Report of Meeting
L-60-1 Surveillance Panel Conference Call
August 11th, 2021

Attendees:

SwRI -	**Warden,** Kostan, Louis
Lubrizol -	Venhoff, **Slocum**, Bealko
Afton -	**Sangpeal,** Bell
Intertek -	**Lange**
TMC -	**Beck**
ExxonMobil -	**Banas**
BASF -	**Goyal,** Mosher
Dana -	**Zyski**
Meritor -	LaBond, **Carter**
Army -	Sattler
AAM -	**Muransky**
Chevron -	Martinez
Retiree -	Kanga

Todd Dvorak

Voting Members in **BOLD**

1.0 Membership Review

- No change

2.0 Meeting minutes Approval

- May 12th, 2021, ASTM Meeting LRI #201

Motion #1 → R. Slocum 1st /2nd J. Carter to approve the meeting minutes from the May 12th, 2021 (LRI# 201) Motion passed unanimously, 10-0-0 (Yes-No-Abstain).

3.0 L-60-1 Severity Statistician Review Summary

- Possible lab visits?
- Arjun - Does the data have stand differences?
- Arjun - Does it have any effect on viscosity increase parameter issues? None.
- Rebecca - worried about compression of candidates on the top end
- Wes - could always look at raw versus corrected merits
- TMC could initially visit labs
- Could raters have variability
- TMC said raters seem inline
- Rebecca said round robin done when 0.6 was implemented and no smoking guns
- Action-
  - At least 1 month from now revisit what we should do on merit correction

4.0 Procedure Proposal "Shake Reference Oils"- TMC

- Will table for now till possibly next LRI meeting

5.0 Old Business

- 155-2 – Approval?
  - Still need additional data points. Will need to decide on severity direction.
- 148-1 Replacement
  - LZ to investigate possibilities?
- L60 Stand Drawing Location - TMC
  - R. Slocum to work with TMC on link and Procedure Update
- Test Hardware
  - Action item: Lubrizol
    - Look for Alloy Certs
    - Search for Jerry Gropp files on material specifics

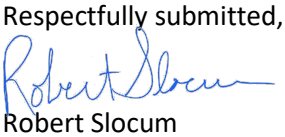
6.0 News Business

- None

7.0 Adjourn

Motion #2 → A. Lange 1st /2nd A. Goyal to adjourn. Motion passed unanimously, 10-0-0 (Yes-No-Abstain).

Respectfully submitted,



Robert Slocum
L-60-1 Surveillance Panel Chairman

D02.B0.03

L-60-1 Surveillance Panel Meeting

08/11/2021

3:00pm– 4:00pm

Robert Slocum

Agenda

- Call to Order/Agenda review
- Membership review
- Meeting Minute Approvals
  - May 12th, 2021, ASTM Meeting
- L-60-1 Severity Statistician Review Summary
- Procedure Proposal “Shake Reference Oils”- TMC
- Old Business
  - 155-2 – Approval – One additional data point needed
  - 148-1 Replacement
  - L60 Stand Drawing Location - TMC
    - Procedure Update
- New business
- Adjournment

Membership Review

L-60-1 Surveillance Voting Members

Allen Comfort	US Army
Amy Zyski	Dana
Arjun Goyal	BASF
Anthony Lange	Intertek
Jason W. Carter	Meritor
Dylan Beck	TMC
Robert Slocum	Lubrizol
Matt Sangpeal	Afton
Mike Cabaj	Linamar
Rebecca Warden	SwRI
Rob Banas	ExxonMobil
Troy Muransky	AAM

Meeting Minutes Approval

- May 12th, 2021, ASTM Meeting

L-60-1 Severity Statistician Review Summary

Procedure Proposal “Shake Reference Oils”- TMC

Replace the text of section 10.1 with the following:

10.1 Pour 120 mL +/- 5 mL of the lubricant to be tested into a clean container. Weigh the container of oil. Charge the gear case with the test lubricant. For reference tests shake the oil sample beforehand. Reweigh the container and deter[1]mine the oil charged by subtraction. Record the weight of the test oil charge to the nearest 0.01 g.

Old Business

- 155-2 – Approval?
- 148-1 Replacement
- L60 Stand Drawing Location - TMC
  - Procedure Update

New Business / Adjournment

L-60-1 Severity Review

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Statistics Group

- Jo Martinez, Chevron Oronite
- Martin Chadwick, Intertek
- Todd Dvorak, Afton
- Kevin Manouchehri, Lubrizol
- Dylan Beck, Test Monitoring Center
- Travis Kostan, SwRI
- Rob Slocum, Lubrizol
- Wes Vehhoff, Lubrizol
- Allen Comfort, U.S. Army

Objective

Investigate the severity of average carbon/varnish (ACV) and ASL.

- Try to identify potential causes of the shift
- Determine the appropriateness of correction factors for these parameters.

Executive Summary

Average Carbon/Varnish

- Reference oil data historically has been consistently severe of target.
- Though initial testing on 2018 hardware was closer to target, all labs who have switched have seen a shift, and the one lab that hasn't has remained stable, therefore indicating a high likelihood of the new gear batch as the cause of the shift.
- Both reference oils have shifted similarly, providing evidence that candidate behavior is likely also shifted.
- Options:
    1. Correction factor 0.6 merits is recommended for a tests run with the 2018 hardware, in addition to the 0.6 merit correction currently in place, for a total correction of 1.2 merits for tests run on the 2018 hardware.
    2. There are clear differences in precision of ACV across labs, with Lab D running much more precise than other labs. Lab visits are recommended to better understand these differences.
        - Updates to the ACV correction factor may be delayed - pending the findings / conclusions of the lab visits
    3. Do nothing

