

Sequence X

ASTM D8729

Ford Chain Wear Test Surveillance Panel Meeting Minutes

November 16, 2022

Prepared By: Alfonso Lopez, S.P. Chairman

Sequence X Surveillance Panel Meeting Agenda

11/16/22

- Roll call
- Approval of the meeting minutes 08/16/22
- TMC Report
- Fuel Report
- Hardware Status
- Reference Oil 271 – Statisticians Report
- Report to Sub B
- Next Meeting

Motion/ Action List

- Approval of the meeting minutes from 08/16/22
 - Motion – Mike Deegan
 - Second Jason Bowden
 - Pass unanimous
- Action Item 1
 - Review fuel batch data COA during 2019 time period. (Al, Jason, Haltermann)
- Action Item 2
 - Compose a motion to accept oil 271 as a discrimination oil per Doyle's proposal. Send motion out as an E-ballot. (Al , Rich)

Meeting Minutes

- Roll Call – Roster attached
- Minutes from 08/16/22 approved
- TMC report presented by Rich Grundza, (Slides attached)
- Fuel Report (Slide Attached)
 - Action item to review COA data at the start of severity shift in 2019
 - IIIH, IX and X all had severity shift in 2019
- Hardware Status, (Slide attached)
 - Recent critical hardware purchase by the independent labs.
 - Hardware secure for the next 5 plus years.
 - New engine platform planned for GF8
 - AOAP reviewing needs for GF7 and GF8

Meeting Minutes

- Reference Oil 271
 - Oil has been suspended since 04/08/21
 - The panel agreed to use oil 271 as a discrimination oil
 - Doyle presented method to use oil 271 (slides attached)
- The protocol summary is as follows
 1. Run 270
 - a. If results are within calibration limits, go to step 2.
 - b. If results are outside calibration limits, repeat run of 270.
 2. Run 271
 - a. If 271 result is less than lower Level 3 ei limit (-2.066), discrimination criteria is met, that is discrimination test is passed. If not, go to step 2b.
 - b. If 271 result is within Level 3 ei limit (-2.066 to 2.066), test is deemed normal and discrimination test is not required. If not go to step 2c.
 - c. If transformed chain stretch of 270 is at least 0.32362 greater than that of 271, pass discrimination test. If not, then ?.

Meeting Minutes

- Reference Oil 271 cont'd
 - The group agreed to the proposal presented by Doyle, with the caveat to show discrimination with oil 271 once per year and have the reference period extended to 12 months or 15 tests.
 - An action item was made to wordsmith the motion and send it out as an E-ballot. (Al and Rich)
- Next meeting TBD

Sequence X



October 2022

Sequence X Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	6
Unacceptable Calibration Test	OC	1
Total Number of Tests		7

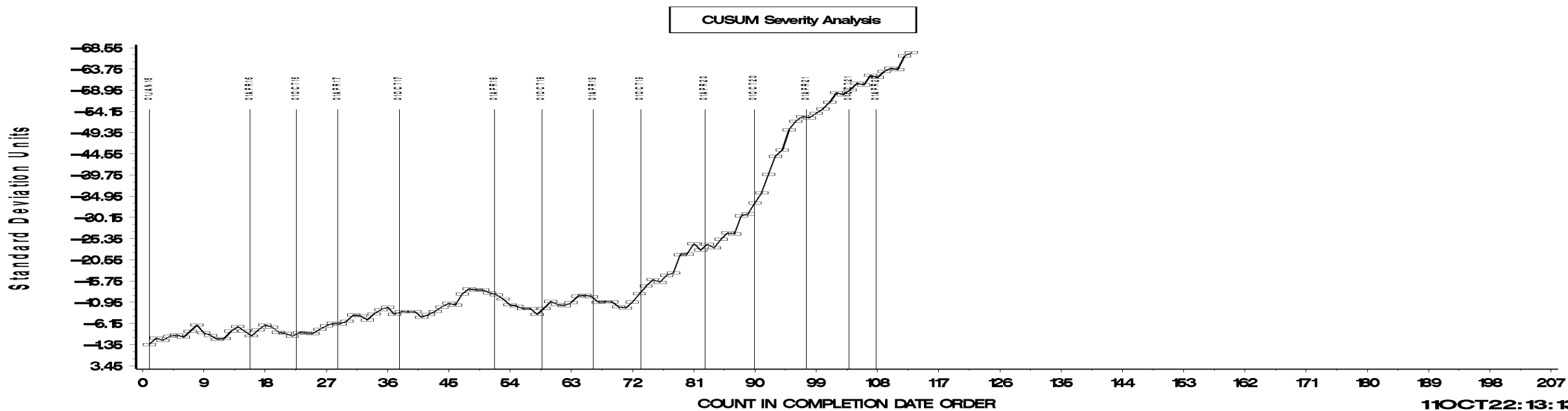
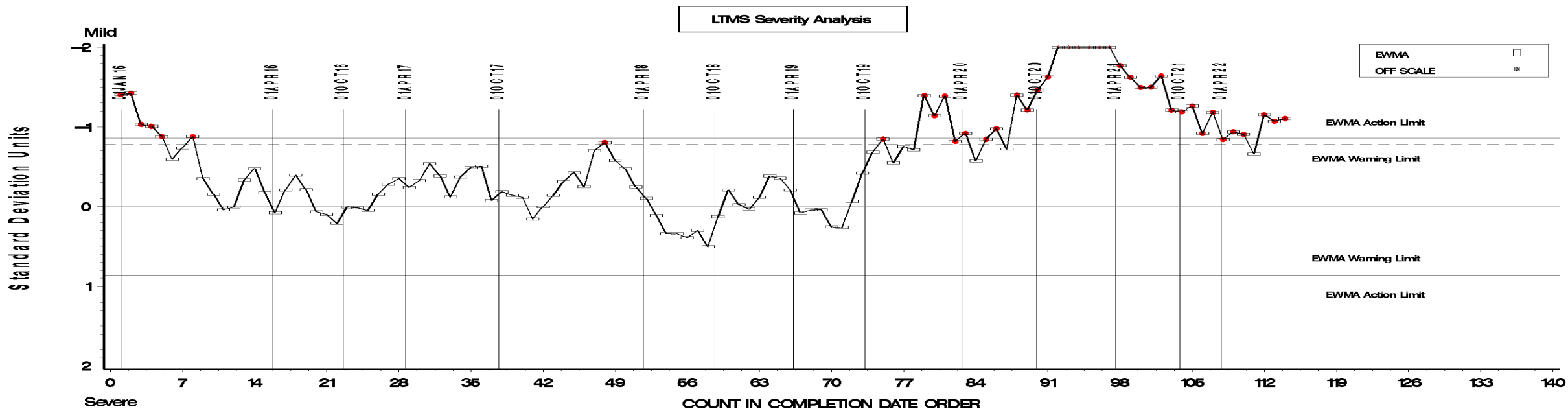
Sequence X – Failed Tests

