HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL

OF

ASTM D02.B0.02

December 7, 2021

Anaheim Marriott – Anaheim, CA

ACTION ITEMS

MINUTES

1.0 Call to order

1.1 The Heavy-Duty Engine Oil Classification Panel (HDEOCP) was called to order by Chairman Shawn Whitacre at 1:30p.m. on Tuesday, December 7, 2021, in the Grand Ballroom C/D of the Anaheim Marriott in Anaheim California.

1.2 There were 14 members present and 55 guests present. The attendance list is included as **Attachment 2.**

2.0 Agenda

2.1 The agenda circulated prior (included as Attachment **1**) was not changed.

3.0 Minutes

3.1 The December 12, 2019, minutes were approved as written.

4.0 Membership

4.1 Dave Taylor of Phillip 66 was added as a member.

5.0 TMC Update; **Attachment 3**

5.1 No verbal update.

6.0 CLOG Update- Brent Calcut. **Attachment 4**

6.1 Working on 4 HDEO topics, Mack T-12 ring / liner, Mack T-12 Lead, Mack T-11 & T-11A and C13 / 1N redundancy.

6.2 T-12 is required for all API “C” categories. CLOG needs to establish equivalency for these categories. They are also working on merit equivalency.

6.3 SAE paper 2005-01-3713 was referenced as a history on the development of the Mack T-12. The paper states that intake manifold temperature was used for liner corrosion and not intake manifold pressure.

6.4 Higher soot was typical before SCR technology was introduced to reduce NOx.

6.5 CLOG current Status

6.5.1 Volvo T13 is not a viable option since it does not generate same wear as T-12.

6.5.2 ACC data shows a correlation with ISB cam lobe wear.
6.5.3 Ford 6.7 was also considered to replace the T-12 but the test is still new and more data would be required to fully assess any correlation.

6.6 CLOG members asked if a valve train wear test can be used to correlate ring and liner wear. There were low comfort levels.
6.7 Data provided to ACC shows a bit of relationship between T-12 and ISB, not perfect. Analysis needs more study.
6.8 API and EMA members could identify a set of tests that could correlate back to T-12.
6.9 Lead parameter originally used T9 test. Prior to CH-4 the Sequence VIII was used.
6.10 Can the T13 be used as a corrosion test?
6.11 Request ACC for Volvo T13, HTCBT and Sequence VIII data for comparison.
6.12 CLOG is investigating the Mack T8E and the Mack T-11. Replacement tests will be required for all existing 'C' categories.
6.13 ISM and ISB are similar as they produce as much soot as the T-11.
6.14 No data exist for T-11A. Need to create a proposal to collect MRV data from ISM and ISB.
6.15 Caterpillar requested CLOG to study redundancy of Cat 1N to C13.
6.16 PC-11 TF did not do much digging for redundancy, mainly because there was no real incentive to eliminate the 1N, but now there may be.
6.17 In summary
6.17.1 Not easy to find replacements for Mack tests. Still looking for ideas
6.17.2 RFWT followed a similar exercise as CAT tests. Re-analyzed old data and found support to for redundancy and advised that test is not needed for future categories.

7.0 COAT/EOAT Compatibility Study- Bob Warden. **Attachment 5**

7.1 Coat and EOAT compatibility, looking to use COAT to replace EOAT test.
7.2 3 labs ran tests on 1005-5. Found weird dip in data. Labs found operational data was good and the only unexpected thing was the oil.
7.3 New oil supplied. 1005-6
7.4 SwRI ran new oil, oil seems to respond well but still unsure if its compatible to EOAT
7.5 Next steps re-run matrix
7.6 Looking to mid next year to provide data for resolution.
7.7 Hope to have resolution by next meeting on new oil. To have limits established.
7.8 **Question:** Who will be paying for the new tests? **Answer:** API helped but will need to ask again for funding of the new matrix.
7.9 **Question**: Is the new oil the resolution? **Answer:** Only one run at the moment, however the one data point looks good. All three labs showed same anomaly on the old oil which led them to believe the oil is the issue.

8.0 Elastomer Compatibility- Joe Franklin, and Robert Stockwell. **Attachment 6**

8.1 Original discussion was to use SL107, not the same oil but similar. Suggest using fixed limits vs variable limits. Data analysis was used to come up with fixed limits.
8.2 Proposed limits were based on calculations.
8.3 The new proposal limits make it easy to understand if a test passed or failed.
8.4 Slide14, shows difference in both oils.
8.5 Rest of slide show very good similarities.
8.6 **Question:** Was industry stats group used to review data? **Answer:** Simple answer, yes. stats group need more time to look at data.
8.7 **Question:** From EMA perspective what is the preference? **Answer:** No clear definition
8.8 A Request was made for EMA on which method they preferred since 1006 is almost out?
8.9 **Question:** Should the stats group officially be asked? Simple answer is yes.
8.10 Shawn W will ask to get data for June ASTM
8.11 **Comment:** Variable limits account for variability in elastomer. Need to consider this before setting fixed limits.

8.12 Next steps, entire stats group to evaluate and proposal and data will be reviewed with EMA directly to help them better understand the two scenarios. No motion or vote required at this time.

9.0 No New business

10.0 Next Meeting

10.1 The next meeting is scheduled for June 28, 2022, at the Hyatt Regency in Seattle Washington, or at the call of the Chair.

11.0 The Meeting was Adjourned at 2:37 p.m. PST

AGENDA
D02.B0.02.1
Heavy-Duty Engine Oil Classification Panel
Tuesday, December 7, 2021 1:30pm PST
Anaheim Marriott
Anaheim, California USA

1) **Call to Order/Anti-trust statement**

2) **Minutes** – Approval of Minutes from December 10, 2019 Meeting in New Orleans, LA USA

3) **Membership**

   a) Review current panel membership

4) **Existing tests/categories**

   a) Review of status of carry-over engine tests that support API CK-4, FA-4 and legacy categories (Sean Moyer, TMC)
   b) CLOG Update (Brent Calcut, Afton)
   c) EMA Perspective on Test Replacement Needs/Priorities (Tia Sutton, EMA)
   d) EOAT/COAT Update (Hind Abi-Akar, Caterpillar)

5) **Old Business**
   a) EOEC Fixed limits (Joe Franklin, Intertek)

6) **New Business**

7) **HDEOCP Adjournment (transition to DEOAP)**

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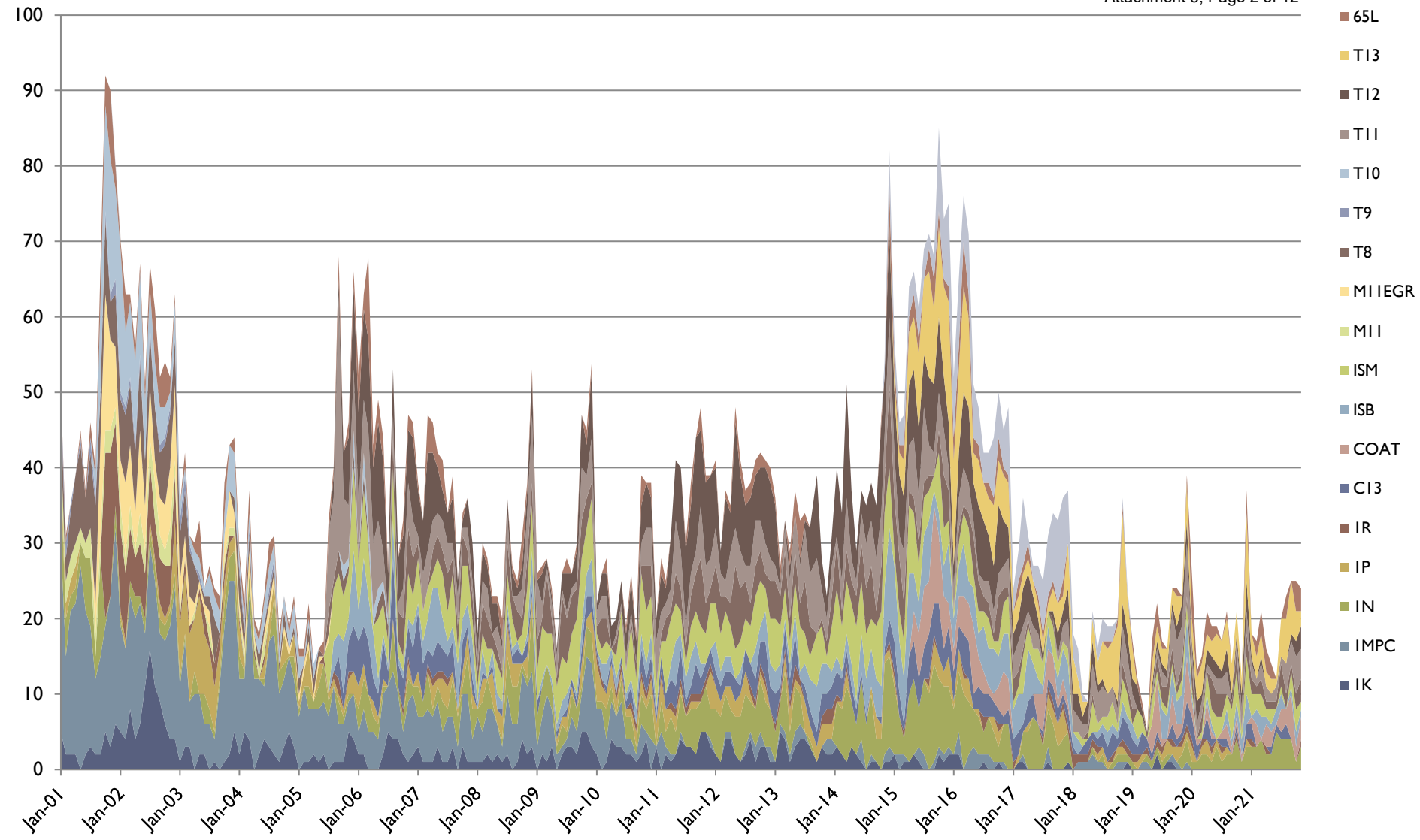
D02.B0.02 Maintenance Report

December 2021

ALL TEST CANDIDATE ACTIVITY



Calibrated Labs and Stands*

Test	Labs	Stands
1K	1	1
1N	3	5
1M-PC	0	0
1P	0	0
1R	1	1
C13	2	2
ISB	4	5
ISM	3	3
EOAT	1	1
RFWT	2	2
T-8/E	1	1
T-11	2	4
T-12/T-12A	3/3	3/3
T-13	4	6
COAT	2	2
DD13	3	3

*As of 09/30/2021

Availability of API CH-4 through CJ-4 Tests

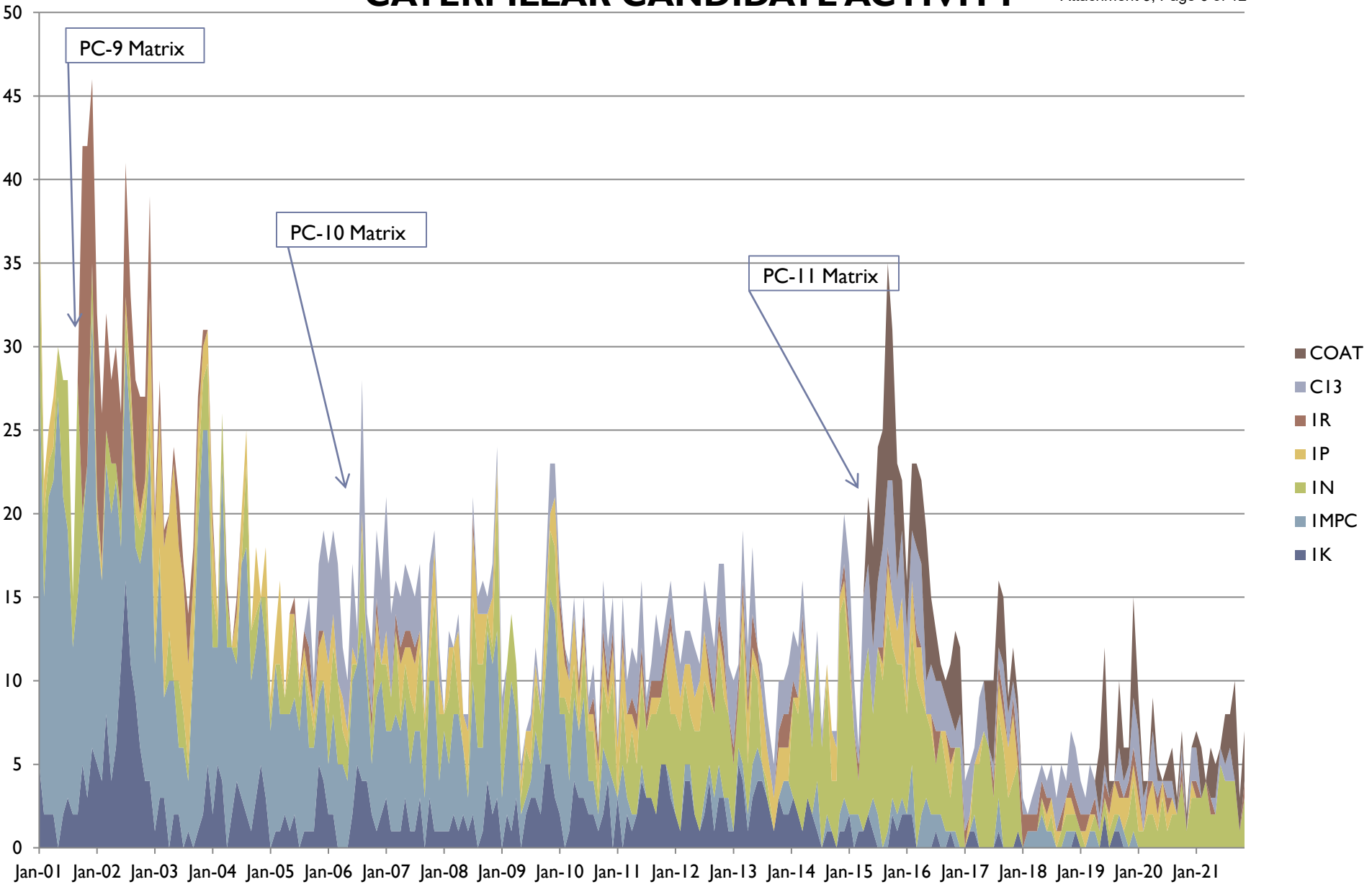
Test	Hardware Issues	Availability Through 2024	Notes
1K/1N	Auxiliary components	Likely	Ongoing resolution of issues with stand auxiliary systems and miscellaneous components.
1P/1R	No current issues	Likely	None
C13	No current issues	Likely	Engine block, injectors, turbos only available through reman.
COAT	None	Likely	

Additional Caterpillar Test Issues

- 1MPC
  - Reference oil supply remaining for 1 test. Reference oil can not be re-blended. Test will be unavailable once reference oil supply is depleted.

- COAT
  - EOAT to COAT correlation testing in progress. New testing to commence in 1Q 2022.

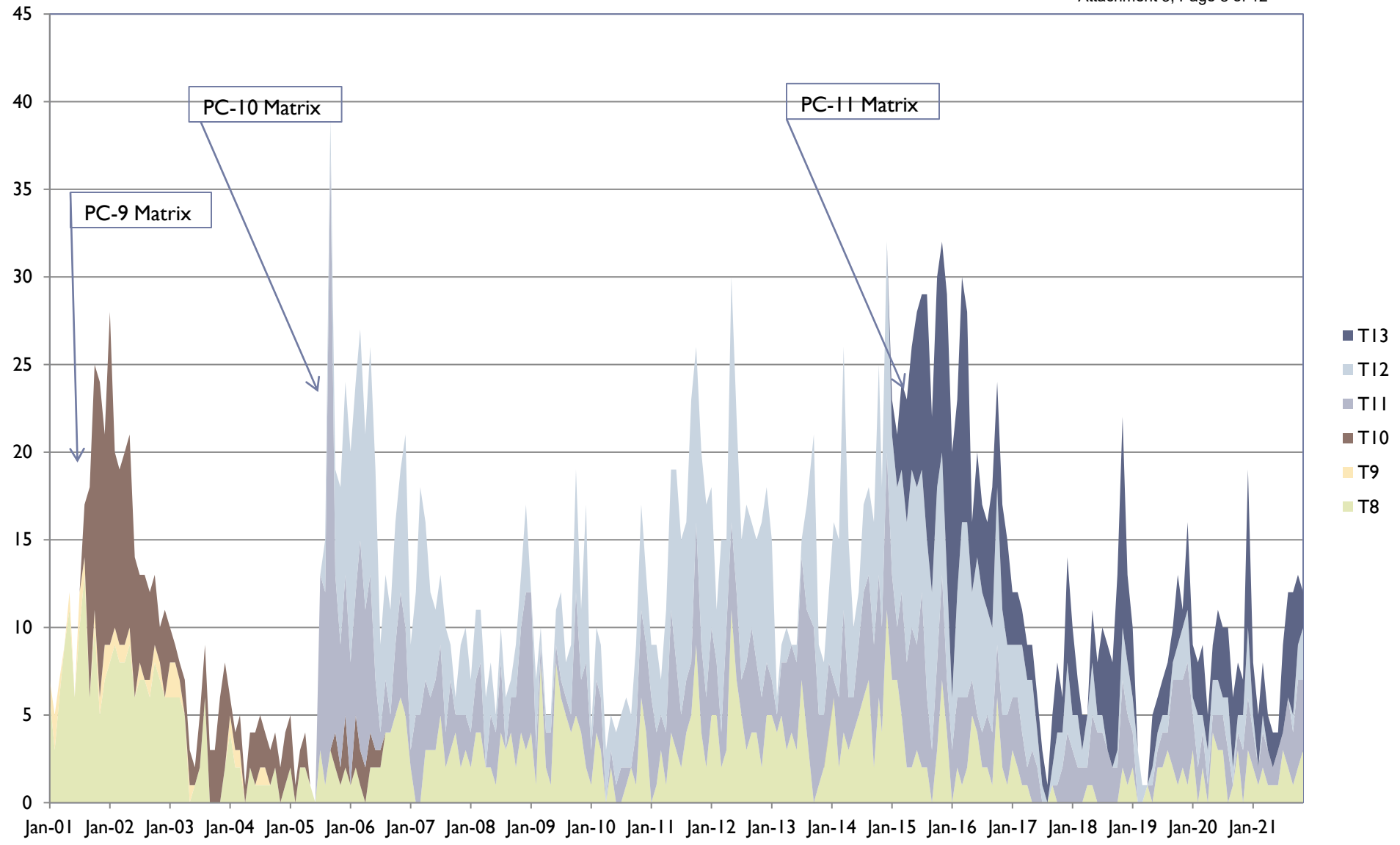
CATERPILLAR CANDIDATE ACTIVITY



Availability of API CH-4 through CJ-4 Tests

Test	Hardware Issues	Availability Through 2024	Notes
T-8	No current issues	Likely	Engine block supply limited. Final liner batch ordered to take test to 2026
T-11	Liners, Pistons, Rings	Likely	Initial coordinated references on new FINAL liner batch showed higher than historic norm oil consumption. Testing found combination of batched hardware with acceptable oil consumption.
T-12	Liners, Pistons, Rings	Likely	Initial coordinated references on new FINAL liner batch showed highest ever Stage I oil consumption. Testing found combination of batched hardware with acceptable oil consumption.
T-13	Cylinder head	Likely	Cylinder head no longer in production and panel investigating whether superseding part is acceptable for test. Multiple other "out of production" parts identified.