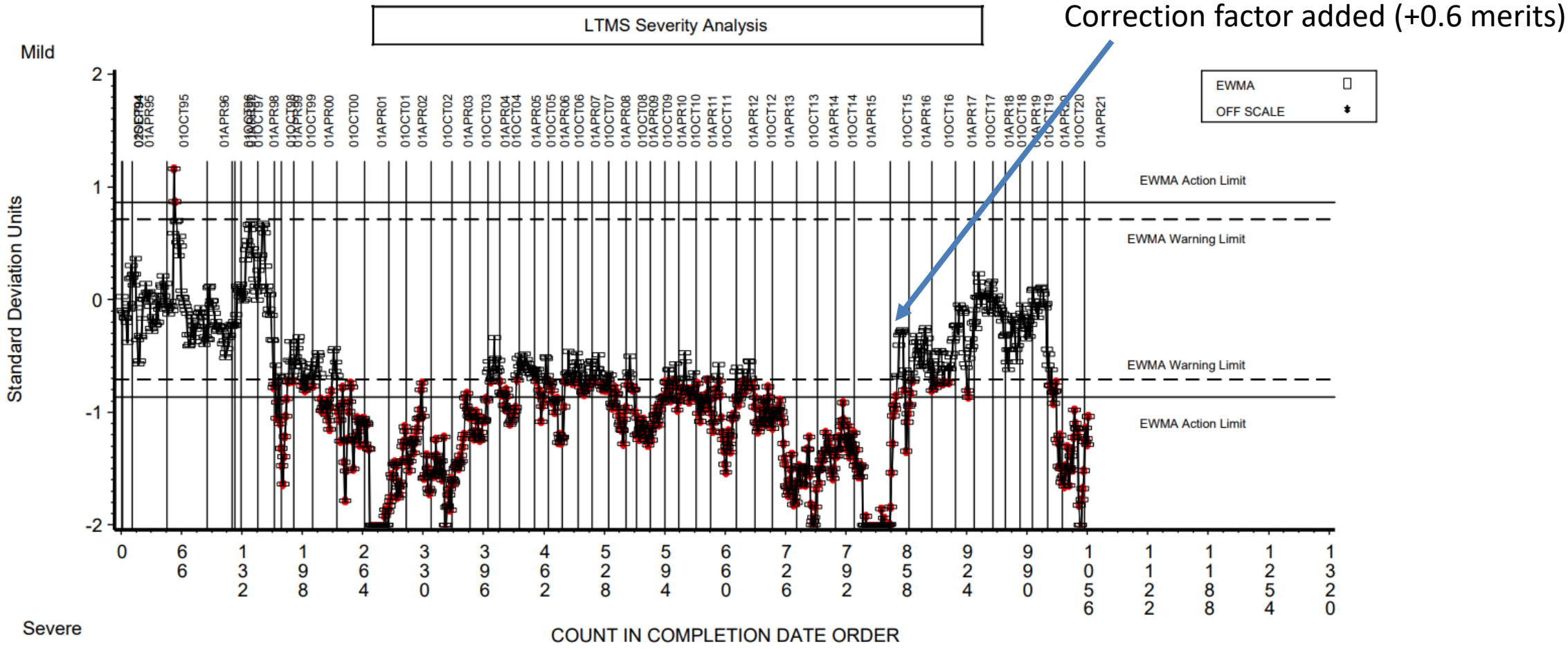
Average Sludge

- Only 3 data points beyond 2.0 sigma severe, and there is no clear shift at the time of the new hardware introduction.
- It is recommended to continue to monitor this parameter without a correction factor and allow severity adjustments to handle differences in severity.

Average Carbon/Varnish (ACV)

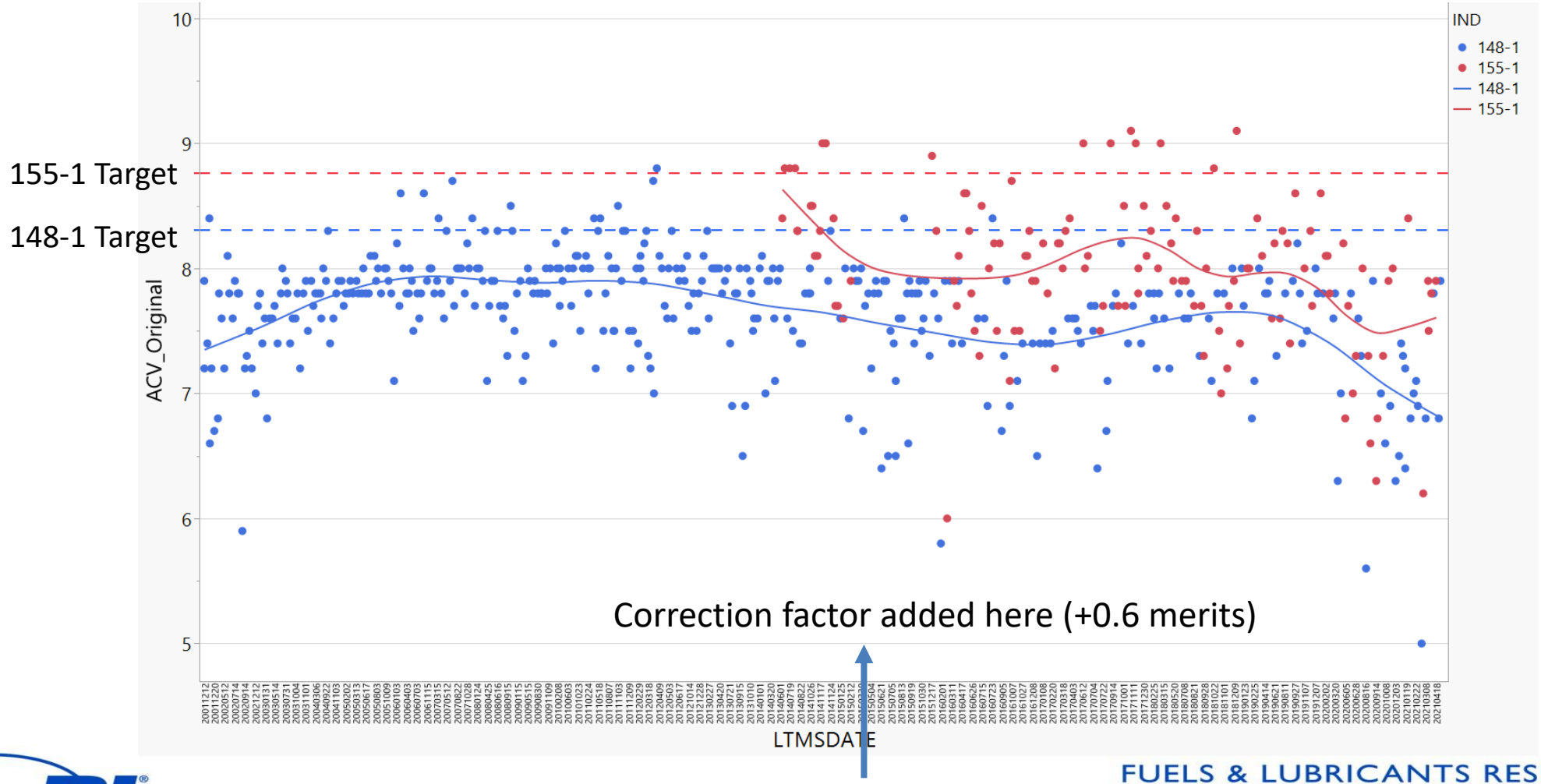
Average Carbon/Varnish (ACV)

This parameter began to move in the severe direction in the fall of 2019, and has been consistently severe since spring of 2020. This is not new behavior for this parameter.