Test Status	Number of Tests
Ei Level 1 alarm (mild direction)	1
Total	

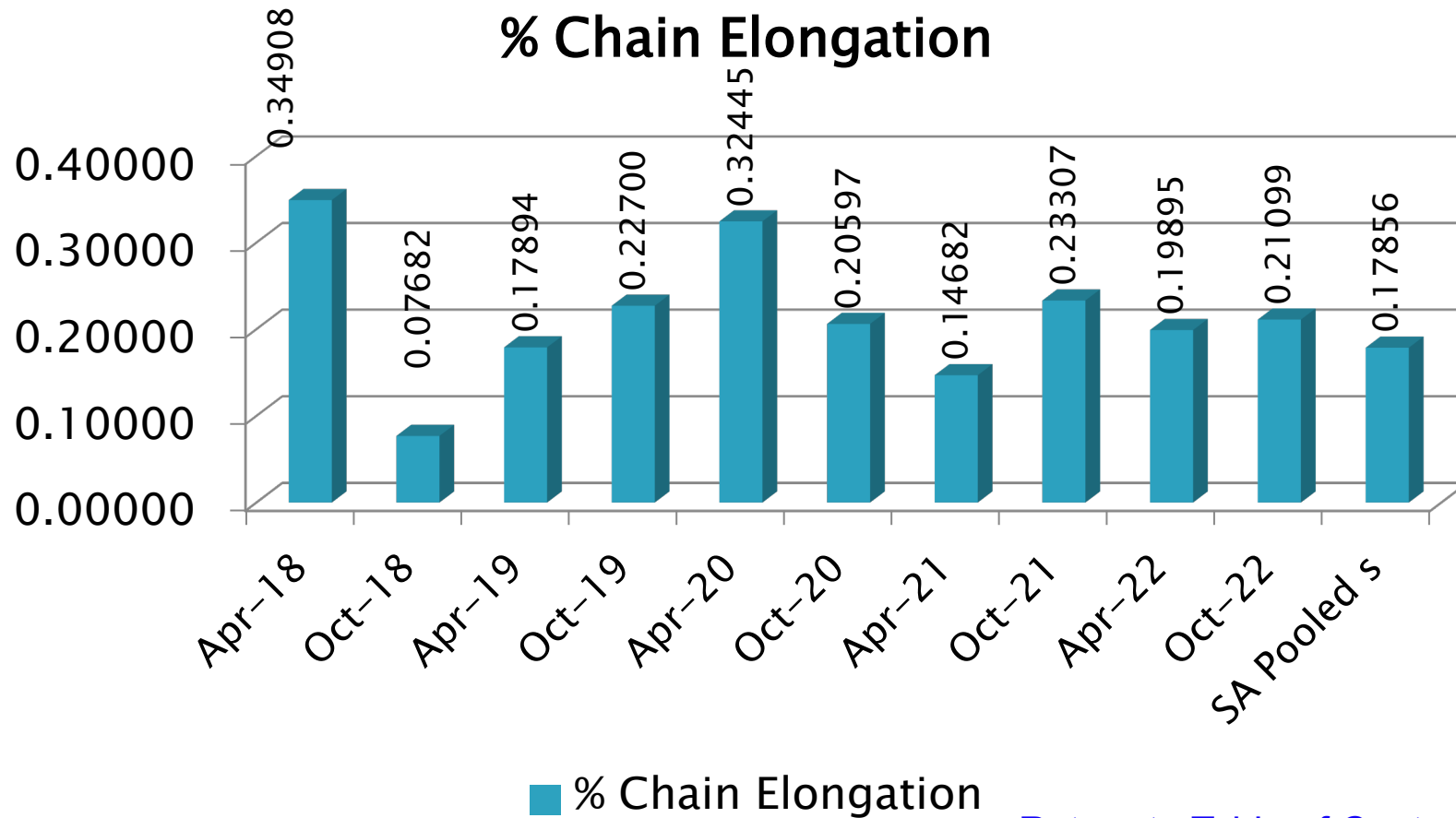
Sequence X Test Severity

- Average Chain Stretch % in Severity Action Alarm (mild).