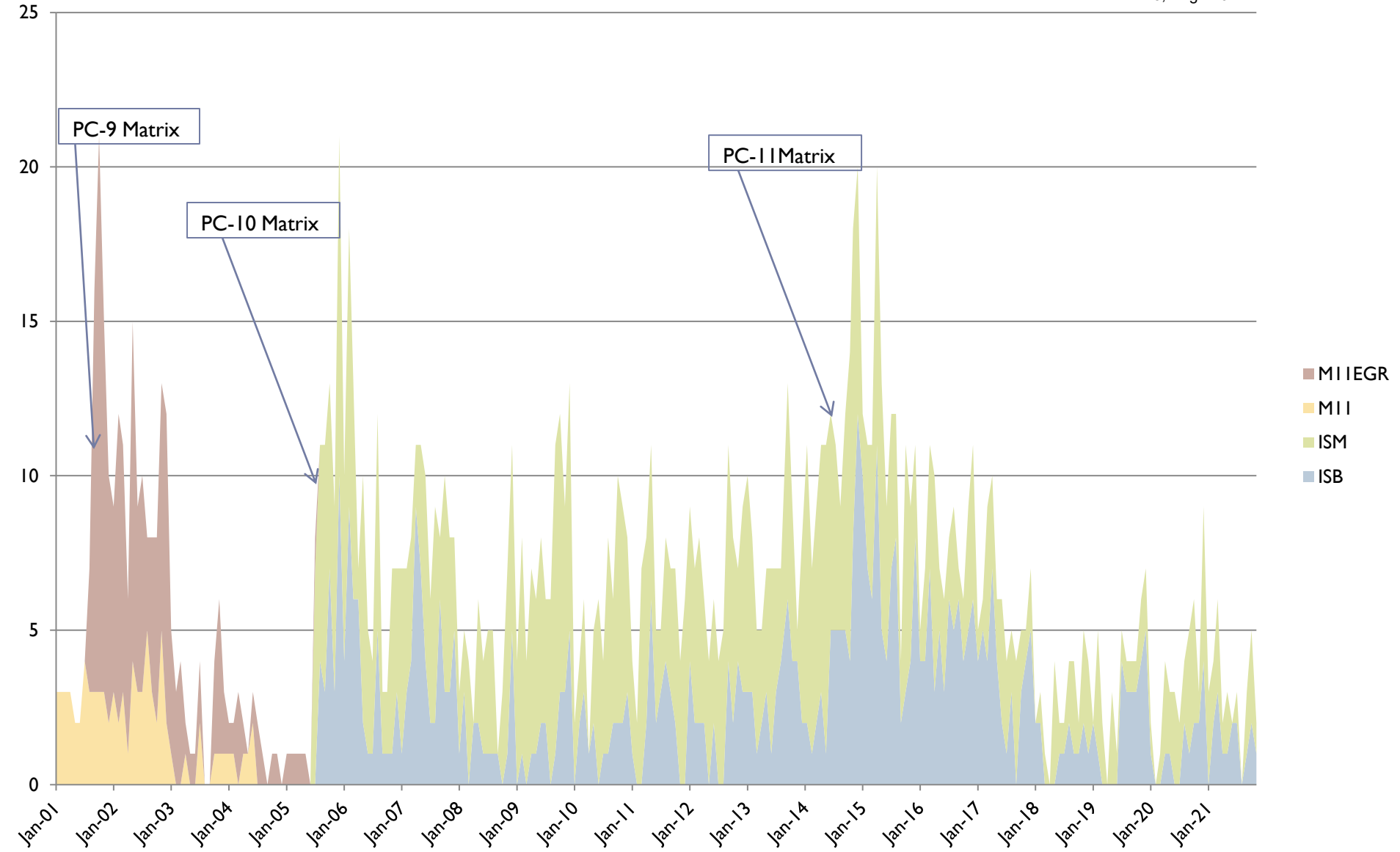
MACK CANDIDATE ACTIVITY



Availability of API CH-4 through CJ-4 Tests for PC-11

Test	Hardware Issues	Availability Through 2024	Notes
ISM	**None**	**Likely**	**None.**
ISB	**None**	**Likely**	**None.**

CUMMINS CANDIDATE ACTIVITY



Availability of API CH-4 through CJ-4 Tests for PC-11

Test	Hardware Issues	Availability Through 2024	Notes
RFWT	**None**	**Likely**	**Long term supply of test parts at CPD.** **6.5 L engine no longer in production at AM General, but available through supply network.** **Injection pump still available.**
EOAT	**Using last engine block**	**No**	**Oil Temperature runs higher w/ current EOAT engine. Working on EOAT / COAT correlation.**

B2 Action Items

- **No Action Items**
- **Comments**

CLOG Update at ASTM

Dec. 7, 2021

CLOG HDEO Topics

- Mack T-12 Ring/Liner
- Mack T-12 Lead
- Mack T-11 & T-11A
- C13 and 1N

Mack T-12 Equivalency

- Mack T-12 is required in all current API ‘C’ categories

Target Test & Parameter(s) for Tie-Back		Categories at Stake if Tie-Back Not Established				
Test	**Parameters**	**CH-4**	**CI-4**	**CI-4 PLUS**	**CJ-4**	**CK-4**
T-9	Average Liner Wear, normalized to 1.75 % soot, µm max	☑	-	-	-	-
	Average Top Ring Mass Loss, mg max	☑	-	-	-	-
	EOT Used Oil Lead Content less New Oil Lead Content, mg/kg, max	☑	-	-	-	-
T-10	Liner wear, µm, max	FBO	-	-	-	-
	Ring wear, mg, max	FBO	-	-	-	-
	Lead content at EOT, mg/kg, max	FBO	-	-	-	-
	Merit rating, min	-	☑	☑	-	-
T-12	Liner wear, µm, max	FBO	-	-	-	☑
	Top Ring Mass Loss, mg, max	FBO	-	-	-	☑
	Lead content at EOT, mg/kg, max	FBO	-	-	-	-
	Merit rating, min	-	FBO	FBO	☑	-

1000 merits, min.
Different rating systems

CK-4 backwards compatibility also expected in PC-12A

Mack T-12 Ring/Liner Mechanism

- Mack T-10 and T-12 developed for similar wear mechanism based on SAE 2005-01-3713
  - “Acid condensate in the cylinder wall film may contribute to corrosive wear of piston ring and cylinder liner surfaces.” (regarding Mack T-10)
  - “From 2007 – 2009, engine manufacturers will use higher EGR rates to reduce NOx.” (regarding Mack T-12)
  - “Phase 1 intake manifold and coolant temperatures were chosen to cause condensation to occur at the cylinder wall and not in the intake manifold.”

	Phase 1 EGR	Phase 2 EGR	Soot after Phase 1	Soot after Phase 2
Mack T-9	0%	0%	1.5-2.0%	2.0-2.5%
Mack T-10	16.5%	2.5%	5.0±0.3%	5.5±0.3%
Mack T-12	35%	15%	4.3±0.3%	6.0±0.3%

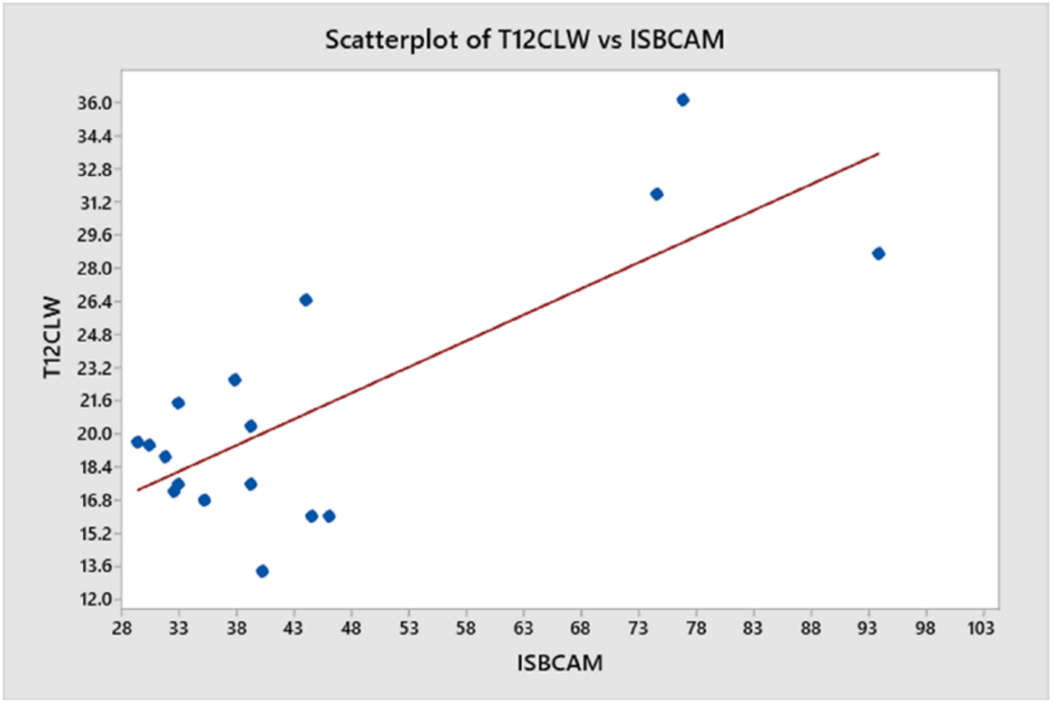
Mack T-12 Ring/Liner Wear

- CLOG current status:
  - Volvo T-13 is not a viable option
  - CEC TDG-L-116 is not a viable option and its future is uncertain
  - ACC data shows a correlation with ISB cam lobe wear (next slide)
  - Ford 6.7L was mentioned; no comparison data available
- CLOG members discussed trying to correlate ring and liner wear to a valvetrain wear test (either ISB or 6.7L)
  - Mechanisms are different; limited support voiced for this approach
- CLOG is open to suggestions for other potential wear tests

PAPTG HDD Test Redundancy Analysis

T-12 cylinder liner wear vs ISB camshaft lobe wear

As T-12 moves in passing direction, ISB moves in passing direction



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Status: Mack T-12 Ring/Liner Wear

- A replacement test will be required to license all existing ‘C’ categories
- No existing wear tests produce enough ring or liner wear to replace T-12

1. Minimal interest to attempt statistical correlation to a valvetrain wear test parameter with a different wear mechanism
2. API and EMA members could identify a replacement test or tests that provide equivalent wear protection and declare it backwards compatible with previous categories
   - Direct correlation with T-12 ring and liner wear is not necessary

Mack T-12 Lead Mechanism

- Mack considers the lead parameters as both corrosion and oxidation related
  - “Ultimate the 500 hour test length and bearing corrosion allowed Mack T-9 test to replace the gasoline fueled L-38 (Seq. VIII) test as the bearing wear test in the API CH-4 category.”
  - Regarding the Mack T-10, “In addition acid condensates can be transported into the crankcase.” and “Mack indicated the heat rejection to the crankcase lubricant could increase by 30 to 40% due to the addition of cooled EGR. This would drive up oil temperatures …”
  - Regarding the Mack T-12, “Mack decided that a new ring and liner wear / oxidation test would be necessary …”

	Phase 2 Oil Gallery Temp, °C	Phase 2 Oil Sump Temp, °C
Mack T-9	105	110
Mack T-10	113	118
Mack T-12	116	129

Mack T-12 Lead

- A replacement test will be required to license all existing ‘C’ categories
- No existing tests generate enough lead to replace T-12
  - In CK-4, T-12 Lead is replaced by T-13 measuring Oxidation using IR Peak Height and KV40 % Increase, confirming that lead increase is driven by oxidation
- Requested ACC CETAG to collect existing data comparing:
  - Volvo T-13
    - Consider limits at shorter test length
  - HTCBT
  - Seq. VIII

TABLE A5.2 Mack T-12 Merit System

	Cylinder Liner Wear, µm	Top Ring Mass Loss, mg	Delta Lead, Final mg/kg	Delta Lead, (250 – 300) h mg/kg	Oil Consumption, g/h
Weight (Total = 1000)	250	200	200	200	150
Maximum	24.0	105	35	15	85.0
Anchor	20.0	70	25	10	65.0
Minimum	12.0	35	10	0	50.0

ASTM D4485

Mack T8E/T-11 Equivalency

- Mack T-8E or Mack T-11 is required in all current API ‘C’ categories

Target Test & Parameter(s) for Tie-Back		Categories at Stake if Tie-Back Not Established				
Test	**Parameters**	**CH-4**	**CI-4**	**CI-4 PLUS**	**CJ-4**	**CK-4**
Ext. T-8E	Relative Viscosity at 4.8 % Soot by TGA, max	☑	☑	-	-	-
	Viscosity increase at 3.8 % Soot by TGA, mm2/s, max	☑	-	-	-	-
T-11	TGA % Soot at 4.0 mm2/s increase, at 100 °C, min	-	-	☑	☑	☑
	TGA % Soot at 12.0 mm2/s increase, at 100 °C, min	-	-	☑	☑	☑
	TGA % Soot at 15.0 mm2/s increase, at 100 °C, min	-	-	☑	☑	☑
T-11A	Sooted Oil MRV TP-1, D6896 Viscosity at 180h	-	-	☑	☑	☑
	Yield Stress of 180h used oil sample	-	-	☑	☑	☑

Status: Mack T-8E/T-11

- A replacement test will be required to license all existing ‘C’ categories
- Cummins ISM and ISB tests produce nearly as much soot as the T-11

- CLOG will compare viscosity increase at given soot levels in Cummins ISM and ISB, which generate nearly as much soot as T-11

- Requested ACC CETAG to collect data comparing T-11, ISM and ISB

- No data exists comparing used oil MRV from ISM or ISB to T-11A
  - A proposal of when to collect used samples and test matrix are needed
  - T-11 replacement and sooted oil MRV tests need not be the same

Status: Cat 1N

- Caterpillar requests that CLOG update the 2013 study on redundancy between C-13 and 1N deposit tests
  - PC-11 Redundancy TF evaluated C-13 v. 1N in 2013. Most data supports redundancy. A few data points passed on C-13 Merits but failed 1N parameters.
  - Concept: if new data show redundancy, 1N may not be needed for PC-12

- Requested ACC CETAG to collect data comparing C-13 and 1N

Summary

- Identifying replacement tests for the Mack T-12 and T-11 is proving to be a significant challenge
  - We have eliminated some options and continue to pursue others
  - Suggestions and volunteers to explore new or different ideas are encouraged
- Thanks to CLOG membership for input so far
  - We are open to more ideas, if anyone has any suggestions
- Requests for comparison data to ACC CETAG are pending and expected to take several months. We appreciate CETAG’s support.