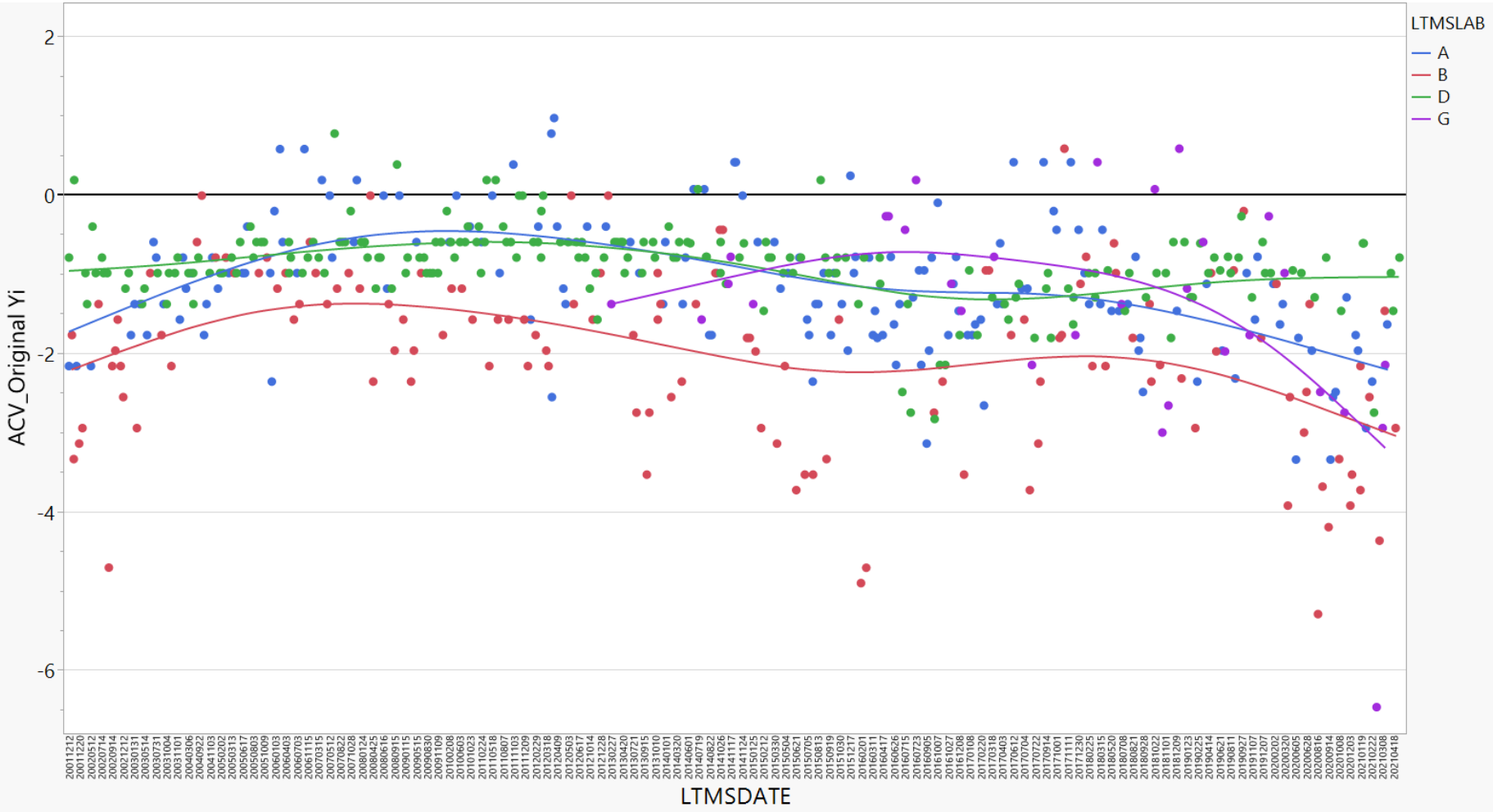
ACV Original Over Time, by Oil

It appear both oils began performing severe of target immediately following the target setting period.



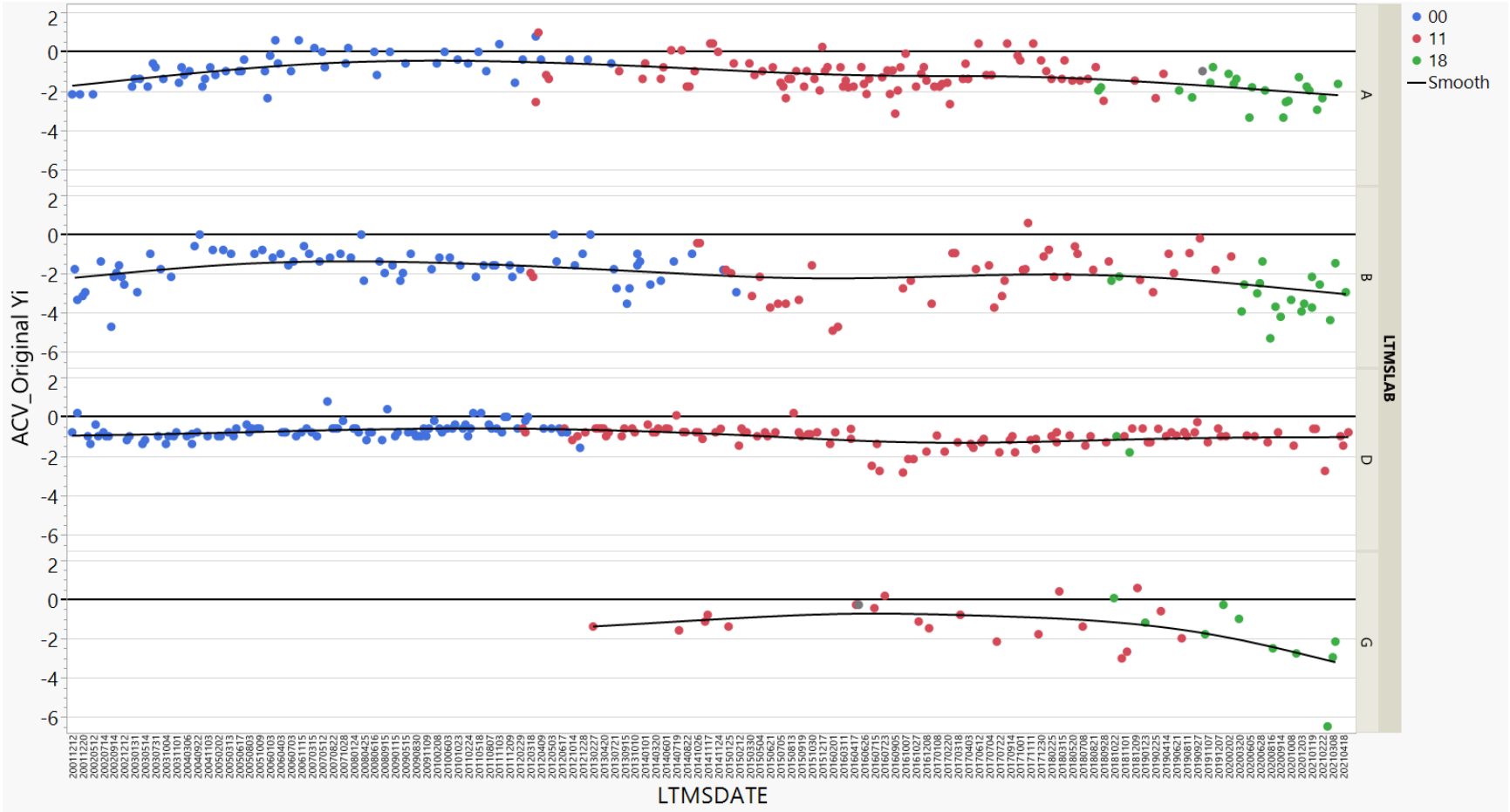
ACV Original Yi Over Time, by Lab

Lab differences exist. Lab D is performing near target. Lab G has noticed the biggest change in recent data. Lab B is the most severe, but has historically been the most severe amongst the labs.



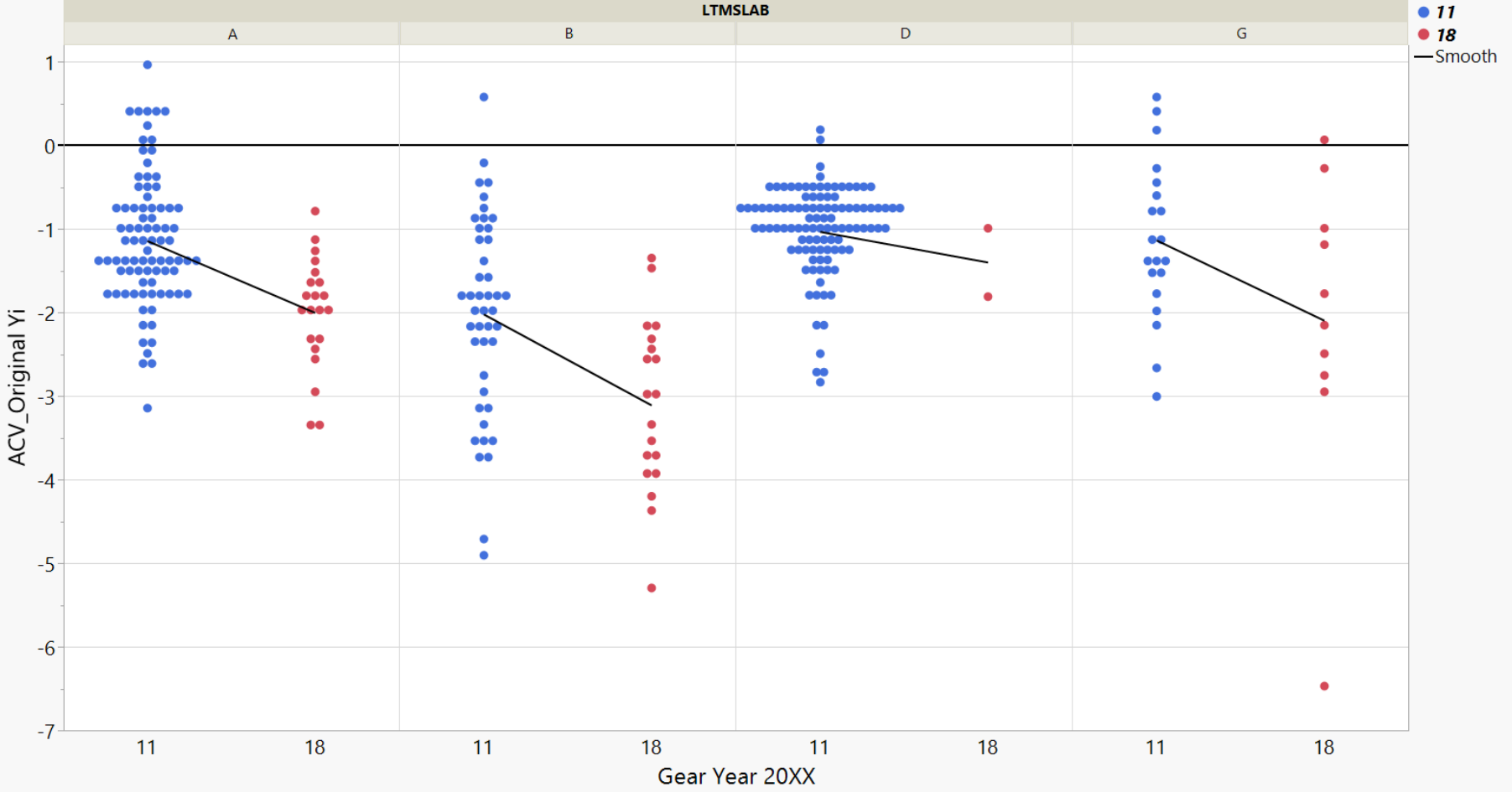
ACV Original Yi Over Time, by Lab/Gear Batch