END OF TEST CHAIN WEAR FINAL RESULT



Sequence X Precision Estimates



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Fuel Report

- Haltermann
 - Fuel Inventory (no issue)
 - Action – Review fuel batched in the 2019 time period. Other tests on EEE show severity shift. Seq X severity shift started in 2019
- Alternative Supplier Update
 - Need to solve mild trend issue

Hardware Status

- Critical component purchase complete
 - Only the independent labs purchased hardware
- Hardware inventory forecast good for at least 5 years.
 - Lab Survey performed (Independent Labs responded)
- GF7 and GF8
 - AOAP timelines
 - Seq X needs to be available through 2027 minimum (GF7)
 - New engine platform for GF8

Sequence X Discrimination

D. Boese

November 16, 2022

Collaboration

- Doyle Boese, Infineum
- Richard Grundza, TMC
- Travis Kostan, SwRI

Discrimination Proposal Summary

- A discrimination protocol proposal was developed which entails testing ROs 270 and 271 consecutively.
- A consequence of failing the discrimination test might be to re-test both ROs 270 and 271.
- That consequence seems extreme.
- Recommend instead to have each lab, or stand, run RO 271 directly after its next calibration test on RO 270 to provide information on current capability of industry and stand to discriminate.
- Determine path forward regarding discrimination after testing.

Background

- Seq. X shifts mild in mid 2019.
- RO 271 is omitted from calibration testing due to being excessively mild.
- Current blend of 1011 runs out.
- Only RO 270 remains for calibration.
- Proposal is raised to annually run ROs 270 and 271 consecutively to verify discrimination capability of stand.

Background (Continued)

- Stats Group recommends a minimum difference limit between ROs 270 and 271 of 0.32362.
 - 0.32362 is the minimum difference between the transformed Chain Stretch of ROs 270 and 271 to be declared statistically significantly different based on one test on each oil.
 - If test is on target, RO 270 transformed Chain Stretch will exceed that of RO 271 by 0.32046 70% of the time. If the test is mild, as it has been for the last 3 years, the probability of the difference exceeding 0.32046 is much higher than 70%

Background (Continued)

- Discussion during last Seq. X teleconference:
 - Some concern with adding an additional criteria to pass calibration - discrimination verification was not a component of initial Seq. X calibration requirements (or that of any other Seq test).
 - An 'off the cuff' suggestion was made that if RO 271 was within 2 standard deviations of target, the discrimination verification (minimum difference) is not required. (Test is considered in normal severity regime.)
 - T. Kostan, R. Grundza and D. Boese were tasked with developing a proposal for the discrimination

Discrimination Testing Protocol

1. Run 270

- a. If results are within calibration limits, go to step 2.
- b. If results are outside calibration limits, repeat run of 270.

2. Run 271

- a. If 271 result is less than lower Level 3 ei limit (-2.066), discrimination criteria is met, that is discrimination test is passed. If not, go to step 2b.
- b. If 271 result is within Level 3 ei limit (-2.066 to 2.066), test is deemed normal and discrimination test is not required. If not go to step 2c.
- c. If transformed chain stretch of 270 is at least 0.32362 greater than that of 271, pass discrimination test. If not, then ?.

Appendix – Additional Slides

Potential Discrimination Limits

- Minimum difference to declare statistically significantly different in Sequence X based on one test of each oil:
 - 0.41536 ($\alpha = 0.05$)
 - 0.32362 ($\alpha = 0.10$)
- Probability of exceeding difference based on one test of each oil when test is on target:
 - 0.38890 (60%)
 - 0.32046 (70%)
 - 0.24035 (80%)
 - 0.12926 (90%)

Example Background

- Calibration Limits:
 - Stand Z_i : ± 1.800
 - Stand e_i : ± 2.066
- Subscript assignment:
 - $i - 1$ = most recent test prior to calibration
 - i = RO 270 calibration test
 - $i + 1$ = RO 271 test

Example 1: $Z_{i-1} = -1.8$ – Minimum Y_i (RO 270)

- RO 270:
 - Minimum $Y_i = -1.8$ (Limited by Z_i)
 - $T_i = 0.085$
 - Transformed $T_i = -2.47082$
- RO 271:
 - Maximum Transformed $T_{i+1} = -2.79433$ (based on minimum difference of 0.32362)
 - $T_{i+1} = 0.061$
 - $Y_{i+1} = -1.57574$
 - $e_{i+1} = 0.74754$
 - Result corresponding to $e_i = -2.066$
 - $T_{i+1} = 0.055$

Example 1: $Z_{i-1} = -1.8$ – Maximum Y_i (RO 270)

- RO 270:
 - Maximum $Y_i = 0.266$ (Limited by e_i)
 - $T_i = 0.121$
 - Transformed $T_i = -2.11061$
- RO 271:
 - Maximum Transformed $T_{i+1} = -2.43423$ (based on minimum difference of 0.32362)
 - $T_{i+1} = 0.088$
 - $Y_{i+1} = 1.00152$
 - $e_{i+1} = 2.18172$ (Exceeds maximum Level 3 Limit)
 - Result corresponding to $e_i = -2.066$
 - $T_{i+1} = 0.085$

Example 1: $Z_{i-1} = 0$

- RO 270:
 - Minimum $Y_i = -2.066$ (Limited by e_i)
 - $T_i = 0.081$
 - Transformed $T_i = -2.51720$
- RO 271:
 - Maximum Transformed $T_{i+1} = -2.84082$ (based on minimum difference of 0.32362)
 - $T_{i+1} = 0.058$
 - $Y_{i+1} = -1.31691$
 - $e_{i+1} = 0.69711$
 - Result corresponding to $e_i = -2.066$
 - $T_{i+1} = 0.060$

Example 1: $Z_{i-1} = 1.8$

- RO 270:
 - Minimum $Y_i = -0.266$ (Limited by e_i)
 - $T_i = 0.110$
 - Transformed $T_i = -2.47082$
- RO 271:
 - Maximum Transformed $T_{i+1} = -2.20337$ (based on minimum difference of 0.32362)
 - $T_{i+1} = 0.080$
 - $Y_{i+1} = 0.47262$
 - $e_{i+1} = -0.70758$
 - Result corresponding to $e_i = -2.066$
 - $T_{i+1} = 0.069$