COAT/EOAT Compatibility Study

SOUTHWEST RESEARCH INSTITUTE®

December 2021 Update

Background

- The Caterpillar Oil Aeration Test (COAT) replaced the Engine Oil Aeration Test (EOAT) for CK/FA-4 aeration protection
- The EOAT uses a half model-year engine from 1994, difficult to find at this point
  - Last few have been pulled from salvage yards
- Need to establish equivalency from COAT to EOAT exists

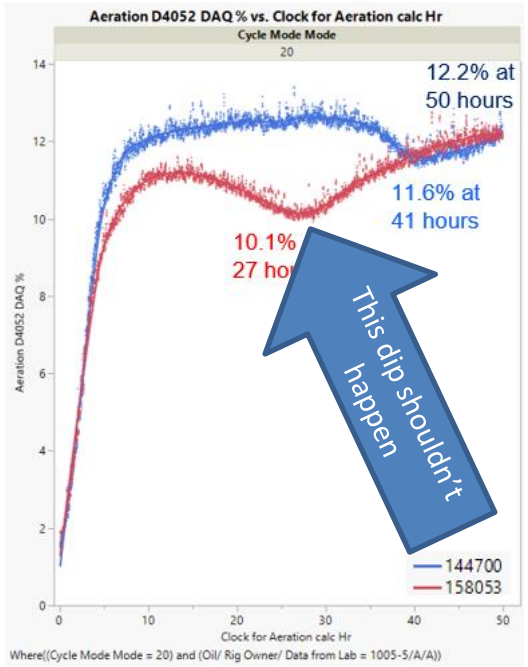
	EOAT	COAT
Introduced	CG-4	CK/FA-4
Engine	MY94 7.3L	C13
Duration	20 Hours	50 Hours
Measurement Method	Graduated Cylinders	Real-time Density
D4485 Limit	10.0% (CG) or 8.0% (CH, CI, CJ)	11.8%

Source for replacement EOAT Engines

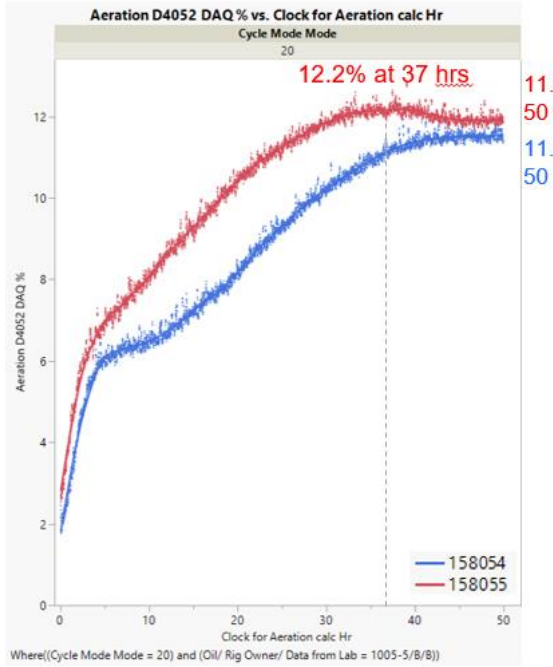
Equivalency Matrix Results

- Unusual behavior seen across all labs running TMC 1005-5
  - Older reference oil for T8, EOAT, and1P era tests as well as some bench tests, in use Jan 2015
  - Extensive operational data review by full Surveillance Panel was conducted
- May have been happening in EOAT, but measurement is discrete and may not capture
- New blend of 1005-5 requested, received at TMC November 2021. Labeled 1005-6

Lab A



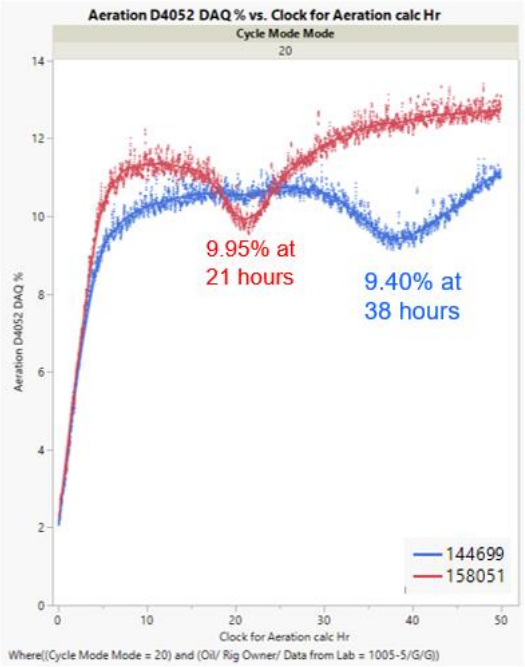
Lab B



11.9% at
50 hours

11.51% at
50 hours

Lab G

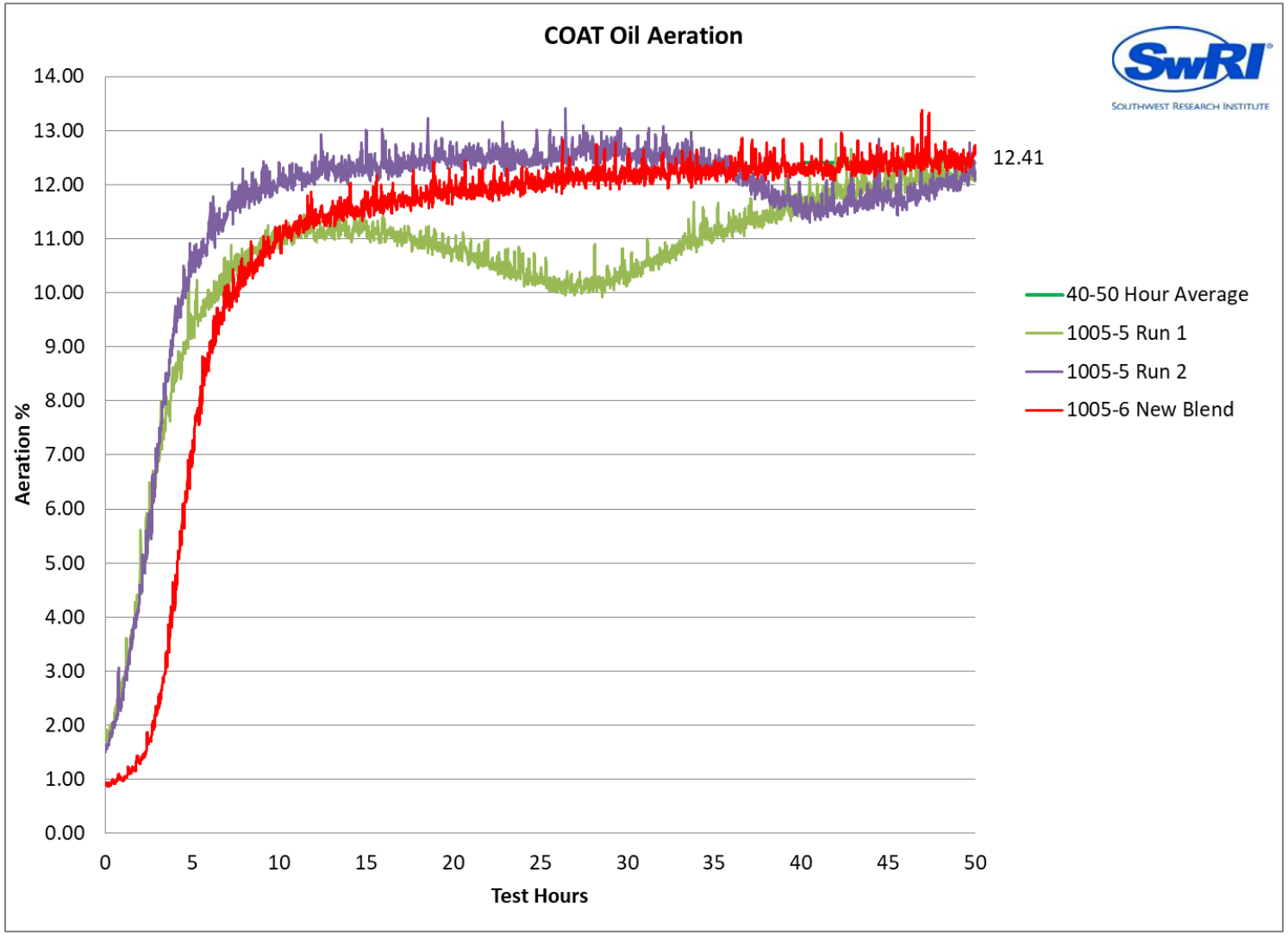


12.7% at
50 hours

11% at
50 hours

1005-6 Results

- Initial check indicates stable performance with no dip in aeration
- More data needed for equivalency conclusion
- Not tested in other methods using TMC 1005 as a reference oil at this point



Next Steps

- Working group to meet and discuss plan for path forward in January 2022
- Options include;
  - Complete matrix using 1005-6
  - Test 1005-6 in EOAT to verify performance vs 1005-5 (current EOAT reference oil)
  - Identify another fluid for use
- Both aeration tests are relatively short duration, should be able to move quickly once a path is decided upon

Chevron Oronite

Elastomer Compatibility
EOEC Limits Proposals

Joe Franklin / Robert Stockwell / Jo Martinez / Laura Birnbaumer

Dec. 2, 2021

ADDING UP

Fixed Limits Path Forward – Option 1

- Some of the elastomer compatibility limits for EOEC are Variable Limits based on TMC 1006.
- Supply of TMC 1006 is diminishing and a new reference oil SL107 is now being used.
- Instead of using SL107 as a replacement for TMC 1006 in the Variable Limits, Joe Franklin proposed to convert the Variable Limits to Fixed Limits in his presentation to ASTM D02.B in Dec. 2019.
- This analysis follows Joe Franklin’s proposal with updated data on 1006-2.
- This method makes it easy for anyone to understand if a test passed or failed

Proposed Fixed Limits for EOEC based on 1006-2

Current Specification Limits

D7216 (Elastomer Compatibility)

Note—These are the *unadjusted specification limits* for elastomer compatibility. Candidate oils shall, however, conform to the *adjusted specification limits*, the calculation of which is described in Annex A4.

Elastomer	Volume Change, %	Hardness Change, Points	Tensile Strength Change, %	Elongation at Break Change, %
Nitrile (NBR)	(+5, –3)	(+7, –5)	(+10, –TMC 1006)	(+10, –TMC 1006)
Silicone (VMQ)	(+TMC 1006, –3)	(+5, –TMC 1006)	(+10, –45)	(+20, –30)
Polyacrylate (ACM)	(+5, –3)	(+8, –5)	(+18, –15)	(+10, –35)
Fluoroelastomer (FKM)	(+5, –2)	(+7, –5)	(+10, –TMC 1006)	(+10, –TMC 1006)
Vamac G	(+TMC 1006, –3)	(+5, –TMC 1006)	(+10, –TMC 1006)	(+10, –TMC 1006)

Note—TMC 1006 is the designation for the reference oil used in this test method. This designation represents the original blend or subsequent approved re-blends of TMC 1006.

Proposed Fixed Limits

Note – These are the *unadjusted specification limits* for elastomer compatibility. Candidate oils shall, however, conform to the *adjusted specification limits*, the calculation of which is described in Annex A4.

Elastomer	Volume Change, %	Hardness Change, Points	Tensile Strength Change, %	Elongation at Break Change, %
Nitrile (NBR)	(+5, -3)	(+7, -5)	(+10, -47)	(+10, -66)
Silicone (VMQ)	(+41, -3)	(+5, -27)	(+10, -45)	(+20, -30)
Polyacrylate (ACM)	(+5, -3)	(+8, -5)	(+18, -15)	(+10, -35)
Fluoroelastomer (FKM)	(+5, -2)	(+7, -5)	(+10, -76)	(+10, -77)
Vamac G	(+25, -3)	(+5, -14)	(+10, -24)	(+10, -40)

Variable Limits Path Forward – Option 2

- The variable limits are more in alignment with the original intent of the elastomer tests.
- Back in the mid 1990's the OEMs met and decided that as long as future oils were no more aggressive to seals than Service Oil 105 they would be OK. Service oil 105 was later renamed TMC 1006.
- Variable limits require looking at more data to determine if a test passed or failed.
- With either Option 1 or Option 2 an information letter will complete the full B ballot process before the change is made to D4485

Proposed Variable Limits for EOEC based on SL107

Current Specification Limits

D7216 (Elastomer Compatibility)

Note—These are the *unadjusted specification limits* for elastomer compatibility. Candidate oils shall, however, conform to the *adjusted specification limits*, the calculation of which is described in Annex A4.

Elastomer	Volume Change, %	Hardness Change, Points	Tensile Strength Change, %	Elongation at Break Change, %
Nitrile (NBR)	(+5, –3)	(+7, –5)	(+10, –TMC 1006)	(+10, –TMC 1006)
Silicone (VMQ)	(+TMC 1006, –3)	(+5, –TMC 1006)	(+10, –45)	(+20, –30)
Polyacrylate (ACM)	(+5, –3)	(+8, –5)	(+18, –15)	(+10, –35)
Fluoroelastomer (FKM)	(+5, –2)	(+7, –5)	(+10, –TMC 1006)	(+10, –TMC 1006)
Vamac G	(+TMC 1006, –3)	(+5, –TMC 1006)	(+10, –TMC 1006)	(+10, –TMC 1006)

Note—TMC 1006 is the designation for the reference oil used in this test method. This designation represents the original blend or subsequent approved re-blends of TMC 1006.

Proposed Variable Limits

Note – These are the *unadjusted specification limits* for elastomer compatibility. Candidate oils shall, however, conform to the *adjusted specification limits*, the calculation of which is described in Annex A4.

Elastomer	Volume Change, %	Hardness Change, Points	Tensile Strength Change, %	Elongation at Break Change, %
Nitrile (NBR)	(+5, -3)	(+7, -5)	(+10, -SL107-30)	(+10, -SL107-15)
Silicone (VMQ)	(+SL107, -3)	(+5, -SL107+2)	(+10, -45)	(+20, -30)
Polyacrylate (ACM)	(+5, -3)	(+8, -5)	(+18, -15)	(+10, -35)
Fluoroelastomer (FKM)	(+5, -2)	(+7, -5)	(+10, -SL107+3)	(+10, -SL107+3)
Vamac G	(+SL107+2, -3)	(+5, -SL107-2)	(+10, -SL107-2)	(+10, -SL107+14)

Data

- Analysis includes LTMS data with validity AC, AG and AO as of August 13, 2021. Extreme outliers were excluded.
- With the proposed fixed limits, 1006-2 probability of pass is ~100% for most parameters and materials.
- With the variable limits based on SL107, the factor was calculated as the difference between the limits for 1006-2 and SL107 having probability of pass as ~100%.
- The proposed limits also align with the TMC 1006 calibration limits.

Comparison with Joe Franklin's Proposal in Dec 2019 for Unadjusted Fixed Limits

Oronite's Update

Elastomer	Spec Limits	Volume Change, %	Hardness Change, Points	Tensile Strength Change, %	Elongation at Break Change, %
Nitrile (NBR)	Current	(+5, -3)	(+7, -5)	(+10, -TMC1006)	(+10, -TMC1006)
	Proposed	(+5, -3)	(+7, -5)	(+10, -47)	(+10, -66)
Silicone (VMQ)	Current	(+TMC1006, -3)	(+5, -TMC1006)	(+10, -45)	(+20, -30)
	Proposed	(+41, -3)	(+5, -27)	(+10, -45)	(+20, -30)
Polyacrylate (ACM)	Current	(+5, -3)	(+8, -5)	(+18, -15)	(+10, -35)
	Proposed	(+5, -3)	(+8, -5)	(+18, -15)	(+10, -35)
Fluoroelastomer (FKM)	Current	(+5, -2)	(+7, -5)	(+10, -TMC1006)	(+10, -TMC1006)
	Proposed	(+5, -2)	(+7, -5)	(+10, -76)	(+10, -77)
Vamac G	Current	(+TMC1006, -3)	(+5, -TMC1006)	(+10, -TMC1006)	(+10, -TMC1006)
	Proposed	(+25, -3)	(+5, -14)	(+10, -24)	(+10, -40)

Joe Franklin's

Elastomer	Volume Change, %	Hardness Change, Points	Tensile Strength Change, %	Elongation at Break Change, %
Nitrile (NBR)	(+5, —3)	(+7, —5)	(+10, —38)	(+10, —59)
Silicone (VMQ)	(+37, —3)	(+5, —24)	(+10, —45)	(+20, —30)
Polyacrylate (ACM)	(+5, —3)	(+8, —5)	(+18, —15)	(+10, —35)
Fluoroelastomer (FKM)	(+5, —2)	(+7, —5)	(+10, —71)	(+10, —69)
Vamac G	(+32, —3)	(+5, —17)	(+10, —17)	(+10, —33)

Proposed Fixed Limits Comparison with TMC 1006 Calibration Limits

A reference is run together with the candidate to validate the test. Since some labs are still using TMC 1006, the calibration limits should align with the proposed fixed limits as shown below.

Elastomer	Limits	Volume Change, %	Hardness Change, Points	Tensile Strength Change, %	Elongation at Break Change, %
Nitrile (NBR)	Proposed Spec	(+5, -3)	(+7, -5)	(+10, -47)	(+10, -66)
	TMC 1006 Cal	(+3, -2)	(+7, -4)	(-5, -49)	(-31, -71)
Silicone (VMQ)	Proposed Spec	(+41, -3)	(+5, -27)	(+10, -45)	(+20, -30)
	TMC 1006 Cal	(+41, 23)	(-15, -28)	(-22, -44)	(-5, -43)
Polyacrylate (ACM)	Proposed Spec	(+5, -3)	(+8, -5)	(+18, -15)	(+10, -35)
	TMC 1006 Cal	(+3, -1)	(+4, -7)	(+25, -23)	(+9, -45)
Fluoroelastomer (FKM)	Proposed Spec	(+5, -2)	(+7, -5)	(+10, -76)	(+10, -77)
	TMC 1006 Cal	(+1, 0)	(+14, 1)	(-53, -85)	(-32, -86)
Vamac G	Proposed Spec	(+25, -3)	(+5, -14)	(+10, -24)	(+10, -40)
	TMC 1006 Cal	(+25, 17)	(-6, -12)	(+1, -28)	(-2, -47)

Proposed Limits Comparison with SL107 Calibration Limits

A reference is run together with the candidate to validate the test so the calibration limits should align with the proposed limits as shown below.