It seems evident that the new gear batch is likely the cause of the severity shift, though the first few tests were not as severe on average as the tests following the hardware approval.



ACV Original Yi Over Time, by Lab/Gear Batch

Side-by-side comparison of the gear batches shows a consistent difference of about 1 sigma for the labs which have run a significant amount of tests on the new hardware.



ACV Original Model

- ACV Original ~ Oil + Lab + Stand[Lab]
- Delta between 2018 and 2000 hardware about 1 merit (0.98)
- Ran another model with Lab-Stand in place of Stand[Lab]. Used indicator parameterization to calculate expected performance of reference oils on current active stands in industry (A-10B, A-11, B-5B, B-6B, D-2F, D-3F, and G1).
  - 148-1 : 7.053 merits (-1.25 merits from target)
  - 155-1 : 7.516 merits (-1.24 merits from target)
- Correction factor of 1.2 merits will bring test back to target.

Effect Tests

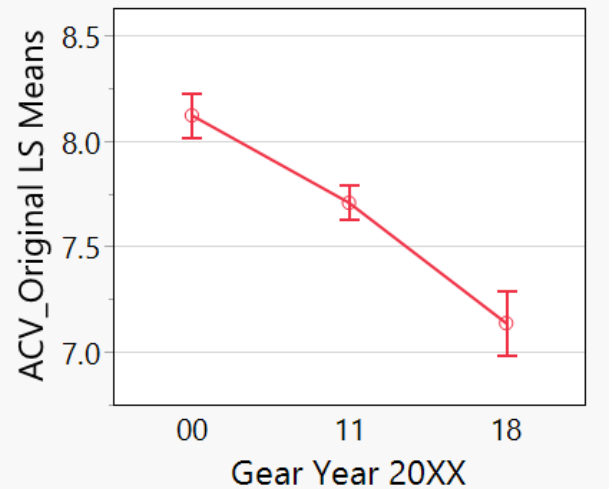
Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	1	1	15.059414	91.7060	<.0001*
LTMSLAB	3	3	12.060759	24.4818	<.0001*
LTMSAPP[LTMSLAB]	22	22	8.087591	2.2386	0.0011*
Gear Year 20XX	2	2	14.953345	45.5300	<.0001*

Hardware Batch LS Means

Least Squares Means Table

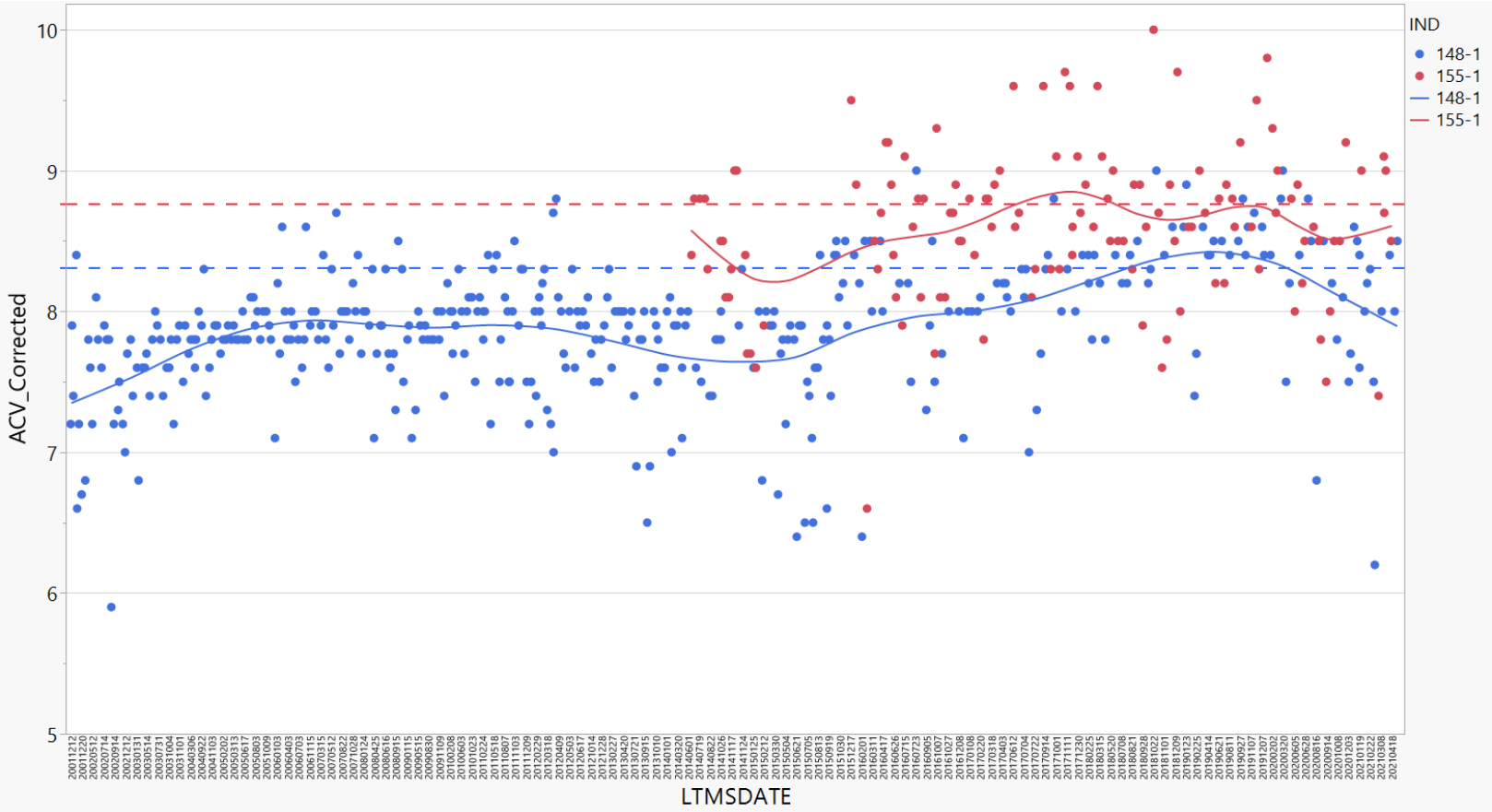
Level	Least Sq Mean	Std Error	Mean
00	8.1206329	0.05392217	7.77877
11	7.7064854	0.04145409	7.81627
18	7.1363578	0.07663539	7.20769

