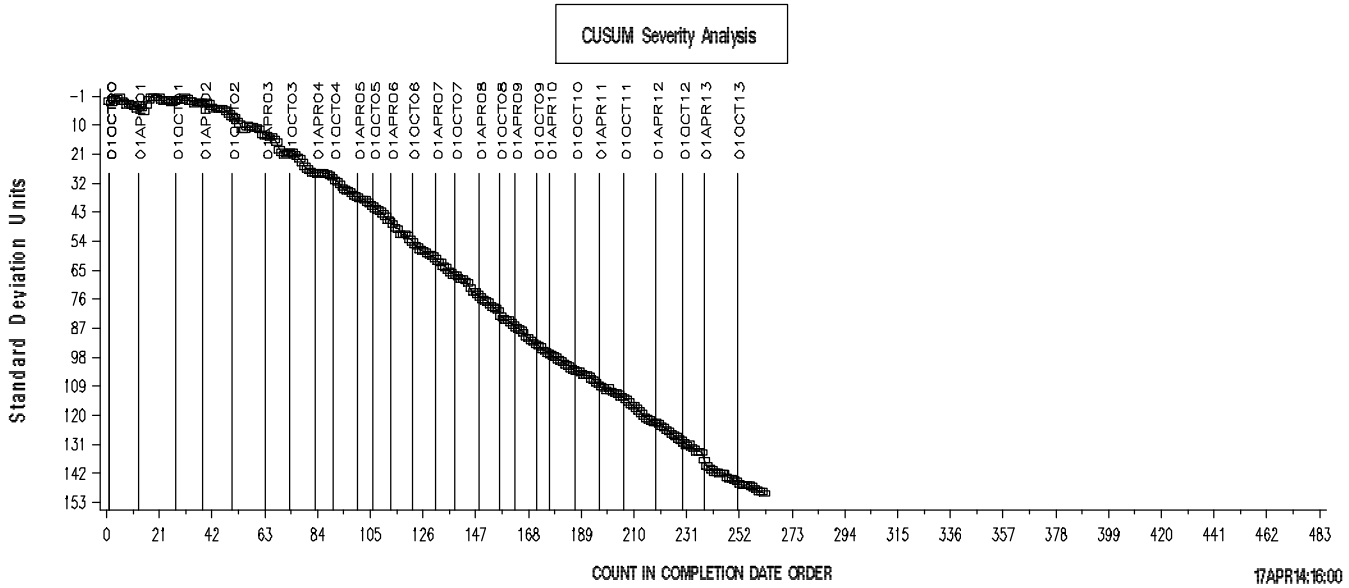


CUSUM Severity Analysis



17APR14:16:00