Note: Original presentation was missing the “-” before Nitrile SL results

Elastomer	Limits	Volume Change, %	Hardness Change, Points	Tensile Strength Change, %	Elongation at Break Change, %
Nitrile (NBR)	Proposed Spec	(+5, -3)	(+7, -5)	(+10, -SL107-30)	(+10, -SL107-15)
	TMC 1006 Cal	(+3, -2)	(+7, -4)	(-5, -49)	(-31, -71)
	SL107 Cal	(+4, -1)	(+7, -3)	(-25, -19)	(-14, -54)
Silicone (VMQ)	Proposed Spec	(+SL107, -3)	(+5, -SL107+2)	(+10, -45)	(+20, -30)
	TMC 1006 Cal	(+41, 23)	(-15, -28)	(-22, -44)	(-5, -43)
	SL107 Cal	(+41, 23)	(-16, -28)	(-23, -45)	(-6, -44)
Polyacrylate (ACM)	Proposed Spec	(+5, -3)	(+8, -5)	(+18, -15)	(+10, -35)
	TMC 1006 Cal	(+3, -1)	(+4, -7)	(+25, -23)	(+9, -45)
	SL107 Cal	(+2, -2)	(+5, -5)	(+24, -24)	(+4, -49)
Fluoroelastomer (FKM)	Proposed Spec	(+5, -2)	(+7, -5)	(+10, -SL107+3)	(+10, -SL107+3)
	TMC 1006 Cal	(+1, 0)	(+14, 1)	(-53, -85)	(-32, -86)
	SL107 Cal	(+1, 0)	(+15, 1)	(-55, -87)	(-32, -85)
Vamac G	Proposed Spec	(+SL107+2, -3)	(+5, -SL107-2)	(+10, -SL107-2)	(+10, -SL107+14)
	TMC 1006 Cal	(+25, 17)	(-6, -12)	(+1, -28)	(-2, -47)
	SL107 Cal	(+23, 14)	(-5, -10)	(-1, -30)	(-13, -57)

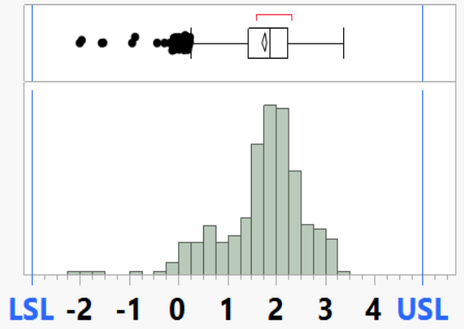
Nitrile (NBR)

VOLC (+5, -3)

- TMC 1006

Distributions IND= 1006-1

VOLC

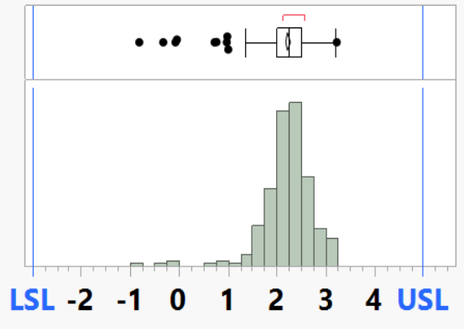


Quantiles		
100.0%	maximum	3.38
99.5%		3.19015
97.5%		3.08
90.0%		2.66
75.0%	quartile	2.23
50.0%	median	1.88
25.0%	quartile	1.44
10.0%		0.58
2.5%		0.02925
0.5%		-0.94885
0.0%	minimum	-2.01

Summary Statistics	
Mean	1.7596084
Std Dev	0.7769226
Std Err Mean	0.0246177
Upper 95% Mean	1.8079171
Lower 95% Mean	1.7112998
N	996

Distributions IND= 1006-2

VOLC



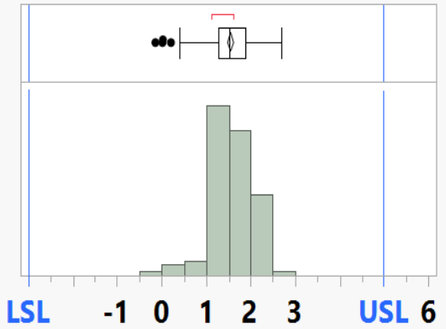
Quantiles		
100.0%	maximum	3.23
99.5%		3.20675
97.5%		3.10375
90.0%		2.75
75.0%	quartile	2.49
50.0%	median	2.25
25.0%	quartile	2.01
10.0%		1.72
2.5%		1.36625
0.5%		-0.23875
0.0%	minimum	-0.81

Summary Statistics	
Mean	2.2310991
Std Dev	0.4651699
Std Err Mean	0.021595
Upper 95% Mean	2.2735354
Lower 95% Mean	2.1886628
N	464

- SL107

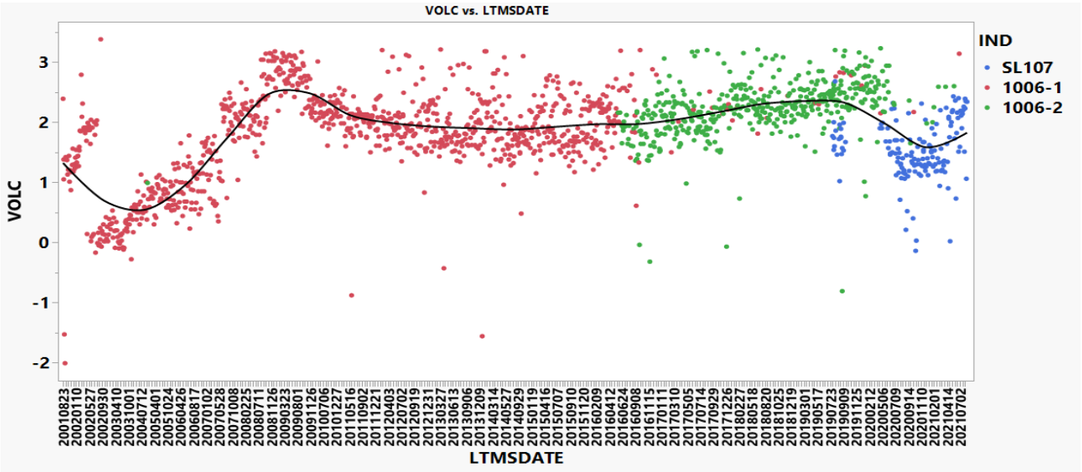
Distributions IND= SL107

VOLC



Quantiles		
100.0%	maximum	2.68
99.5%		2.68
97.5%		2.391
90.0%		2.2
75.0%	quartile	1.9
50.0%	median	1.51
25.0%	quartile	1.28
10.0%		1.106
2.5%		0.192
0.5%		-0.14
0.0%	minimum	-0.14

Summary Statistics	
Mean	1.5538065
Std Dev	0.4822368
Std Err Mean	0.0387342
Upper 95% Mean	1.6303254
Lower 95% Mean	1.4772875
N	155



Chevron Oronite

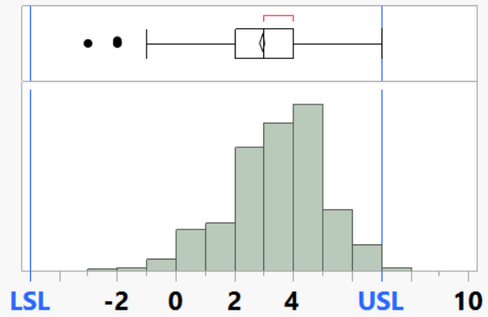
ADDING UP

HARD (+7, -5)

- TMC 1006

Distributions IND= 1006-1

HARD

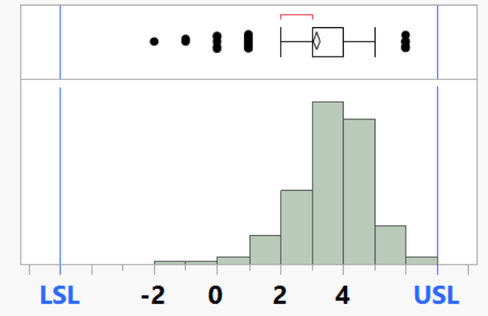


Quantiles		
100.0%	maximum	7
99.5%		6
97.5%		6
90.0%		5
75.0%	quartile	4
50.0%	median	3
25.0%	quartile	2
10.0%		1
2.5%		0
0.5%		-1.01
0.0%	minimum	-3

Summary Statistics	
Mean	2.9618474
Std Dev	1.5859148
Std Err Mean	0.0502516
Upper 95% Mean	3.0604587
Lower 95% Mean	2.863236
N	996

Distributions IND= 1006-2

HARD



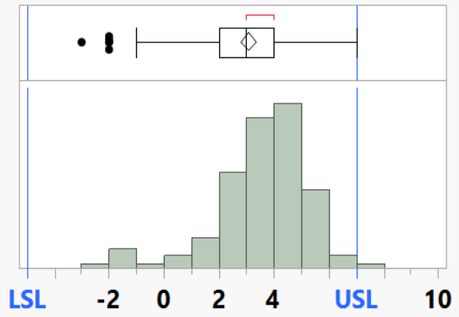
Quantiles		
100.0%	maximum	6
99.5%		6
97.5%		5
90.0%		4
75.0%	quartile	4
50.0%	median	3
25.0%	quartile	3
10.0%		2
2.5%		1
0.5%		-1
0.0%	minimum	-2

Summary Statistics	
Mean	3.174569
Std Dev	1.178332
Std Err Mean	0.0547027
Upper 95% Mean	3.2820653
Lower 95% Mean	3.0670727
N	464

- SL107

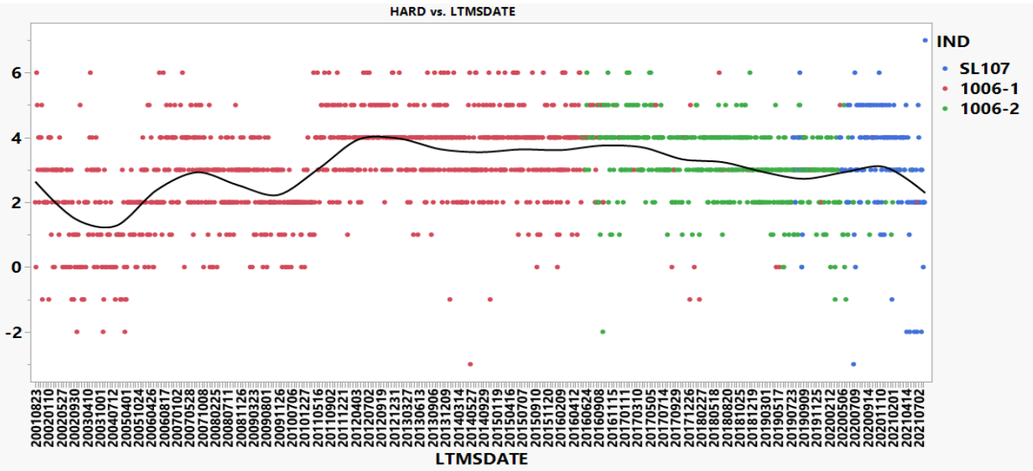
Distributions IND= SL107

HARD



Quantiles		
100.0%	maximum	7
99.5%		7
97.5%		6
90.0%		5
75.0%	quartile	4
50.0%	median	3
25.0%	quartile	2
10.0%		1
2.5%		-2
0.5%		-3
0.0%	minimum	-3

Summary Statistics	
Mean	3.0903226
Std Dev	1.6762967
Std Err Mean	0.1346434
Upper 95% Mean	3.356309
Lower 95% Mean	2.8243362
N	155



Chevron Oronite

ADDING UP

TENS (+10, -TMC 1006)

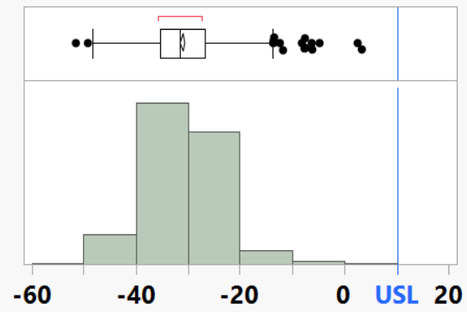
Proposed Spec Limit (+10, -TMC 1006 or -47 or –SL107-30)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

TENS

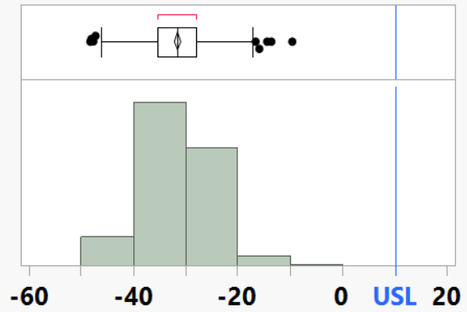


Quantiles		
100.0%	maximum	3.3
99.5%		-6.2985
97.5%		-16.0625
90.0%		-23.3
75.0%	quartile	-26.8
50.0%	median	-31.4
25.0%	quartile	-35.5
10.0%		-39.1
2.5%		-43.36
0.5%		-47.806
0.0%	minimum	-51.5

Summary Statistics	
Mean	-31.06064
Std Dev	6.829825
Std Err Mean	0.2164113
Upper 95% Mean	-30.63597
Lower 95% Mean	-31.48532
N	996

Distributions IND= 1006-2

TENS



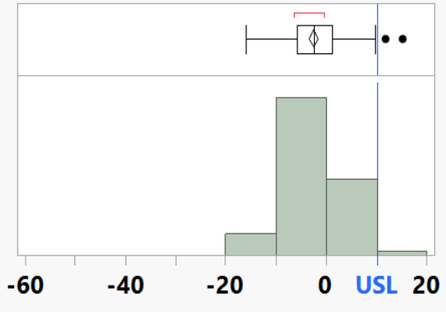
Quantiles		
100.0%	maximum	-9.6
99.5%		-13.86
97.5%		-18.9
90.0%		-24.2
75.0%	quartile	-27.925
50.0%	median	-31.4
25.0%	quartile	-35.375
10.0%		-39
2.5%		-43.8
0.5%		-47.87
0.0%	minimum	-48.2

Summary Statistics	
Mean	-31.48233
Std Dev	6.006378
Std Err Mean	0.2788391
Upper 95% Mean	-30.93438
Lower 95% Mean	-32.03027
N	464

- SL107

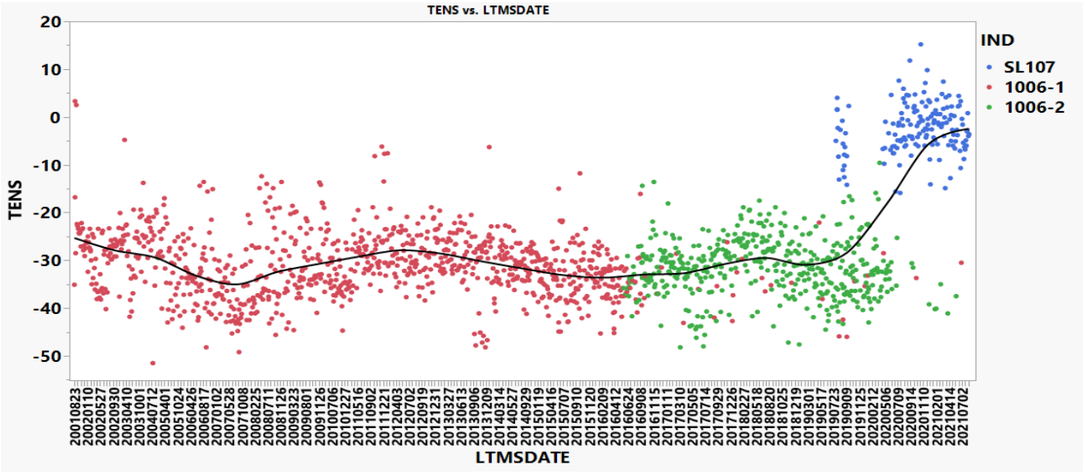
Distributions IND= SL107

TENS



Quantiles		
100.0%	maximum	15.2
99.5%		15.2
97.5%		7.82
90.0%		4.22
75.0%	quartile	1
50.0%	median	-2.6
25.0%	quartile	-5.9
10.0%		-8.84
2.5%		-14.27
0.5%		-15.9
0.0%	minimum	-15.9

Summary Statistics	
Mean	-2.470323
Std Dev	5.2923392
Std Err Mean	0.4250909
Upper 95% Mean	-1.630561
Lower 95% Mean	-3.310085
N	155



Chevron Oronite

ADDING UP

ELON (+10, -TMC 1006)

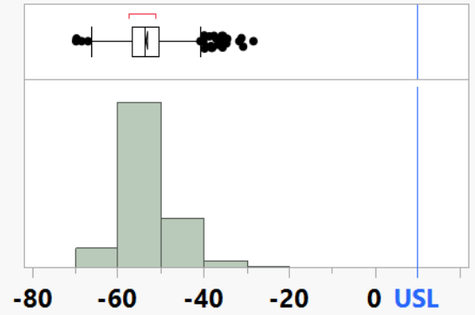
Proposed Spec Limit (+10, -TMC 1006 or -66 or –SL107-15)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

ELON

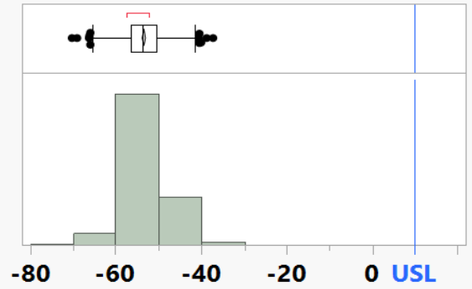


Quantiles		
100.0%	maximum	-28.3
99.5%		-34.358
97.5%		-40.8
90.0%		-46.57
75.0%	quartile	-50.325
50.0%	median	-53.6
25.0%	quartile	-56.7
10.0%		-59.33
2.5%		-62.4075
0.5%		-66.0135
0.0%	minimum	-69.7