Least Squares Means Plot



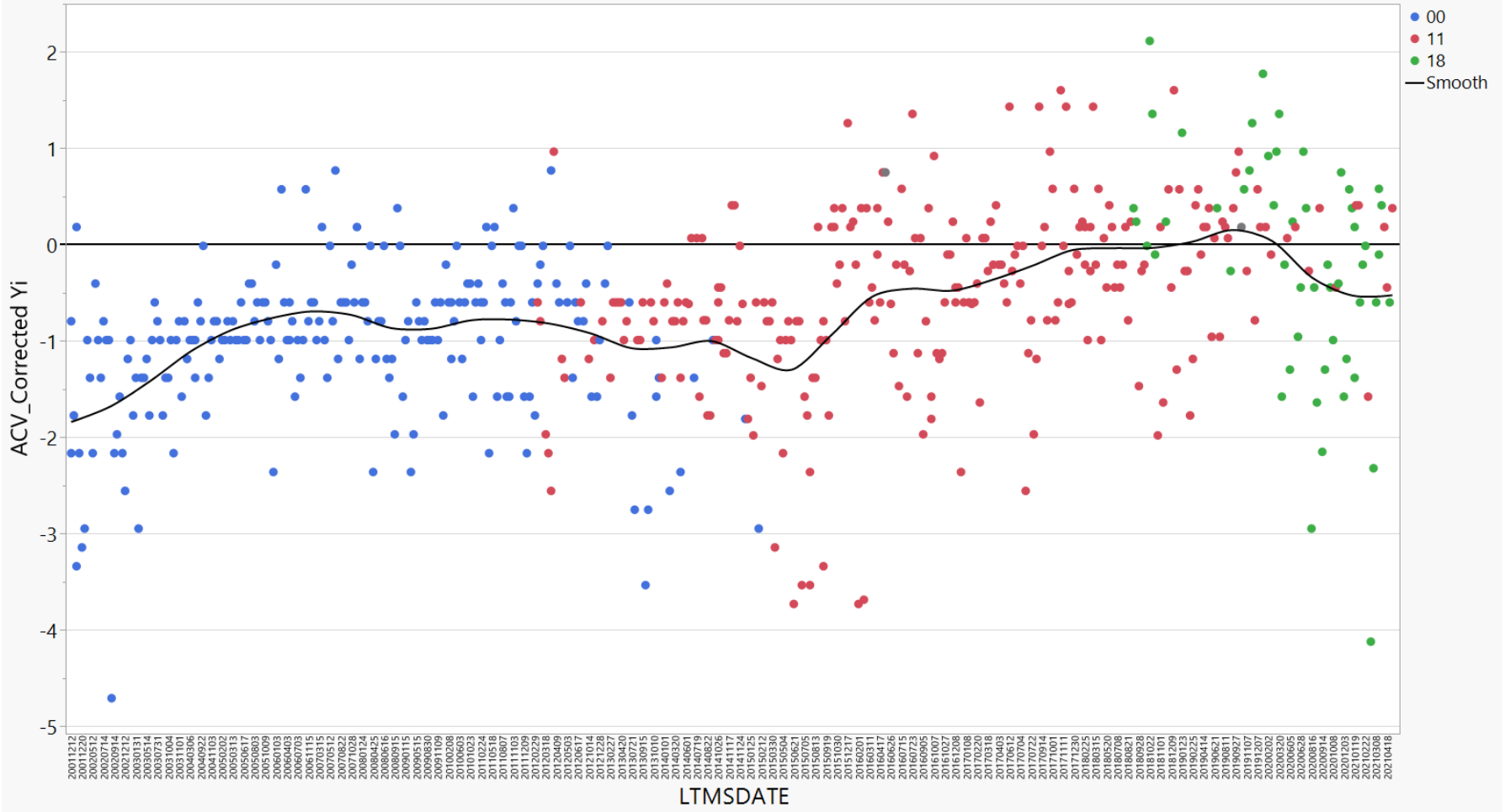
ACV Corrected by Date

In the plot below, the previous correction factor of +0.6 merits applies to tests after 10/01/2015, and an additional +0.6 merits is added to tests run on the 2018 hardware.



ACV Corrected Yi by Gear Batch

The plot below shows that the additional correction brings the data on the 2018 hardware in line with the 2011 hardware.



Average Sludge (ASL)