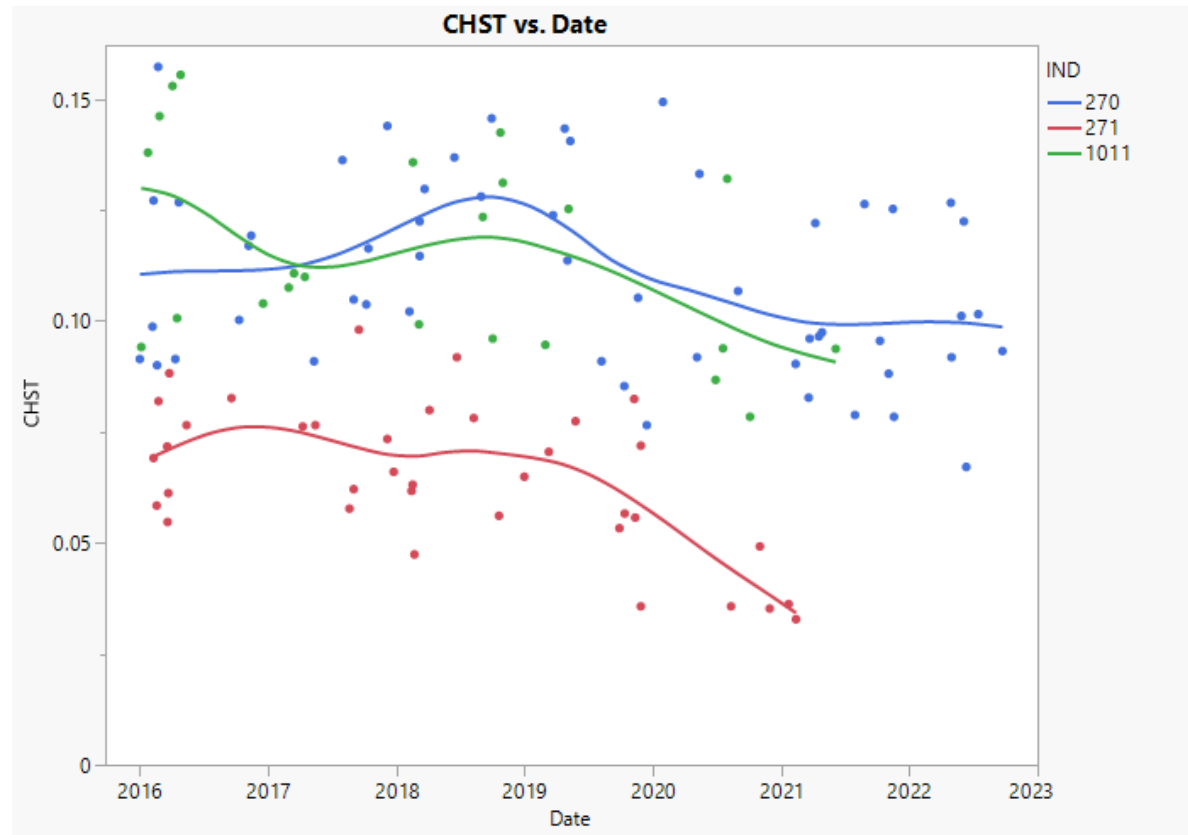
Untransformed RO 271 CHST

Maximum Passing Untransformed 271 Result

RO 270	Stat Sign Difference		Probability of Exceeding Diff			
Untrans CHST	Alpha = 0.05	Alpha = 0.10	60%	70%	80%	90%
	0.41536	0.32362	0.38890	0.32046	0.24035	0.12926
0.120	0.079	0.087	0.081	0.087	0.094	0.105
0.110	0.073	0.080	0.075	0.080	0.086	0.097
0.100	0.066	0.072	0.068	0.073	0.079	0.088
0.090	0.059	0.065	0.061	0.065	0.071	0.079
0.080	0.053	0.058	0.054	0.058	0.063	0.070
0.070	0.046	0.051	0.047	0.051	0.055	0.062
0.060	0.040	0.043	0.041	0.044	0.047	0.053

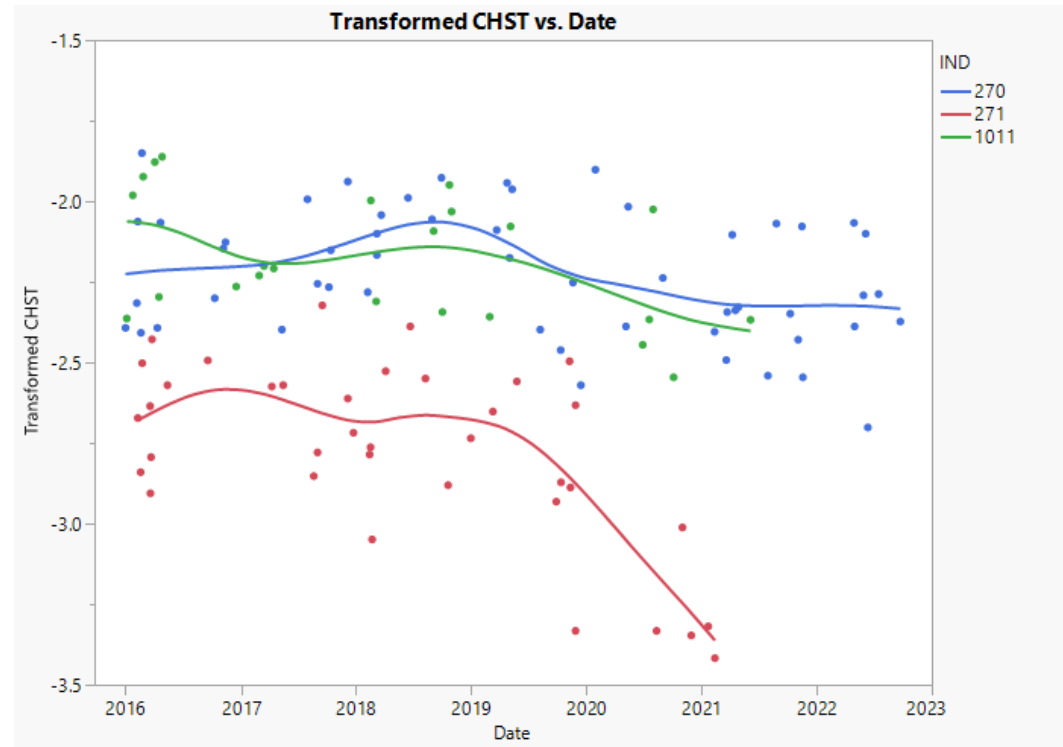
- The above table lists, for several alternate difference limits, the maximum untransformed RO 271 to pass discrimination corresponding to a range of RO 270 results.