Summary Statistics	
Mean	-53.17149
Std Dev	5.392691
Std Err Mean	0.170874
Upper 95% Mean	-52.83617
Lower 95% Mean	-53.5068
N	996

Distributions IND= 1006-2

ELON



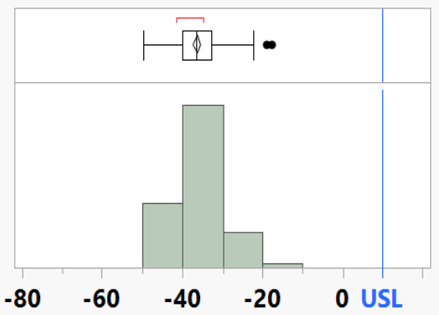
Quantiles		
100.0%	maximum	-37.2
99.5%		-39.1225
97.5%		-42.925
90.0%		-47.2
75.0%	quartile	-50.225
50.0%	median	-53.85
25.0%	quartile	-56.3
10.0%		-58.4
2.5%		-63.9375
0.5%		-68.09
0.0%	minimum	-70.2

Summary Statistics	
Mean	-53.32866
Std Dev	4.8178952
Std Err Mean	0.2236652
Upper 95% Mean	-52.88914
Lower 95% Mean	-53.76819
N	464

- SL107

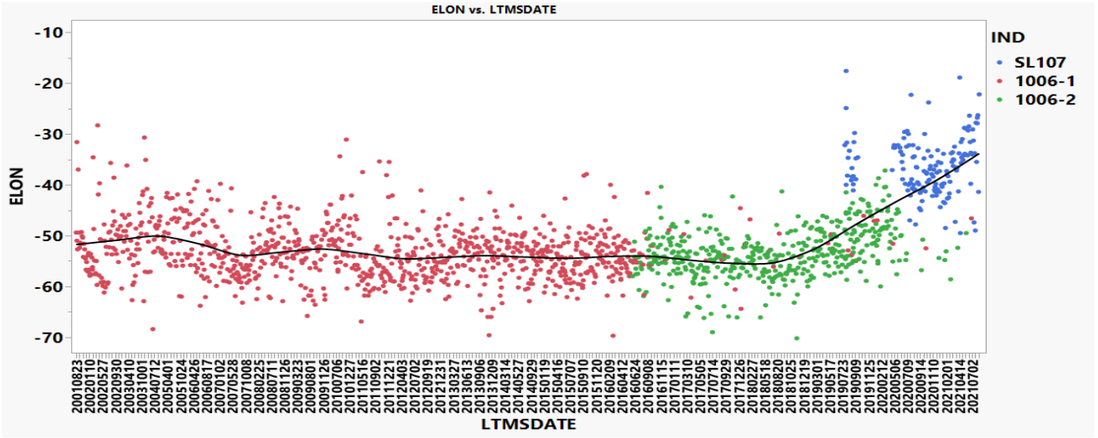
Distributions IND= SL107

ELON



Quantiles		
100.0%	maximum	-17.6
99.5%		-17.6
97.5%		-22.29
90.0%		-29.06
75.0%	quartile	-32.7
50.0%	median	-36.6
25.0%	quartile	-40
10.0%		-42.32
2.5%		-47.87
0.5%		-49.5
0.0%	minimum	-49.5

Summary Statistics	
Mean	-36.25355
Std Dev	5.6859622
Std Err Mean	0.4567075
Upper 95% Mean	-35.35133
Lower 95% Mean	-37.15577
N	155



Chevron Oronite

ADDING UP

Silicone (VMQ)

Chevron Oronite

ADDING UP®

VOLC (+TMC 1006, -3)

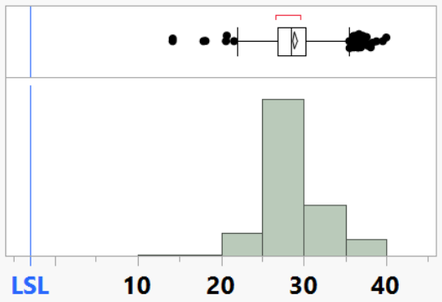
Proposed Spec Limit (+TMC 1006 or +41 or +SL107, -3)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

VOLC

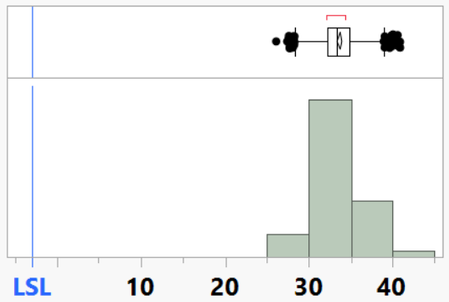


Quantiles		
100.0%	maximum	39.95
99.5%		38.1196
97.5%		36.66
90.0%		33.824
75.0%	quartile	30.28
50.0%	median	28.58
25.0%	quartile	26.85
10.0%		25.184
2.5%		23.436
0.5%		20.0988
0.0%	minimum	14.22

Summary Statistics	
Mean	28.972796
Std Dev	3.4092368
Std Err Mean	0.1103203
Upper 95% Mean	29.189294
Lower 95% Mean	28.756297
N	955

Distributions IND= 1006-2

VOLC



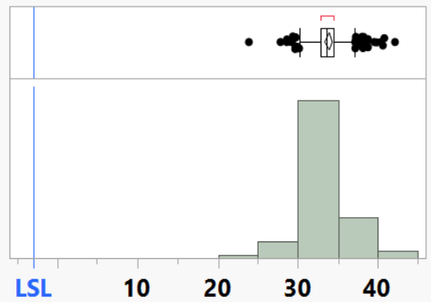
Quantiles		
100.0%	maximum	40.88
99.5%		40.852
97.5%		39.842
90.0%		37.794
75.0%	quartile	34.93
50.0%	median	33.28
25.0%	quartile	32.28
10.0%		30.09
2.5%		28.124
0.5%		27.4776
0.0%	minimum	26.12

Summary Statistics	
Mean	33.660701
Std Dev	2.8235579
Std Err Mean	0.1301027
Upper 95% Mean	33.916356
Lower 95% Mean	33.405046
N	471

- SL107

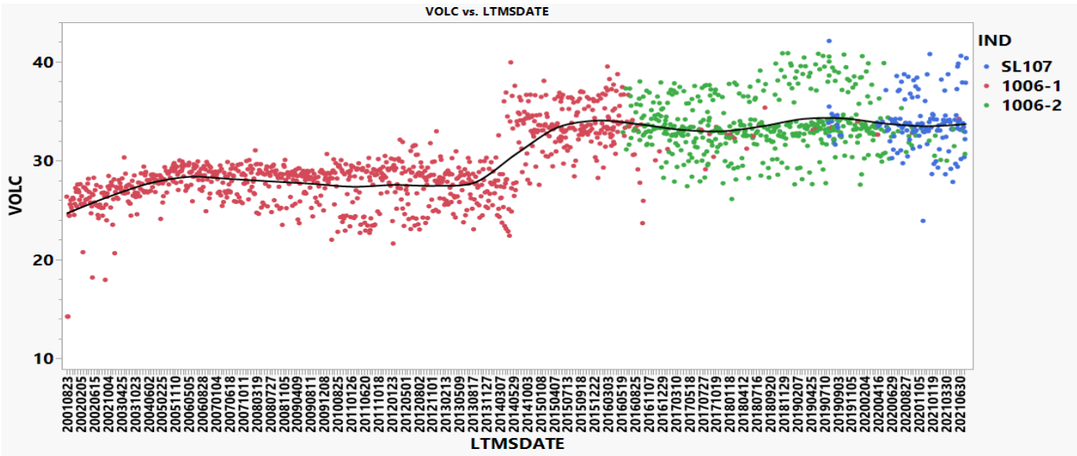
Distributions IND= SL107

VOLC



Quantiles		
100.0%	maximum	42.12
99.5%		42.12
97.5%		40.45475
90.0%		38.035
75.0%	quartile	34.5325
50.0%	median	33.645
25.0%	quartile	32.795
10.0%		30.419
2.5%		28.6435
0.5%		23.91
0.0%	minimum	23.91

Summary Statistics	
Mean	33.85637
Std Dev	2.7470192
Std Err Mean	0.2273449
Upper 95% Mean	34.305708
Lower 95% Mean	33.407032
N	146



Chevron Oronite

ADDING UP

HARD (+5, -TMC 1006)

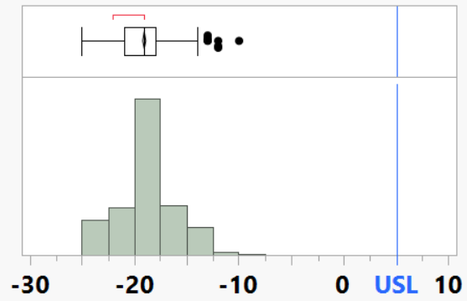
Proposed Spec Limit (+5, -TMC 1006 or -27 or –SL107+2)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

HARD

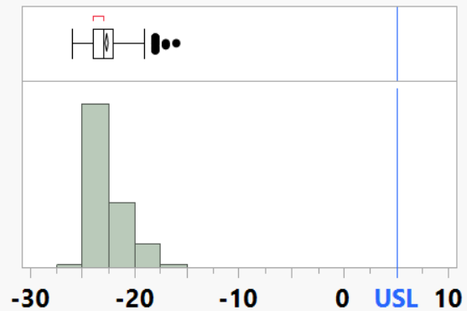


Quantiles		
100.0%	maximum	-10
99.5%		-12.78
97.5%		-14
90.0%		-16
75.0%	quartile	-18
50.0%	median	-19
25.0%	quartile	-21
10.0%		-23
2.5%		-24
0.5%		-25
0.0%	minimum	-25

Summary Statistics	
Mean	-19.09843
Std Dev	2.5914607
Std Err Mean	0.0838577
Upper 95% Mean	-18.93386
Lower 95% Mean	-19.263
N	955

Distributions IND= 1006-2

HARD



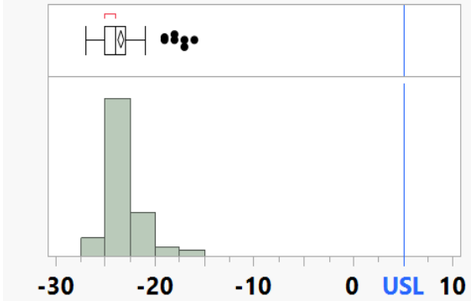
Quantiles		
100.0%	maximum	-16
99.5%		-17
97.5%		-18
90.0%		-20.2
75.0%	quartile	-22
50.0%	median	-23
25.0%	quartile	-24
10.0%		-24
2.5%		-25
0.5%		-25.64
0.0%	minimum	-26

Summary Statistics	
Mean	-22.69639
Std Dev	1.6679608
Std Err Mean	0.0768556
Upper 95% Mean	-22.54537
Lower 95% Mean	-22.84741
N	471

- SL107

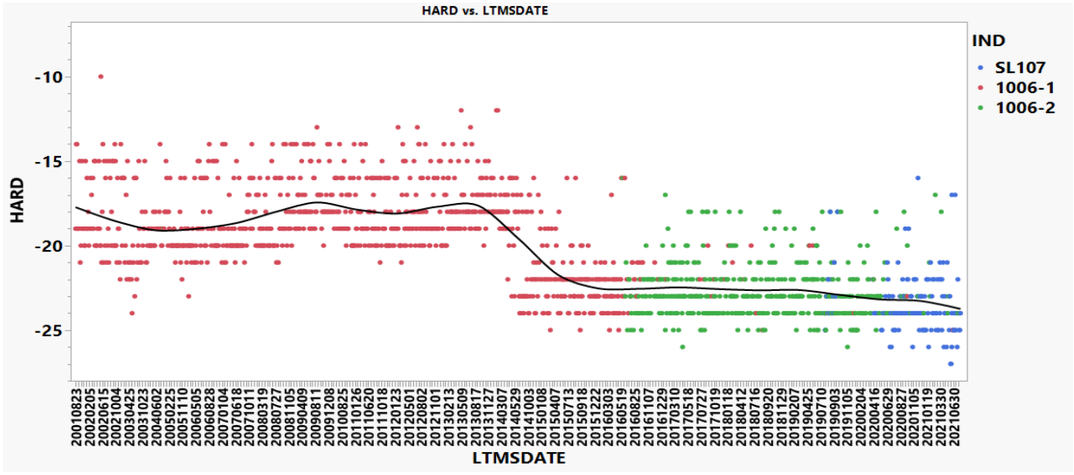
Distributions IND= SL107

HARD



Quantiles		
100.0%	maximum	-16
99.5%		-16
97.5%		-17.675
90.0%		-21
75.0%	quartile	-23
50.0%	median	-24
25.0%	quartile	-25
10.0%		-25
2.5%		-26
0.5%		-27
0.0%	minimum	-27

Summary Statistics	
Mean	-23.44521
Std Dev	1.8938405
Std Err Mean	0.1567354
Upper 95% Mean	-23.13542
Lower 95% Mean	-23.75499
N	146



Chevron Oronite

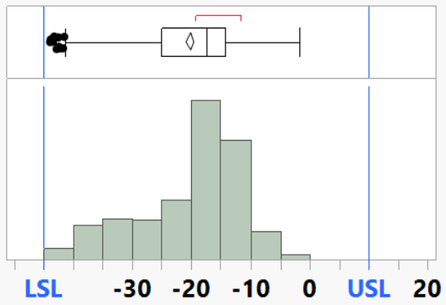
ADDING UP

TENS (+10, -45)

- TMC 1006

Distributions IND= 1006-1

TENS

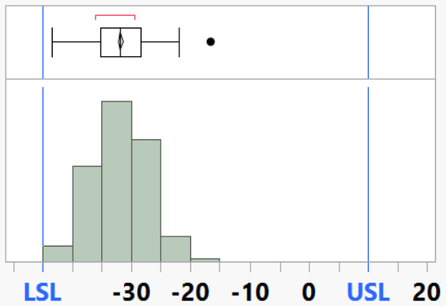


Quantiles		
100.0%	maximum	-1.7
99.5%		-4.89
97.5%		-8.48
90.0%		-11.6
75.0%	quartile	-14.4
50.0%	median	-17.5
25.0%	quartile	-25.2
10.0%		-34.48
2.5%		-39.81
0.5%		-42.888
0.0%	minimum	-43.9

Summary Statistics	
Mean	-20.22775
Std Dev	8.5913097
Std Err Mean	0.2780083
Upper 95% Mean	-19.68217
Lower 95% Mean	-20.77333
N	955

Distributions IND= 1006-2

TENS



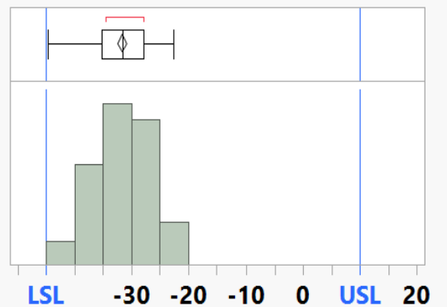
Quantiles		
100.0%	maximum	-16.6
99.5%		-21.936
97.5%		-22.88
90.0%		-26.02
75.0%	quartile	-28.5
50.0%	median	-31.8
25.0%	quartile	-35.2
10.0%		-37.8
2.5%		-40.8
0.5%		-43.092
0.0%	minimum	-43.5

Summary Statistics	
Mean	-31.85435
Std Dev	4.5489603
Std Err Mean	0.209605
Upper 95% Mean	-31.44247
Lower 95% Mean	-32.26623
N	471

- SL107

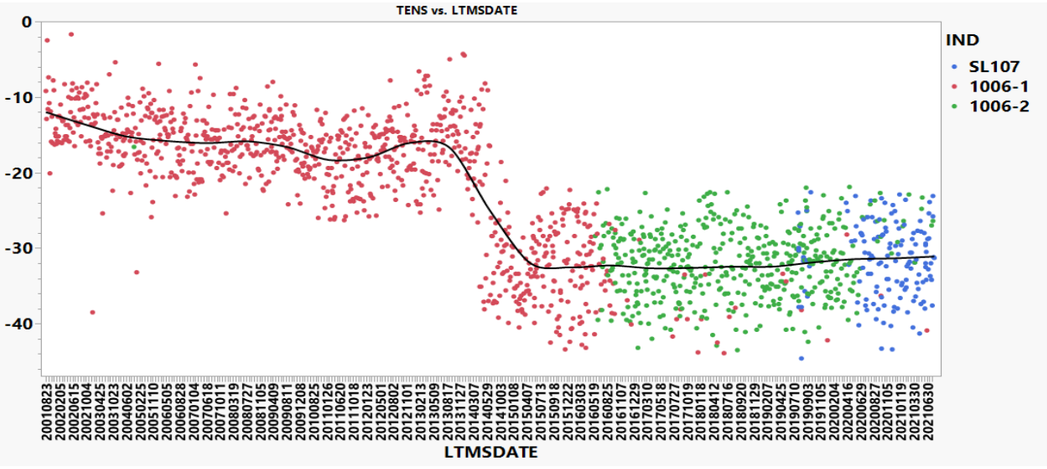
Distributions IND= SL107

TENS



Quantiles		
100.0%	maximum	-22.6
99.5%		-22.6
97.5%		-23.1
90.0%		-25.1
75.0%	quartile	-28
50.0%	median	-31.5
25.0%	quartile	-35.25
10.0%		-38
2.5%		-41.95
0.5%		-44.6
0.0%	minimum	-44.6