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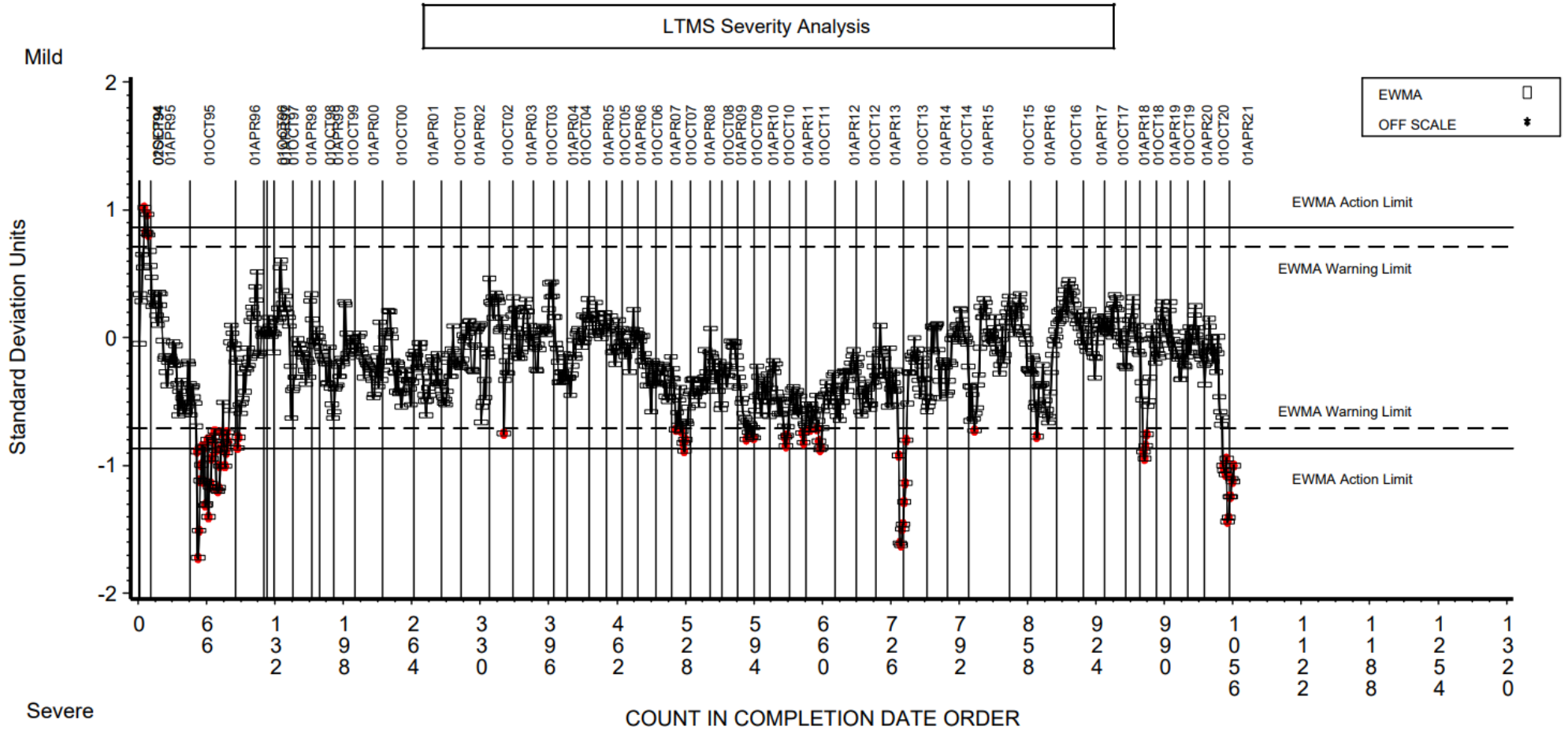
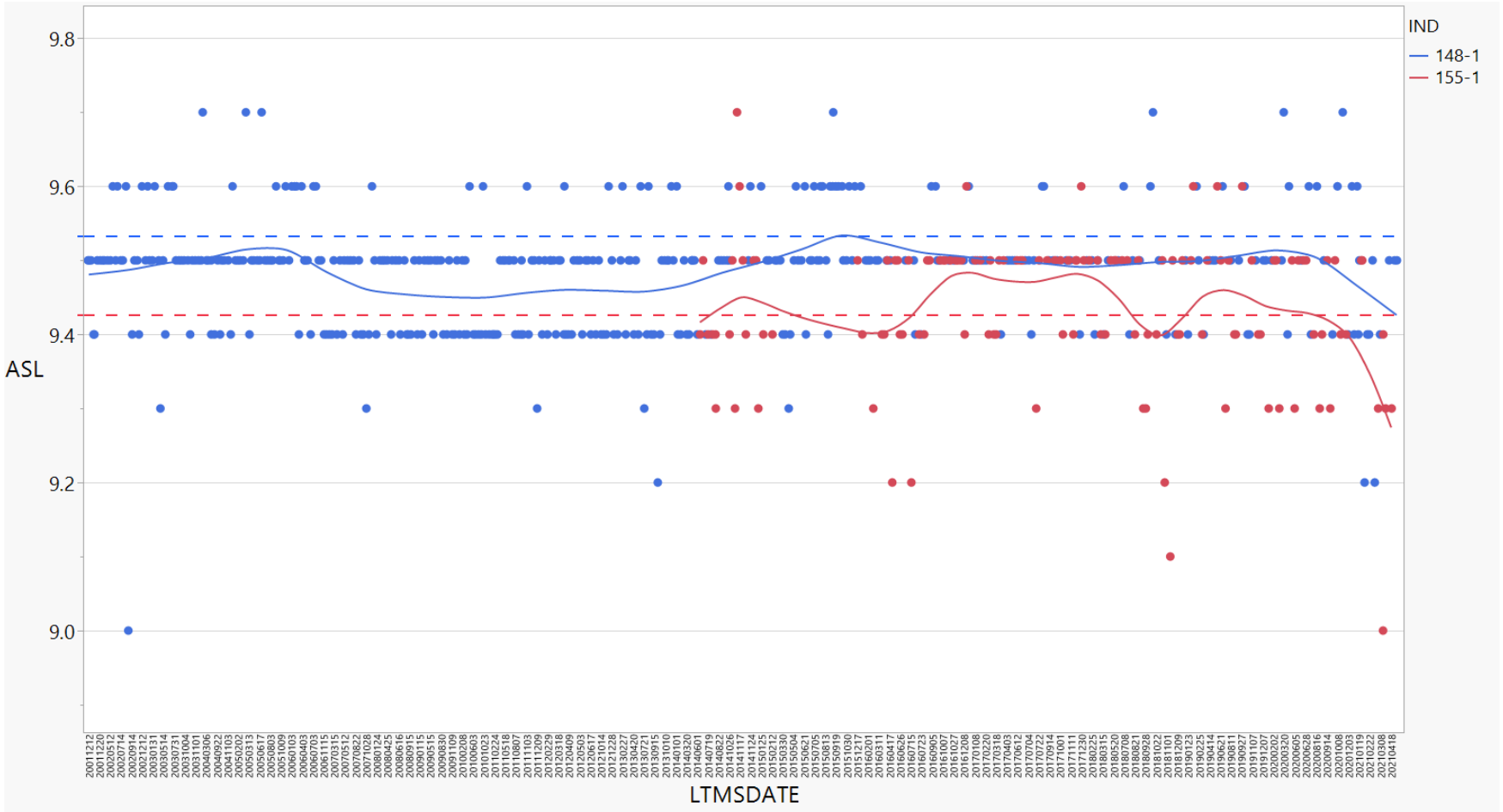
Average Sludge values were close to target until fall of 2020. The last approximately 20 tests have brought the industry charts below the action limit in the severe direction.



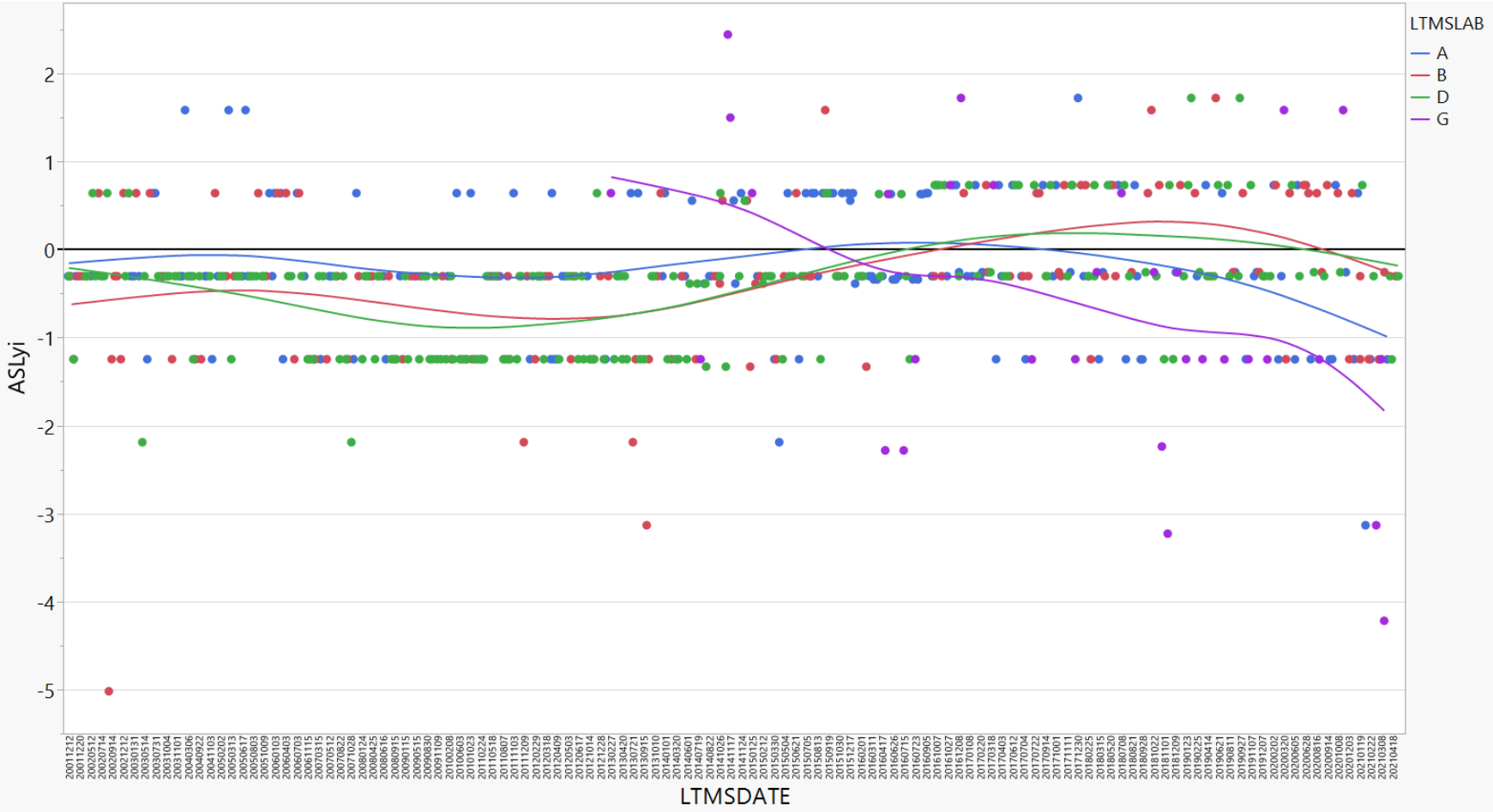
Average Sludge (ASL)

The plot by oil shows that both oils have gone more severe in recent history, well after the gear batch introduction.