CHST (Untransformed)



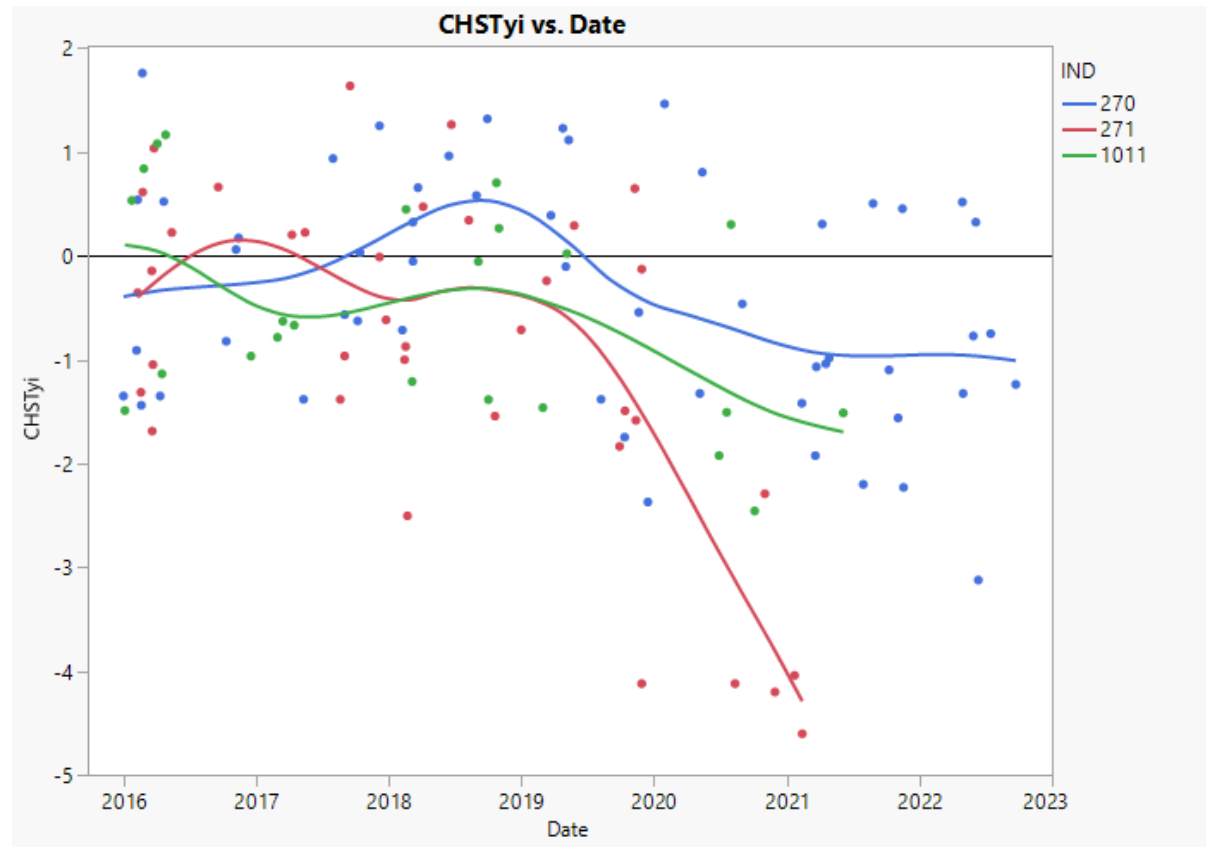
- The difference between 271 and 270 / 1011 remains similar after the mild severity shift.