Summary Statistics	
Mean	-31.64863
Std Dev	4.882442
Std Err Mean	0.4040738
Upper 95% Mean	-30.84999
Lower 95% Mean	-32.44727
N	146



Chevron Oronite

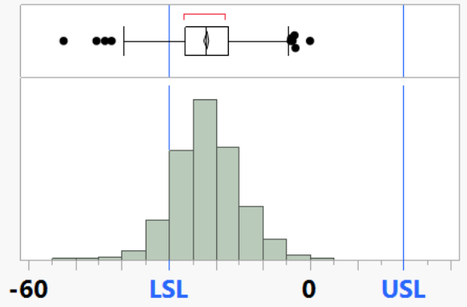
ADDING UP

ELON (+20, -30)

- TMC 1006

Distributions IND= 1006-1

ELON

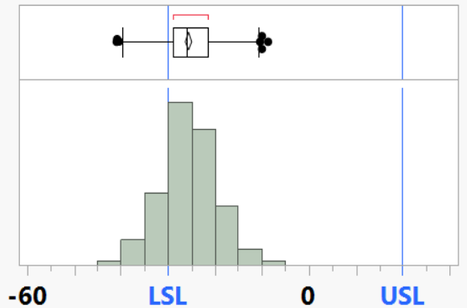


Quantiles		
100.0%	maximum	0
99.5%		-3.934
97.5%		-8.3
90.0%		-13.66
75.0%	quartile	-17.6
50.0%	median	-22.2
25.0%	quartile	-26.5
10.0%		-29.94
2.5%		-34.51
0.5%		-40.328
0.0%	minimum	-52.4

Summary Statistics	
Mean	-22.00325
Std Dev	6.682704
Std Err Mean	0.2162472
Upper 95% Mean	-21.57887
Lower 95% Mean	-22.42762
N	955

Distributions IND= 1006-2

ELON



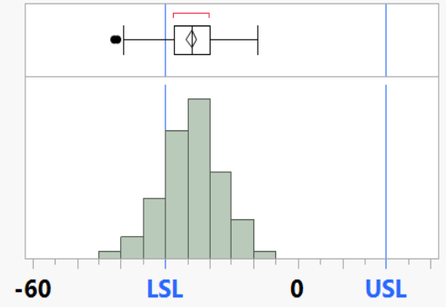
Quantiles		
100.0%	maximum	-8.7
99.5%		-10
97.5%		-12.46
90.0%		-18.2
75.0%	quartile	-21.7
50.0%	median	-25.8
25.0%	quartile	-29
10.0%		-33.2
2.5%		-37.72
0.5%		-40.656
0.0%	minimum	-40.9

Summary Statistics	
Mean	-25.60382
Std Dev	5.8974414
Std Err Mean	0.2717398
Upper 95% Mean	-25.06985
Lower 95% Mean	-26.1378
N	471

- SL107

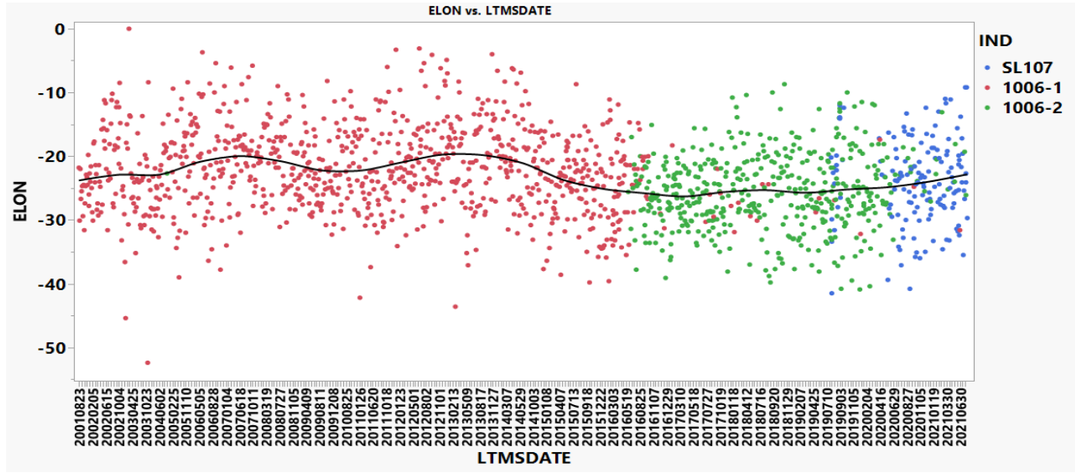
Distributions IND= SL107

ELON



Quantiles		
100.0%	maximum	-9.2
99.5%		-9.2
97.5%		-11.0675
90.0%		-15.34
75.0%	quartile	-19.875
50.0%	median	-24
25.0%	quartile	-28.1
10.0%		-33.23
2.5%		-37.8475
0.5%		-41.5
0.0%	minimum	-41.5

Summary Statistics	
Mean	-24.03288
Std Dev	6.695795
Std Err Mean	0.5541479
Upper 95% Mean	-22.93763
Lower 95% Mean	-25.12813
N	146



Chevron Oronite

ADDING UP

Polyacrylate (ACM)

Chevron Oronite

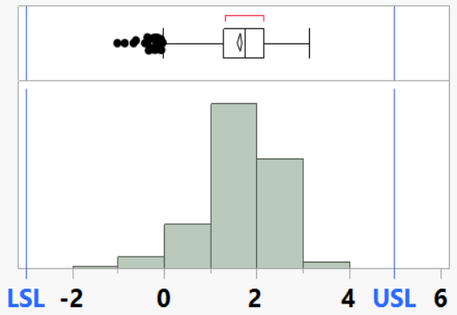
ADDING UP®

VOLC (+5, -3)

- TMC 1006

Distributions IND= 1006-1

VOLC



Quantiles

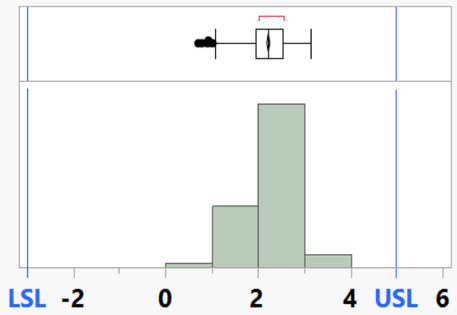
100.0%	maximum	3.12
99.5%		3.0501
97.5%		2.90025
90.0%		2.481
75.0%	quartile	2.15
50.0%	median	1.75
25.0%	quartile	1.28
10.0%		0.559
2.5%		-0.09
0.5%		-0.411
0.0%	minimum	-1.01

Summary Statistics

Mean	1.6448196
Std Dev	0.7315792
Std Err Mean	0.0231577
Upper 95% Mean	1.6902631
Lower 95% Mean	1.5993761
N	998

Distributions IND= 1006-2

VOLC



Quantiles

100.0%	maximum	3.12
99.5%		3.11585
97.5%		3.04925
90.0%		2.857
75.0%	quartile	2.53
50.0%	median	2.21
25.0%	quartile	1.95
10.0%		1.61
2.5%		1.28075
0.5%		0.8398
0.0%	minimum	0.71

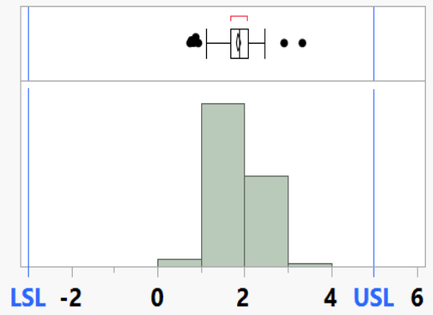
Summary Statistics

Mean	2.2221577
Std Dev	0.4530781
Std Err Mean	0.0206371
Upper 95% Mean	2.2627078
Lower 95% Mean	2.1816076
N	482

- SL107

Distributions IND= SL107

VOLC

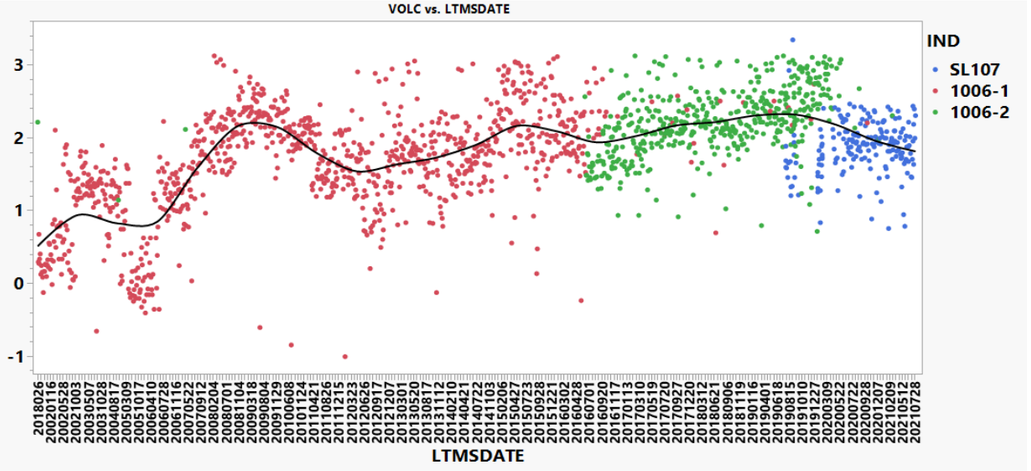


Quantiles

100.0%	maximum	3.34
99.5%		3.34
97.5%		2.4225
90.0%		2.3
75.0%	quartile	2.08
50.0%	median	1.9
25.0%	quartile	1.69
10.0%		1.45
2.5%		0.925
0.5%		0.75
0.0%	minimum	0.75

Summary Statistics

Mean	1.869418
Std Dev	0.3649019
Std Err Mean	0.0265427
Upper 95% Mean	1.9217778
Lower 95% Mean	1.8170582
N	189

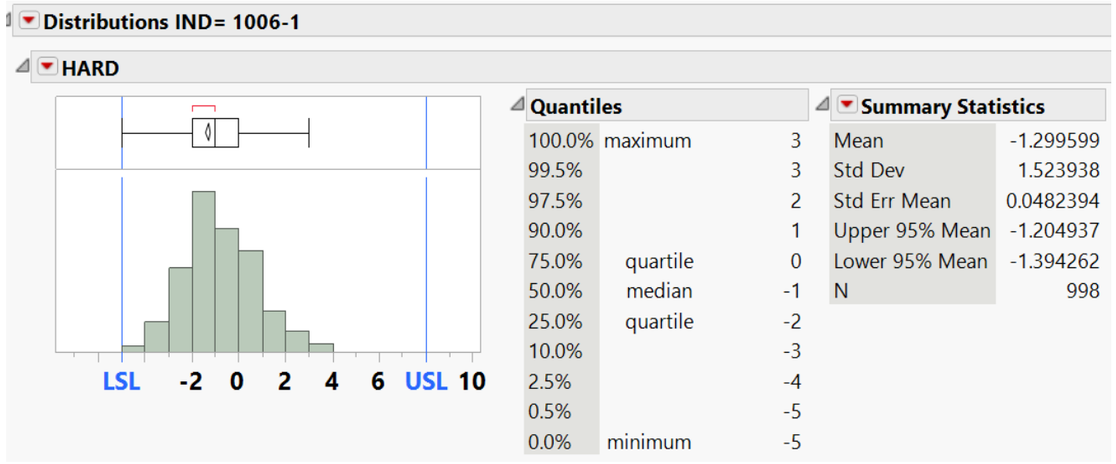


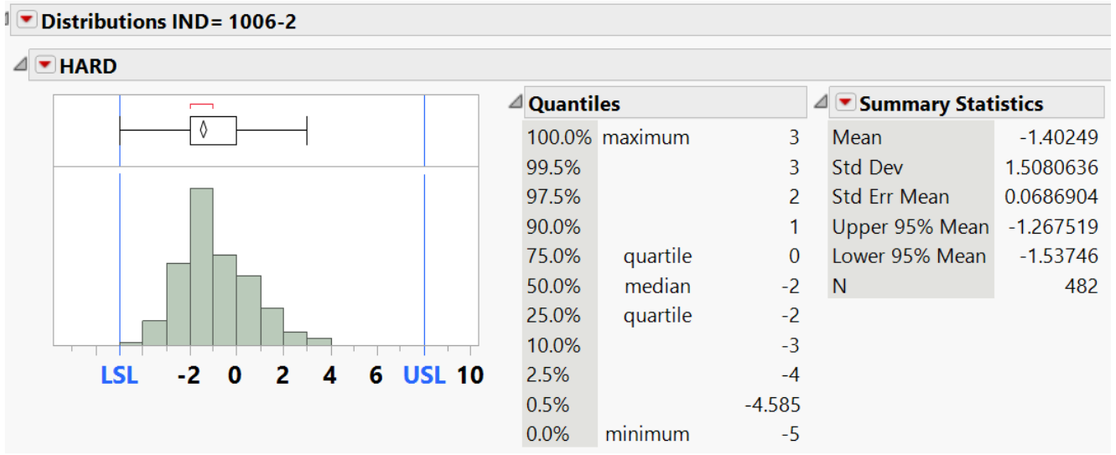
Chevron Oronite

ADDING UP

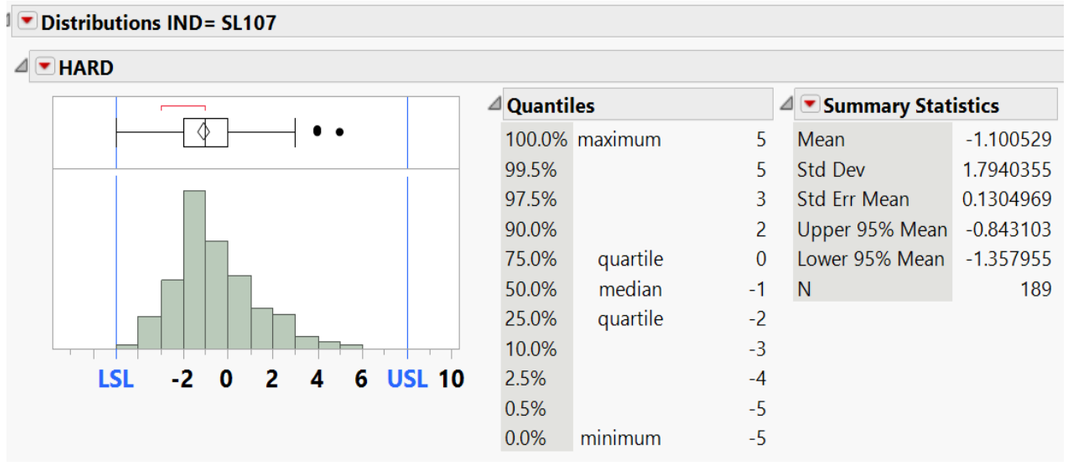
HARD (+8, -5)

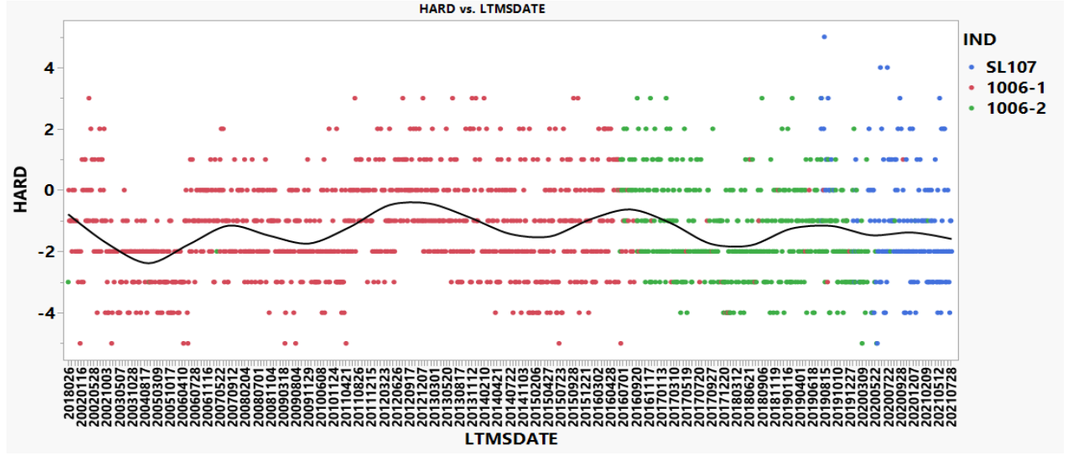
- TMC 1006





- SL107





Chevron Oronite

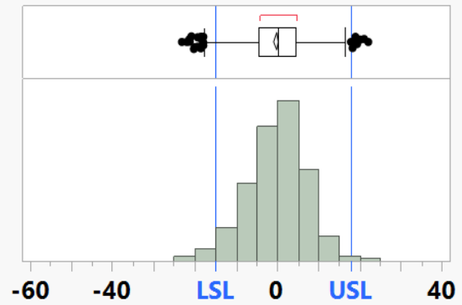
ADDING UP

TENS (+18, -15)