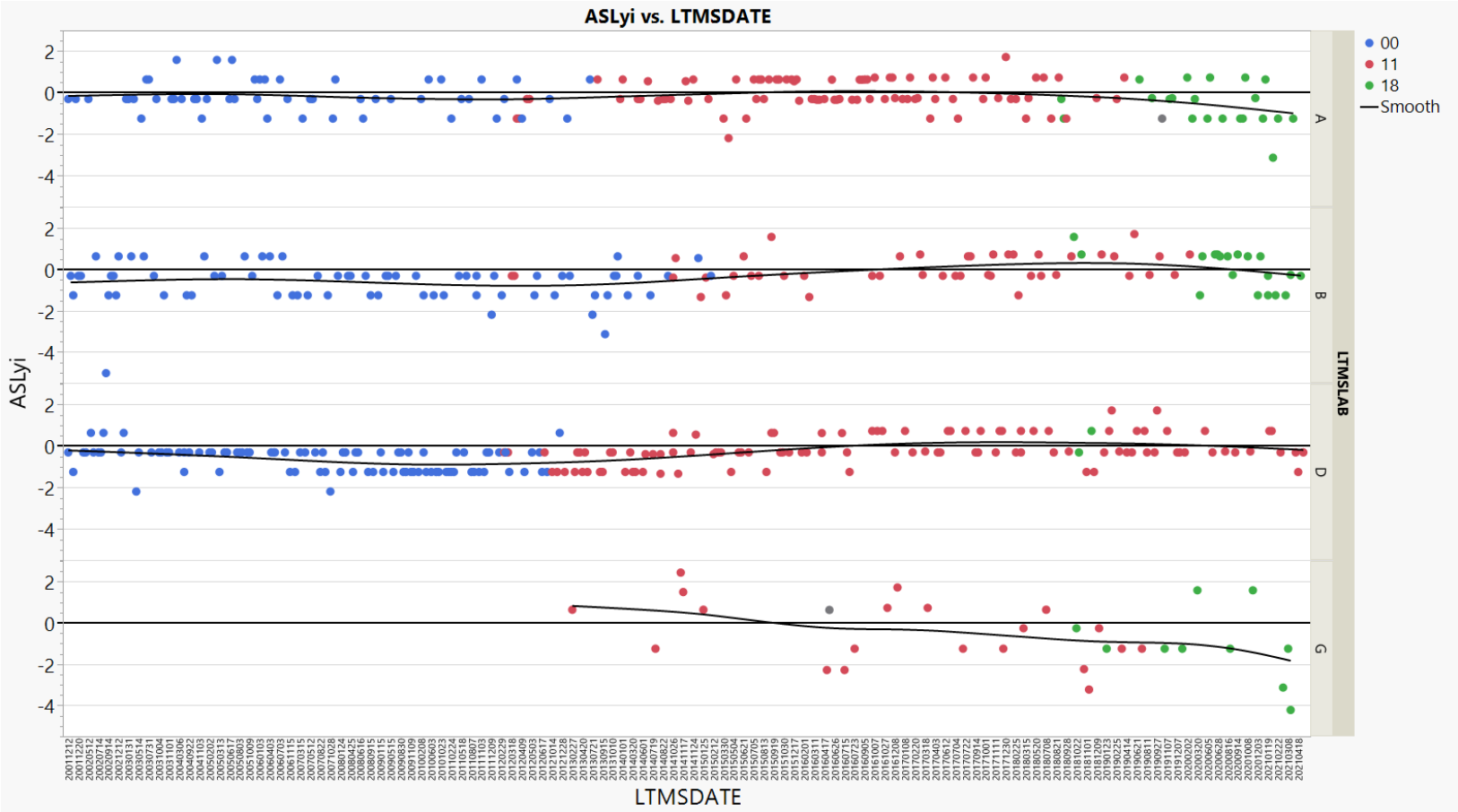
Average Sludge (ASL)

While the industry is on average severe, there are only 3 data points beyond 2 sigma severe. This parameter is likely still manageable with severity adjustments only.



Average Sludge (ASL)

There is no major shift in the data with the near gear batch. It is recommended to continue to monitor this parameter and allow severity adjustments to handle the minor differences from target.