Transformed CHST

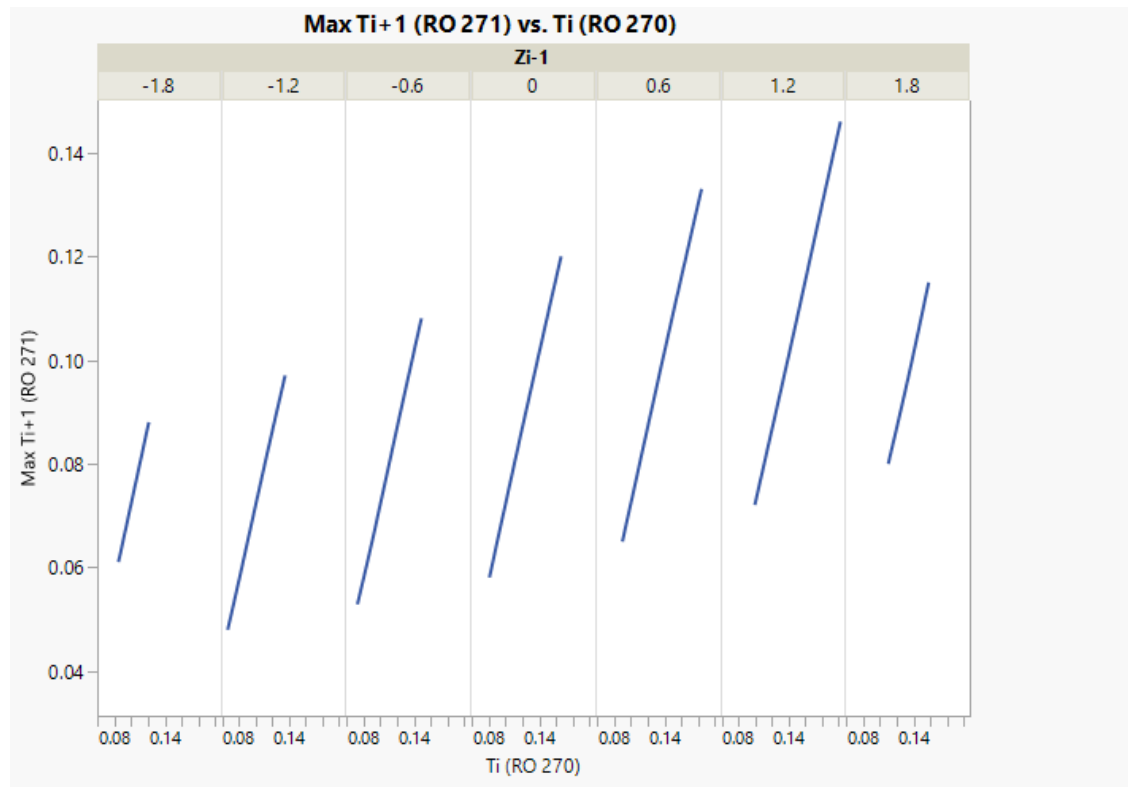


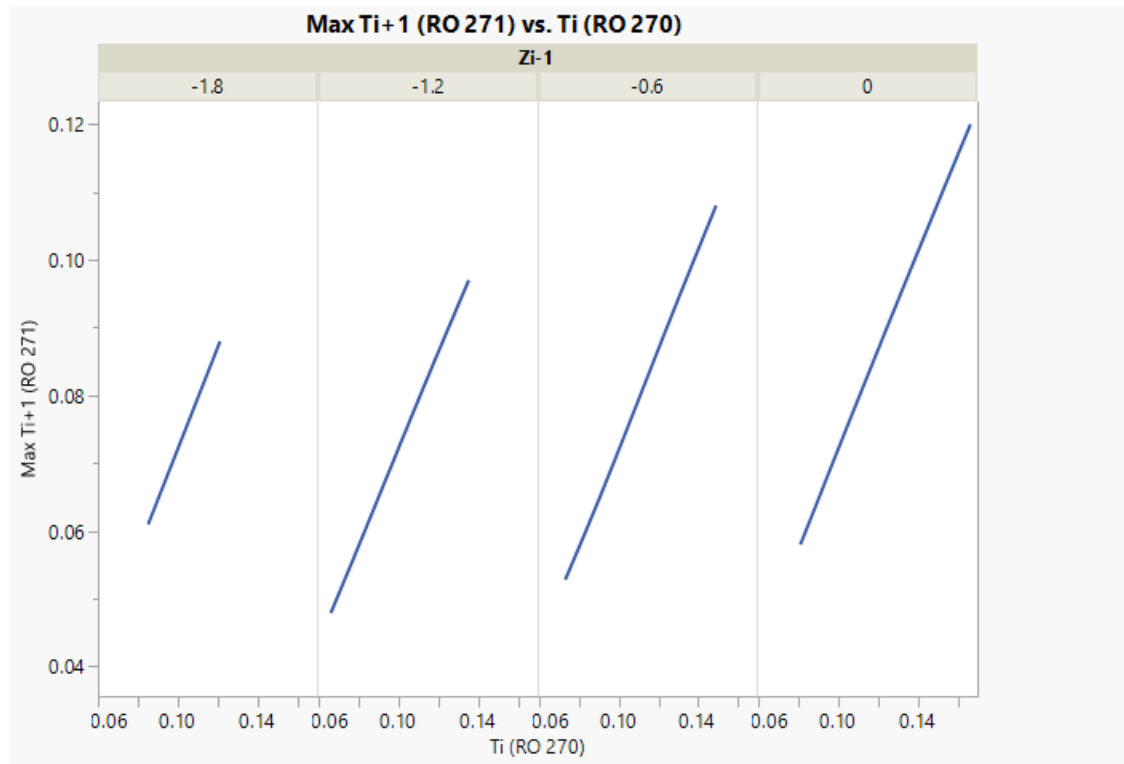
The difference between RO 271 and ROs 270 and 1011 of the transformed CHST increased in mid 2019 when test went mild.

CHST Y_i



- Y_i for 271 decreases more than 270 and 1011 when test shifts mild.





Reference Oil 271 – Pre-Read

Rich Grundza, Travis Kostan and I were tasked at the last Seq X SP teleconference to prepare a pre-read for the potential protocol for discrimination testing using ROs 270 and 271. This request slipped our minds until when we were recently reminded and we have had a few discussions on the issue since. Because of being a bit last minute we did not have time to include the full stats group in those discussions and this email will have to suffice for the pre-read with which we were tasked. I will be working on some slides that go into more detail, to include examples and possibly plots in attempt to make this somewhat complicated issue more clear, which I will present at the face to face meeting next week. Rich, Travis and I are in agreement regarding the information that follows but, in the interest of time, I did not have them review this email prior to sending it to you.