- TMC 1006

Distributions IND= 1006-1

TENS

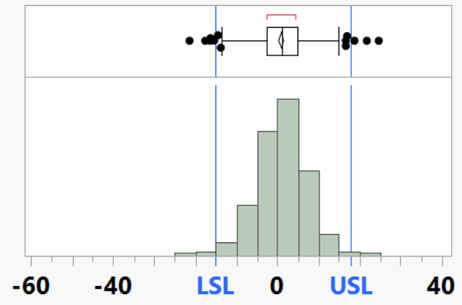


Quantiles		
100.0%	maximum	22.1
99.5%		19.201
97.5%		12.5025
90.0%		8.11
75.0%	quartile	4.425
50.0%	median	0.15
25.0%	quartile	-4.5
10.0%		-9.6
2.5%		-15.52
0.5%		-20.802
0.0%	minimum	-23.1

Summary Statistics	
Mean	-0.250802
Std Dev	7.0118695
Std Err Mean	0.2219568
Upper 95% Mean	0.1847546
Lower 95% Mean	-0.686358
N	998

Distributions IND= 1006-2

TENS



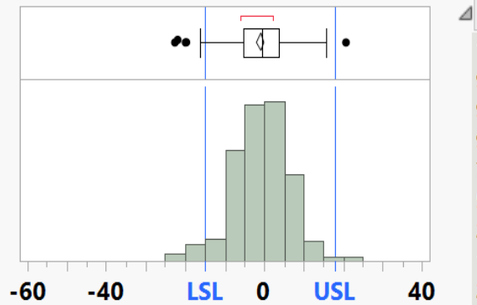
Quantiles		
100.0%	maximum	24.6
99.5%		20.455
97.5%		12.4925
90.0%		7.97
75.0%	quartile	4.725
50.0%	median	1.05
25.0%	quartile	-2.6
10.0%		-6.8
2.5%		-12.1925
0.5%		-17.102
0.0%	minimum	-21.4

Summary Statistics	
Mean	0.8690871
Std Dev	6.0761401
Std Err Mean	0.2767606
Upper 95% Mean	1.4128963
Lower 95% Mean	0.325278
N	482

- SL107

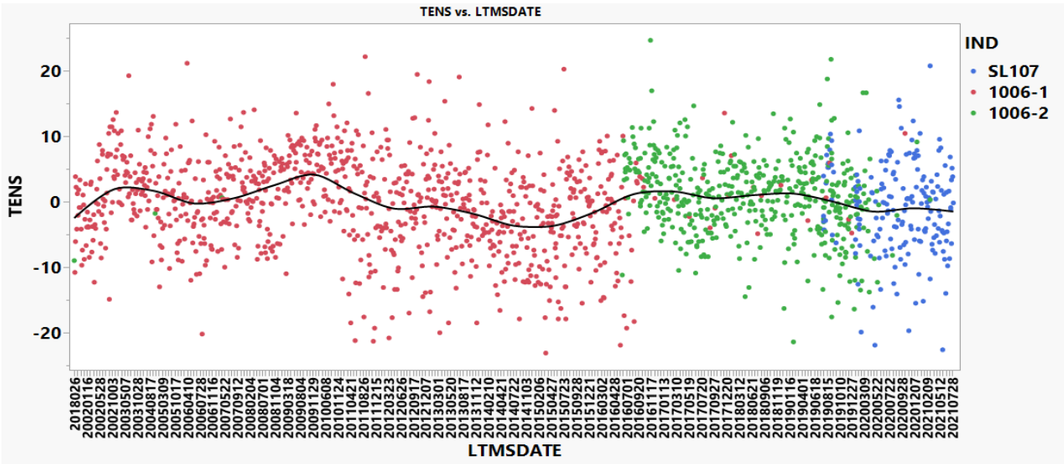
Distributions IND= SL107

TENS



Quantiles		
100.0%	maximum	20.7
99.5%		20.7
97.5%		11.475
90.0%		7.3
75.0%	quartile	3.55
50.0%	median	-0.4
25.0%	quartile	-5.3
10.0%		-8.8
2.5%		-17
0.5%		-22.6
0.0%	minimum	-22.6

Summary Statistics	
Mean	-1.015873
Std Dev	6.920311
Std Err Mean	0.5033786
Upper 95% Mean	-0.022877
Lower 95% Mean	-2.008869
N	189



Chevron Oronite

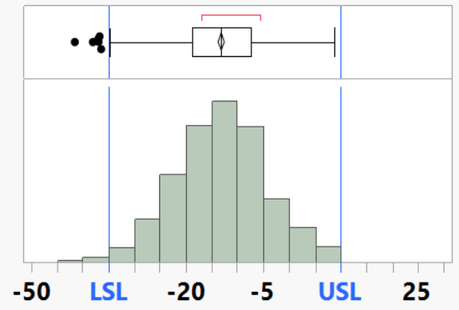
ADDING UP

ELON (+10, -35)

- TMC 1006

Distributions IND= 1006-1

ELON



Quantiles

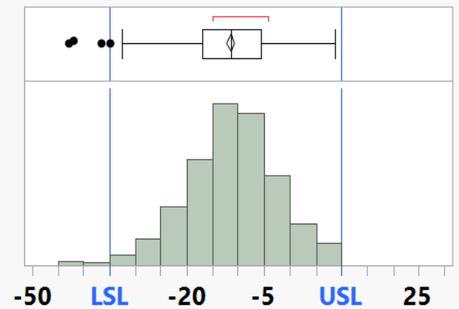
100.0%	maximum	8.7
99.5%		7.3005
97.5%		4.5
90.0%		-2.08
75.0%	quartile	-7.375
50.0%	median	-13
25.0%	quartile	-18.925
10.0%		-24.3
2.5%		-30.7075
0.5%		-36.701
0.0%	minimum	-41.5

Summary Statistics

Mean	-13.16703
Std Dev	8.6076291
Std Err Mean	0.2724697
Upper 95% Mean	-12.63235
Lower 95% Mean	-13.70171
N	998

Distributions IND= 1006-2

ELON



Quantiles

100.0%	maximum	8.7
99.5%		8.117
97.5%		5.7925
90.0%		-0.5
75.0%	quartile	-5.775
50.0%	median	-11.4
25.0%	quartile	-17.025
10.0%		-23
2.5%		-28.94
0.5%		-39.659
0.0%	minimum	-42.8

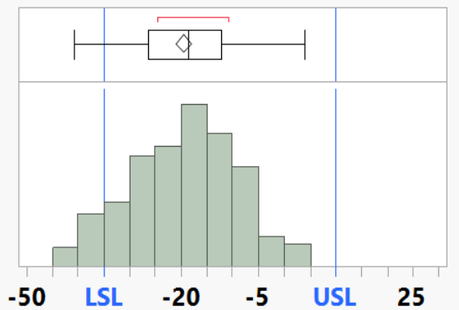
Summary Statistics

Mean	-11.45353
Std Dev	8.6545914
Std Err Mean	0.3942058
Upper 95% Mean	-10.67895
Lower 95% Mean	-12.22811
N	482

- SL107

Distributions IND= SL107

ELON

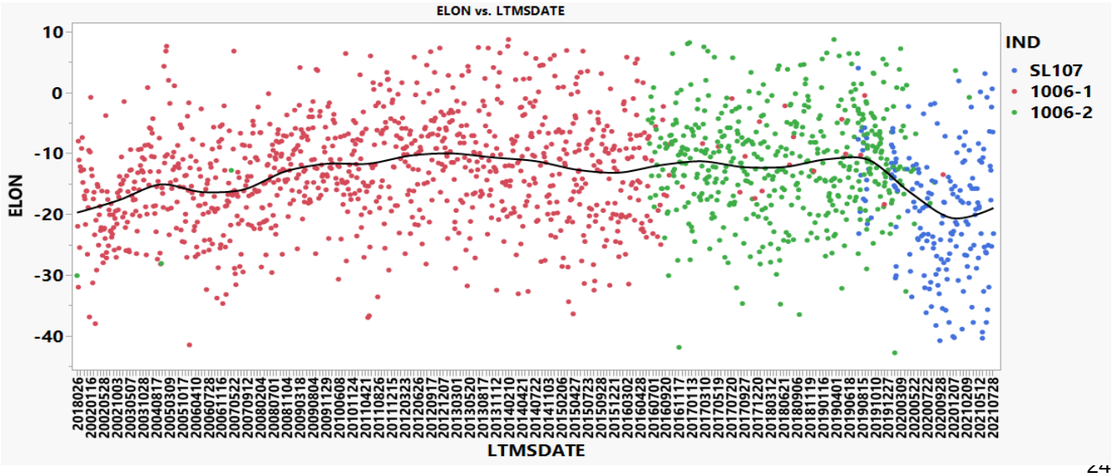


Quantiles

100.0%	maximum	4
99.5%		4
97.5%		0.225
90.0%		-6.5
75.0%	quartile	-12.2
50.0%	median	-18.6
25.0%	quartile	-26.45
10.0%		-32.7
2.5%		-39.575
0.5%		-40.8
0.0%	minimum	-40.8

Summary Statistics

Mean	-19.33651
Std Dev	10.025722
Std Err Mean	0.7292639
Upper 95% Mean	-17.89792
Lower 95% Mean	-20.7751
N	189



Chevron Oronite

ADDING UP

Fluoroelastomer (FKM)

Chevron Oronite

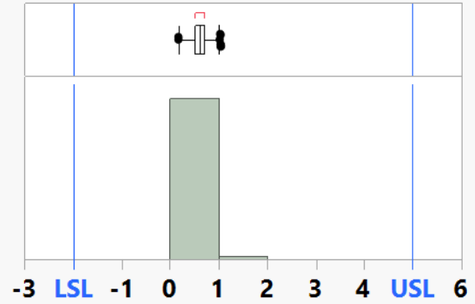
ADDING UP®

VOLC (+5, -2)

- TMC 1006

Distributions IND= 1006-1

VOLC

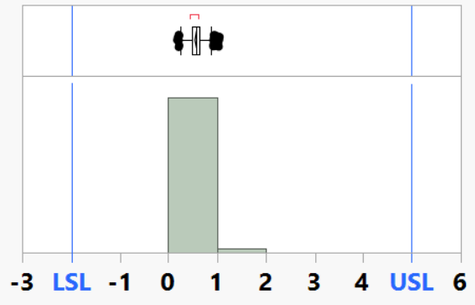


Quantiles		
100.0%	maximum	1.05
99.5%		1.04
97.5%		0.95
90.0%		0.83
75.0%	quartile	0.7
50.0%	median	0.6
25.0%	quartile	0.5
10.0%		0.41
2.5%		0.31
0.5%		0.21
0.0%	minimum	0.17

Summary Statistics	
Mean	0.6077956
Std Dev	0.159495
Std Err Mean	0.0050487
Upper 95% Mean	0.6177029
Lower 95% Mean	0.5978882
N	998

Distributions IND= 1006-2

VOLC



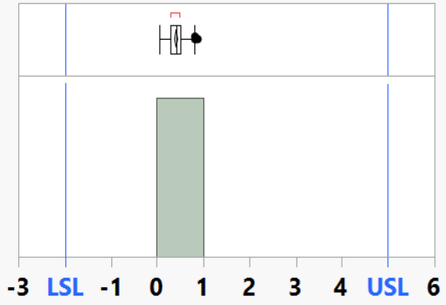
Quantiles		
100.0%	maximum	1.05
99.5%		1.0367
97.5%		0.9735
90.0%		0.744
75.0%	quartile	0.645
50.0%	median	0.56
25.0%	quartile	0.48
10.0%		0.4
2.5%		0.26
0.5%		0.19
0.0%	minimum	0.18

Summary Statistics	
Mean	0.5713548
Std Dev	0.1536892
Std Err Mean	0.0071272
Upper 95% Mean	0.5853604
Lower 95% Mean	0.5573493
N	465

- SL107

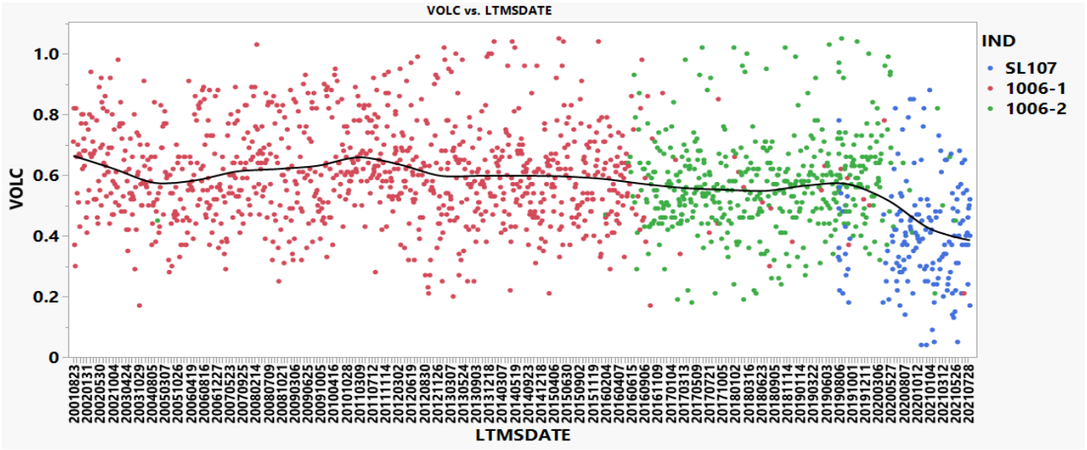
Distributions IND= SL107

VOLC



Quantiles		
100.0%	maximum	0.88
99.5%		0.88
97.5%		0.82
90.0%		0.65
75.0%	quartile	0.5
50.0%	median	0.4
25.0%	quartile	0.29
10.0%		0.205
2.5%		0.055
0.5%		0.04
0.0%	minimum	0.04

Summary Statistics	
Mean	0.4053049
Std Dev	0.1729833
Std Err Mean	0.0135077
Upper 95% Mean	0.4319776
Lower 95% Mean	0.3786322
N	164

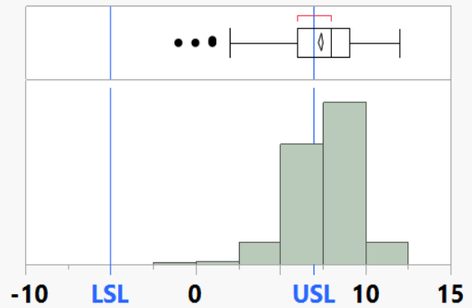


HARD (+7, -5)

- TMC 1006

Distributions IND= 1006-1

HARD

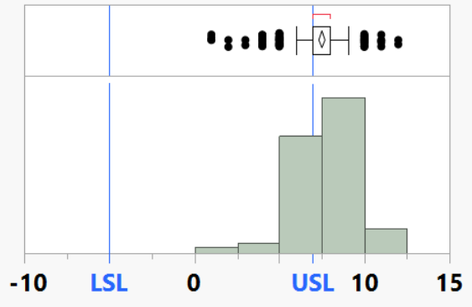


Quantiles		
100.0%	maximum	12
99.5%		11.005
97.5%		10
90.0%		9
75.0%	quartile	9
50.0%	median	8
25.0%	quartile	6
10.0%		5
2.5%		4
0.5%		1.995
0.0%	minimum	-1

Summary Statistics	
Mean	7.3787575
Std Dev	1.7366281
Std Err Mean	0.054972
Upper 95% Mean	7.4866316
Lower 95% Mean	7.2708834
N	998

Distributions IND= 1006-2

HARD



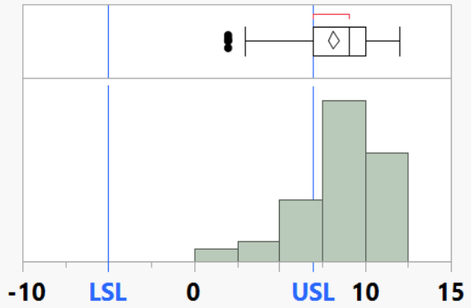
Quantiles		
100.0%	maximum	12
99.5%		11.67
97.5%		10
90.0%		9
75.0%	quartile	8
50.0%	median	8
25.0%	quartile	7
10.0%		6
2.5%		4
0.5%		1
0.0%	minimum	1

Summary Statistics	
Mean	7.511828
Std Dev	1.616313
Std Err Mean	0.0749547
Upper 95% Mean	7.6591207
Lower 95% Mean	7.3645352
N	465

- SL107

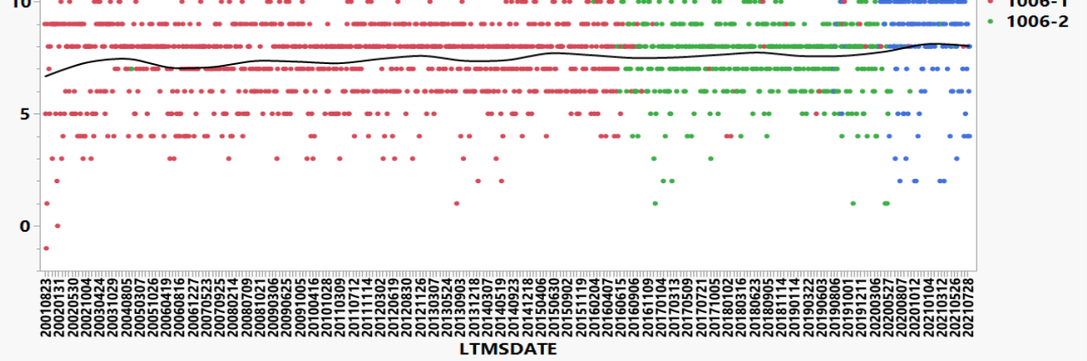
Distributions IND= SL107

HARD



Quantiles		
100.0%	maximum	12
99.5%		12
97.5%		11
90.0%		10
75.0%	quartile	10
50.0%	median	9
25.0%	quartile	7
10.0%		5
2.5%		2
0.5%		2
0.0%	minimum	2