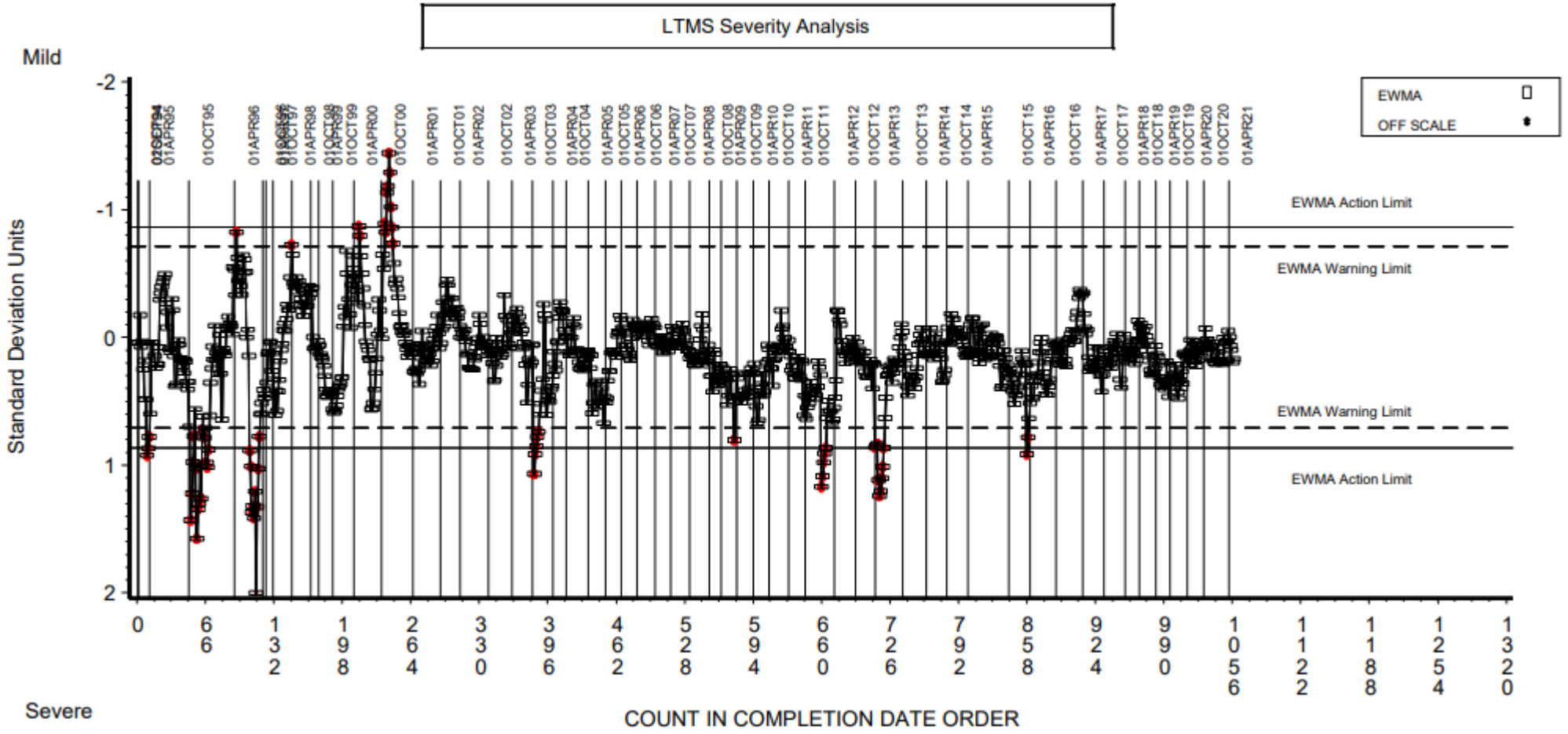


Appendix

Other Plots

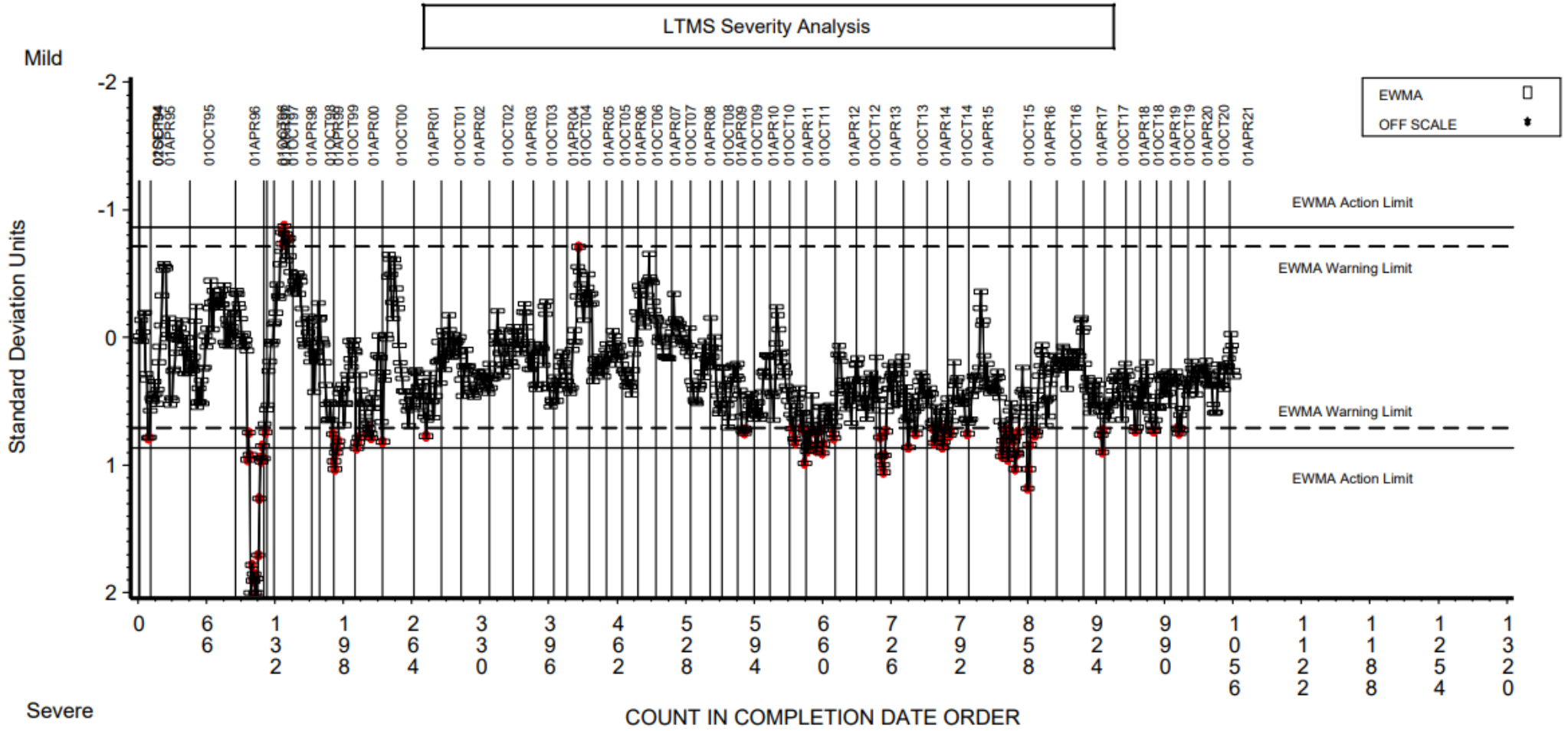
Pentane Insolubles

This parameter is in control.



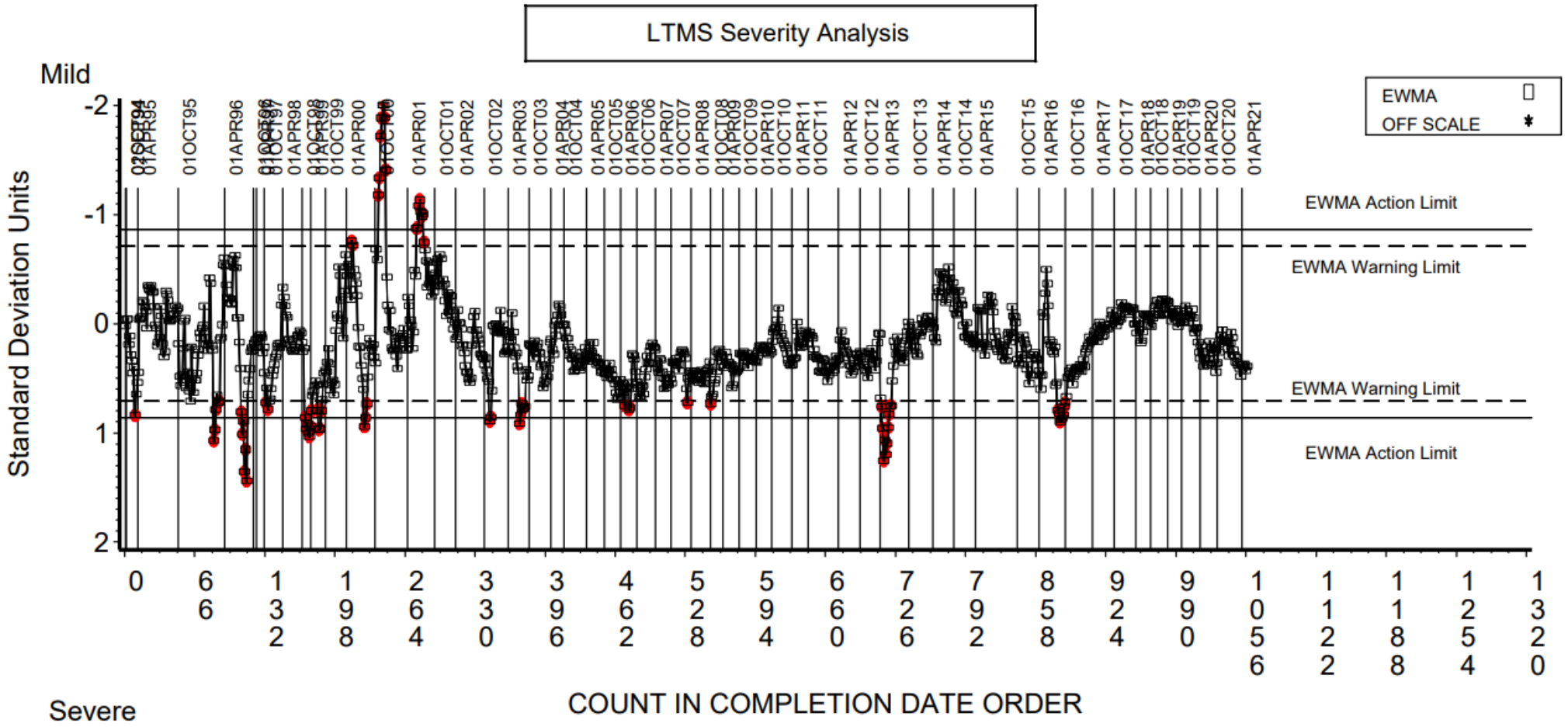
Toluene Insolubles

This parameter is in control, though the past 10+ years have averaged about 0.50-0.75 standard deviations severe.



Viscosity Increase

This parameter is in control, though the past 15 years have averaged slightly severe of target.



Initial Oil Charge (g)

Lab differences exist for initial oil charge.