As a reminder, during the last Seq X SP teleconference, we discussed testing both RO 270 and RO 271 once a year to verify discrimination capability. The concept considered was that the RO 271 result would not be chartable or used in the severity adjustment calculation but if the difference between the chain stretch results for the 2 oils was greater than some specified amount, the discrimination was verified. Travis Kostan presented some potential difference limits with a difference of approximately 0.32 in log transformed chain stretch units being recommended. The 0.32 corresponds to the minimum difference required for the 2 to be considered statistically significantly different with an alpha of 0.1. It also is the difference exceeded 70% of the time when the test is on target. When it is mild, as it has been for the last few years, the probability of exceeding that difference is much higher. When discussed during the SP teleconference a concern was raised that a 70% chance of passing was not sufficient. Also, under normal circumstances, calibration is not dependent on proving discrimination and therefore it did not seem appropriate to add this discrimination criteria. At that point another criteria was suggested that, if the test had indeed returned to near target levels as indicated by RO 271 result, the difference limit could be omitted. (An off the cuff offering for this assessment was RO 271 being within 2 standard deviations of target.) After much discussion, Rich, Travis and I were requested to develop this concept further.

The protocol that Travis, Rich and I discussed is the below 2 step process with explanation following:

1. Run 270
 - a. If results are within calibration limits, go to step 2.
 - b. If results are outside calibration limits, repeat run of 270.
2. Run 271
 - a. If 271 result is less than Level 3 ei limit (-2.066), discrimination criteria is met, that is discrimination test is passed. If not, go to step 2b.
 - b. If 271 result is within Level 3 ei limit (-2.066 to 2.066), test is deemed normal and discrimination test is not required. If not go to step 2c.
 - c. If transformed chain stretch of 270 is at least 0.32362 greater than that of 271, pass discrimination test. If not, then ?.

The explanation: First, RO 270 is run and judged against normal LTMS calibration criteria. If it does not pass calibration, it is re-run as under normal calibration rules. Once a pass is obtained, Oil 271 is run. If ei for RO 271 is below level 3 ei limit (-2.066), the difference between the transformed chain stretch results for 270 and 271 is greater than the 0.32 or any other reasonable limit and discrimination is verified. (I will provide plots and examples in the presentation to demonstrate that the difference is exceeded between any passing 270 result and a 271 result that fails mild.) If the 271 result is within ei limits, that stand is considered to be back to normal and the discrimination criteria is not applied. If the 271 ei result is higher than the Level 3 limit (2.066), determine if the transformed result for RO 270 is at least 0.32362 greater than that of RO 271. If it is, then it passes the discrimination test. If not, the stand fails the discrimination test. If that is the case, an appropriate criteria **might** be to re-run both RO 270 and 271 and determine if the difference is exceeded in the averages.

The potential of having to re-run both ROs seems pretty drastic and perhaps unreasonable or as a minimum, not likely to be well received. For that reason we feel that, in lieu of at this point initiating a once a year discrimination test that is part of calibration, a more appropriate first step in verifying discrimination is simply to get a donated test on 271 from each lab, or stand, when the stand next calibrates (on RO 270). This will provide current data on RO 271 and we can then judge if there is a discrimination problem and if so, is it industry wide or confined to a stand or lab.

Doyle

Minimum Delta Calculation

Oil 271 Mean	0.074
Oil 270 Mean	0.116
Oil 271 Mean_Trans (LTMS Target)	-2.60987
Oil 270 Mean_Trans (LTMS Target)	-2.15699
Repeatability Std. Dev.	0.17856
Repeatability Variance	0.03188

Distribution of (Oil 270 - Oil 271) - Transformed	
Mean	-0.45288
Variance	0.06377
Std. Dev.	0.25252

Quantiles of the Normal Distribution Above	
50%	-0.45288
60%	-0.38890
70%	-0.32046
80%	-0.24035

Using one tailed Z-test	
z-alpha, alpha = 0.05	-1.645
z-alpha, alpha = 0.10	-1.282
Critical value, alpha = 0.05	-0.41536
Critical value alpha = 0.10	-0.32362

Maximum Allowable 271 Result Based on 270 Result

		Oil 270 Result				
		0.12	0.11	0.10	0.09	0.08
Probability of Pass Under Typical Severity	50%	0.076	0.070	0.064	0.057	0.051
	60%	0.081	0.075	0.068	0.061	0.054
	70%	0.087	0.080	0.073	0.065	0.058
	80%	0.094	0.086	0.079	0.071	0.063

Table Above In Terms of Delta

		Oil 270 Result				
		0.12	0.11	0.10	0.09	0.08
Probability of Pass Under Typical Severity	50%	0.044	0.040	0.036	0.033	0.029
	60%	0.039	0.035	0.032	0.029	0.026
	70%	0.033	0.030	0.027	0.025	0.022
	80%	0.026	0.024	0.021	0.019	0.017

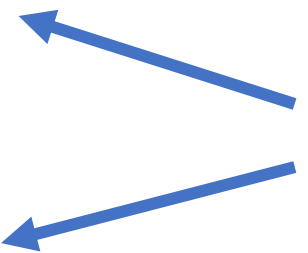
Maximum Allowable 271 Result Based on 270 Result

		Oil 270 Result				
		0.12	0.11	0.10	0.09	0.08
Alpha	0.05	0.079	0.073	0.066	0.059	0.053
	0.10	0.087	0.080	0.072	0.065	0.058

Table Above In Terms of Delta

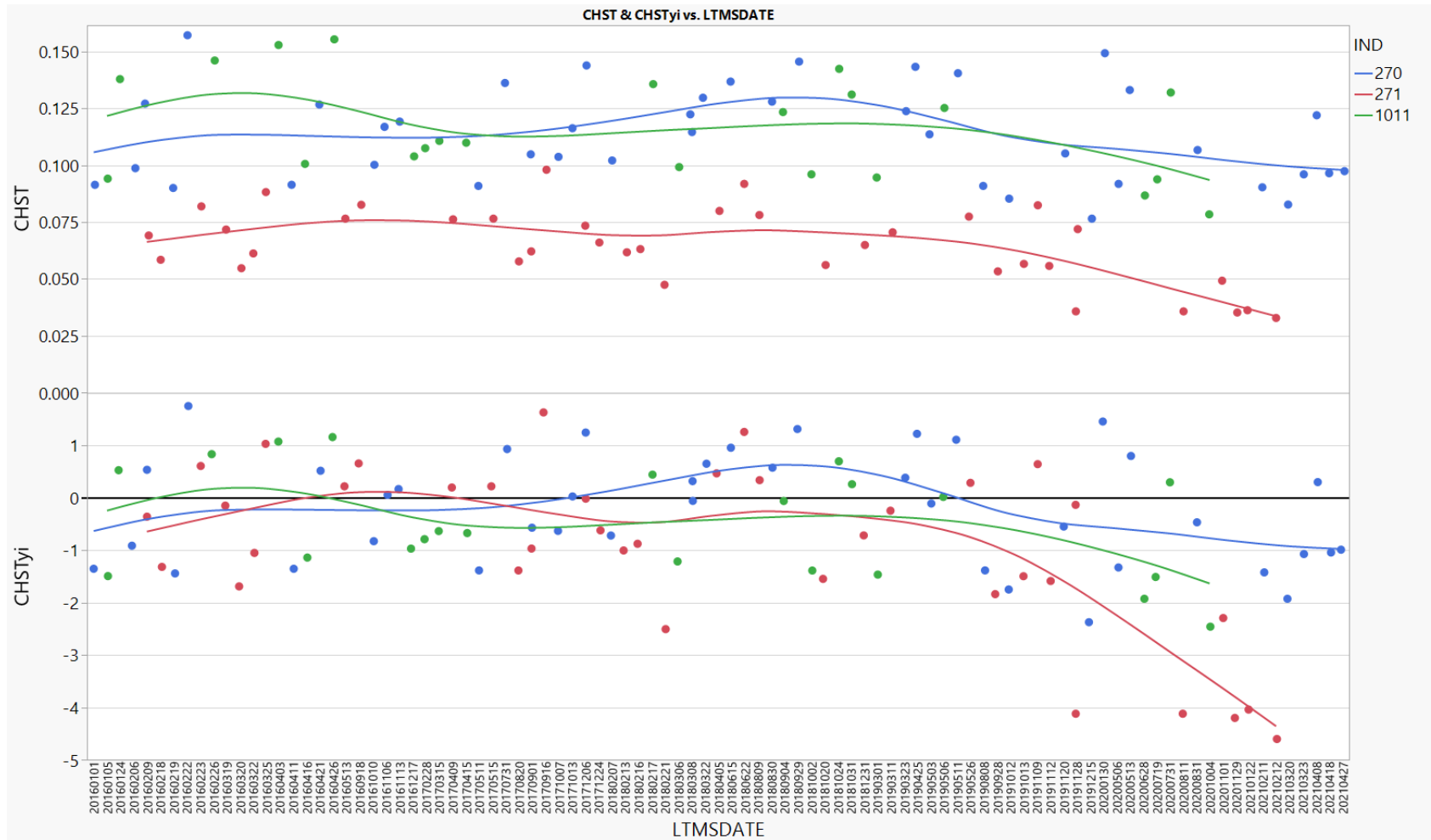
		Oil 270 Result				
		0.12	0.11	0.10	0.09	0.08
Alpha	0.05	0.041	0.037	0.034	0.031	0.027
	0.10	0.033	0.030	0.028	0.025	0.022

Actual Motion would be to accept one of these values as the "Minimum Delta."



Background

All 3 reference oils appear to have shifted by similar CHST amount. Therefore Ln(CHST) more greatly impacted Oil 271. Oil 271 has been temporarily suspended.



Sequence X SP Meeting
San Antonio, Tx
16-Nov-22

Attendance Sheet

Name	Company	E-mail
NA TYLER	GM	
Isabela GARCIA	Corless ^{KALPERNEU}	
CHRISTINE EICKSTEAD	SWRI	
Richard Grundler	ASTM TMC	
Doyle Boop	Intierum	
WILLIAM BUSCHEN	INTERTEK	
Jason Bowden	OHT	
Joe Hehn	Affon	
Ben Maddock	Affon	
Bob Campbell	Affon	
Andrew Pauling	Affon	
Michael Lochte	SWRI	
Khaled Rais	SWRI	

Sequence X SP Meeting

San Antonio, Tx
16-Nov-22

Attendance Sheet

Name	Company	E-mail
Travis Kostan	SWRI	
PAT LANG	SWRI	
Geo. Sappanos	LZ	
Tony Catanese	LZ	
ROBERT STOCKWELL	ORONITE	
Amol Savant	Valvoline	
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Jason Seto	IAT	
Rob Zdrodowski	Ford	rzdrowe@ford.com
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A. Ritchie	Infineum	andrew.ritchie@infineum.com

Sequence X History

Sequence X Milestones	
1/1/2012	Start of Chain Wear Test Development
12/7/2017	AOAP Approval for GF6
4/2/2018	Live Registration (03/19/16 Retro - Registration)
2/20/2019	Surveillance Panel Procedure Acceptance Vote
4/4/2019	Subcommittee B Ballot
6/16/2019	Main Committee D02 Ballot - ASTM Procedure D8279
11/7/2019	Memorandum 19-043 Use of Calibrated Sequence X Stands to Generate Used Oil Samples for Seq IX (LSPI)
11/20/2020	Information Letter 20-1 Procedure Edits / Drive Shaft Spec
1/27/2020	Information Letter 20-2 Criteria for Multiple Test Type Calibration
6/1/2020	Mild Severity Shift Task Force Formed
9/11/2020	Information Letter 20-3 Correction to Table 12
10/14/2020	Information Letter 20-4 (1) Correcting PCV Flow Meters (2) Correction to Section 12.1.1
4/8/2021	Oil 271 Suspended from use due to mild results
9/17/2021	Information Letter 22-1 Engine run limits, honing procedure, connecting rod orientation, blowby gas thermocouple orientation