Summary Statistics	
Mean	8.1707317
Std Dev	2.1410672
Std Err Mean	0.1671893
Upper 95% Mean	8.5008677
Lower 95% Mean	7.8405957
N	164



Chevron Oronite

ADDING UP

TENS (+10, -TMC 1006)

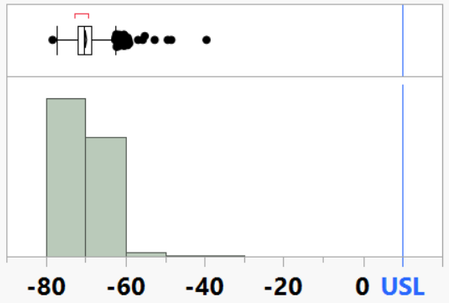
Proposed Spec Limit (+10, -TMC 1006 or -76 or –SL107+3)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

TENS

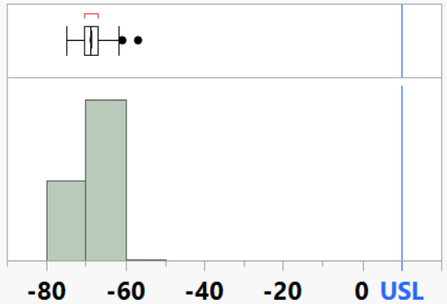


Quantiles		
100.0%	maximum	-39.5
99.5%		-55.0875
97.5%		-61.6975
90.0%		-65.89
75.0%	quartile	-68.4
50.0%	median	-70.5
25.0%	quartile	-72.2
10.0%		-73.3
2.5%		-74.8
0.5%		-76.202
0.0%	minimum	-78.4

Summary Statistics	
Mean	-69.95271
Std Dev	3.4052599
Std Err Mean	0.1077916
Upper 95% Mean	-69.74118
Lower 95% Mean	-70.16423
N	998

Distributions IND= 1006-2

TENS



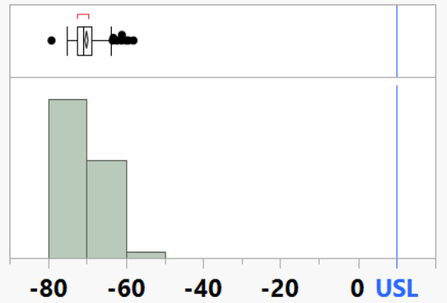
Quantiles		
100.0%	maximum	-56.8
99.5%		-61.097
97.5%		-62.6
90.0%		-65.4
75.0%	quartile	-66.95
50.0%	median	-68.9
25.0%	quartile	-70.7
10.0%		-71.9
2.5%		-73
0.5%		-73.801
0.0%	minimum	-74.9

Summary Statistics	
Mean	-68.68882
Std Dev	2.6152742
Std Err Mean	0.1212804
Upper 95% Mean	-68.45049
Lower 95% Mean	-68.92714
N	465

- SL107

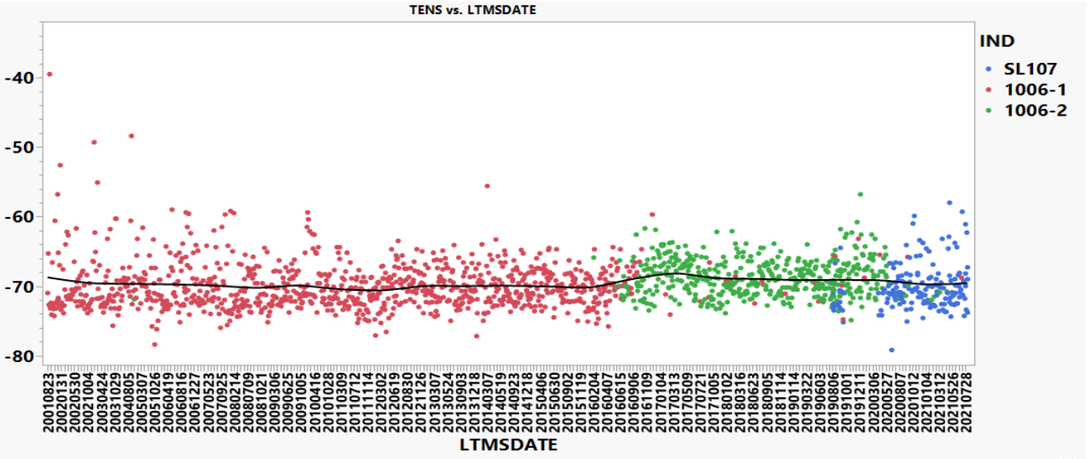
Distributions IND= SL107

TENS



Quantiles		
100.0%	maximum	-58
99.5%		-58
97.5%		-61.0125
90.0%		-64.8
75.0%	quartile	-68.925
50.0%	median	-70.9
25.0%	quartile	-72.375
10.0%		-73.4
2.5%		-74.575
0.5%		-79.2
0.0%	minimum	-79.2

Summary Statistics	
Mean	-70.0878
Std Dev	3.302514
Std Err Mean	0.257883
Upper 95% Mean	-69.57858
Lower 95% Mean	-70.59703
N	164



Chevron Oronite

ADDING UP

ELON (+10, -TMC 1006)

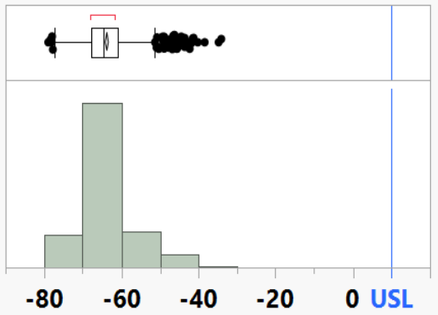
Proposed Spec Limit (+10, -TMC 1006 or -77 or –SL107+3)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

ELON

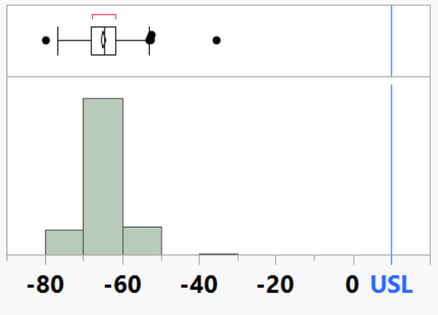


Quantiles		
100.0%	maximum	-34.1
99.5%		-41.195
97.5%		-45.8925
90.0%		-55.89
75.0%	quartile	-61.2
50.0%	median	-64.5
25.0%	quartile	-67.7
10.0%		-70.71
2.5%		-74.5
0.5%		-77.801
0.0%	minimum	-79

Summary Statistics	
Mean	-63.73206
Std Dev	6.528631
Std Err Mean	0.2066602
Upper 95% Mean	-63.32653
Lower 95% Mean	-64.1376
N	998

Distributions IND= 1006-2

ELON



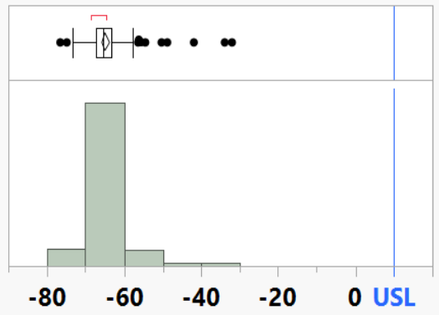
Quantiles		
100.0%	maximum	-35.4
99.5%		-52.366
97.5%		-54.825
90.0%		-59.06
75.0%	quartile	-62
50.0%	median	-64.7
25.0%	quartile	-68
10.0%		-70.54
2.5%		-74.1
0.5%		-76.8
0.0%	minimum	-79.8

Summary Statistics	
Mean	-64.79054
Std Dev	4.722091
Std Err Mean	0.2189817
Upper 95% Mean	-64.36022
Lower 95% Mean	-65.22086
N	465

- SL107

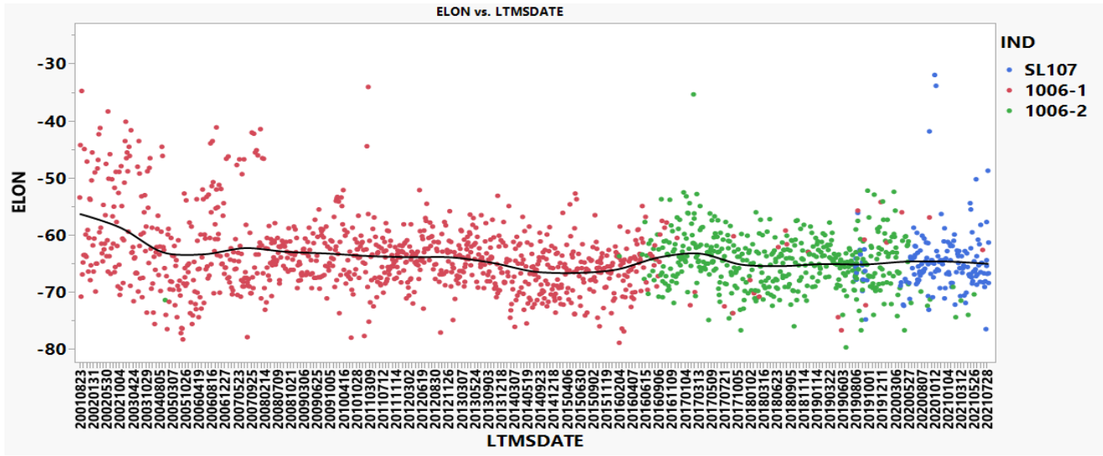
Distributions IND= SL107

ELON



Quantiles		
100.0%	maximum	-32
99.5%		-32
97.5%		-48.9875
90.0%		-60.1
75.0%	quartile	-63.225
50.0%	median	-65.45
25.0%	quartile	-67.5
10.0%		-69.4
2.5%		-72.475
0.5%		-76.6
0.0%	minimum	-76.6

Summary Statistics	
Mean	-64.78598
Std Dev	5.6138729
Std Err Mean	0.4383698
Upper 95% Mean	-63.92036
Lower 95% Mean	-65.65159
N	164



Chevron Oronite

ADDING UP

Vamac G

Chevron Oronite

ADDING UP®

VOLC (+TMC 1006, -3)

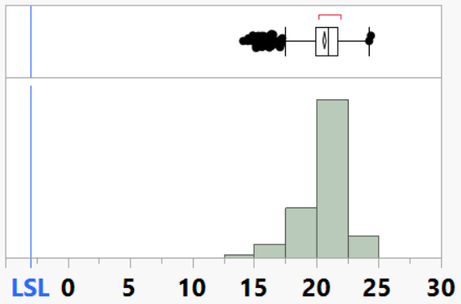
Proposed Spec Limit (+TMC 1006 or +25 or +SL107+2, -3)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

VOLC

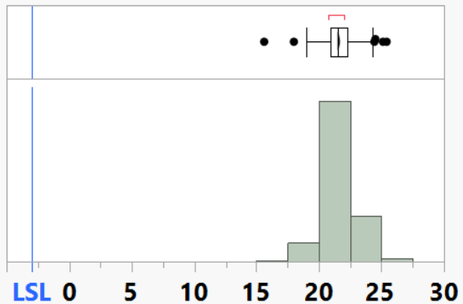


Quantiles		
100.0%	maximum	24.38
99.5%		23.9716
97.5%		23.2855
90.0%		22.446
75.0%	quartile	21.63
50.0%	median	20.84
25.0%	quartile	19.905
10.0%		18.804
2.5%		15.774
0.5%		14.6547
0.0%	minimum	14.11

Summary Statistics	
Mean	20.626999
Std Dev	1.6729995
Std Err Mean	0.0586747
Upper 95% Mean	20.742171
Lower 95% Mean	20.511827
N	813

Distributions IND= 1006-2

VOLC



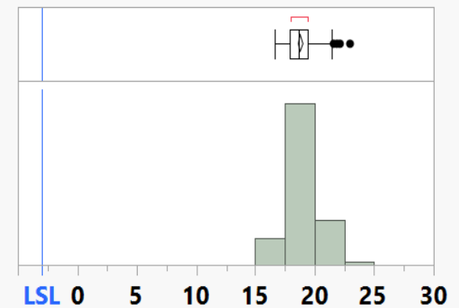
Quantiles		
100.0%	maximum	25.42
99.5%		25.1449
97.5%		24.15
90.0%		23.039
75.0%	quartile	22.295
50.0%	median	21.49
25.0%	quartile	20.88
10.0%		20.195
2.5%		19.4275
0.5%		18.24245
0.0%	minimum	15.61

Summary Statistics	
Mean	21.579956
Std Dev	1.1699691
Std Err Mean	0.0551529
Upper 95% Mean	21.688345
Lower 95% Mean	21.471566
N	450

- SL107

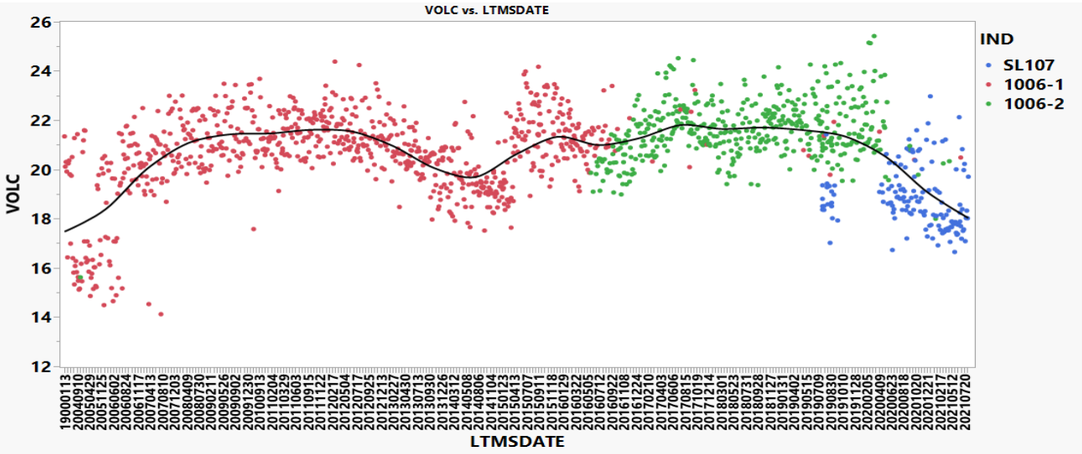
Distributions IND= SL107

VOLC



Quantiles		
100.0%	maximum	22.97
99.5%		22.97
97.5%		21.667
90.0%		20.801
75.0%	quartile	19.3475
50.0%	median	18.62
25.0%	quartile	17.88
10.0%		17.447
2.5%		16.9825
0.5%		16.64
0.0%	minimum	16.64

Summary Statistics	
Mean	18.816419
Std Dev	1.2399216
Std Err Mean	0.1019209
Upper 95% Mean	19.017838
Lower 95% Mean	18.614999
N	148



Chevron Oronite

ADDING UP

HARD (+5, -TMC 1006)

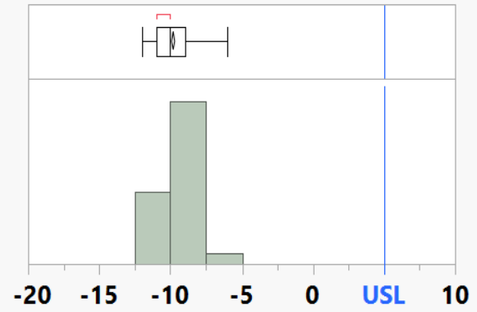
Proposed Spec Limit (+5, -TMC 1006 or -14 or –SL107-2)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

HARD

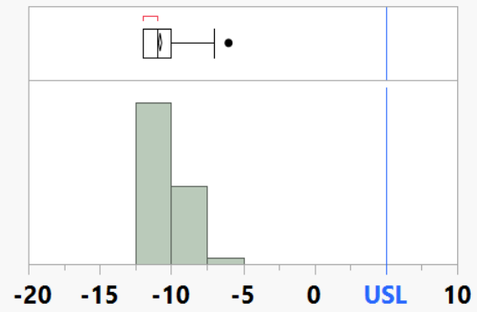


Quantiles		
100.0%	maximum	-6
99.5%		-6
97.5%		-7
90.0%		-8
75.0%	quartile	-9
50.0%	median	-10
25.0%	quartile	-11
10.0%		-12
2.5%		-12
0.5%		-12
0.0%	minimum	-12

Summary Statistics	
Mean	-9.832718
Std Dev	1.332268
Std Err Mean	0.0467247
Upper 95% Mean	-9.741003
Lower 95% Mean	-9.924434
N	813

Distributions IND= 1006-2

HARD



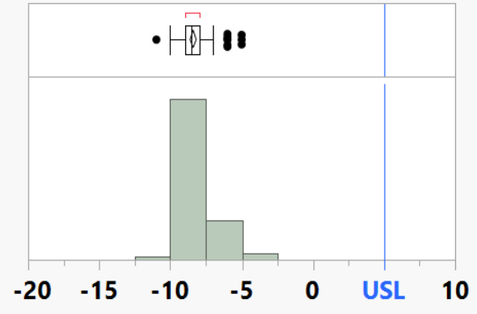
Quantiles		
100.0%	maximum	-6
99.5%		-7
97.5%		-8
90.0%		-9
75.0%	quartile	-10
50.0%	median	-11
25.0%	quartile	-12
10.0%		-12
2.5%		-12
0.5%		-12
0.0%	minimum	-12

Summary Statistics	
Mean	-10.76222
Std Dev	1.2156714
Std Err Mean	0.0573073
Upper 95% Mean	-10.6496
Lower 95% Mean	-10.87485
N	450

- SL107

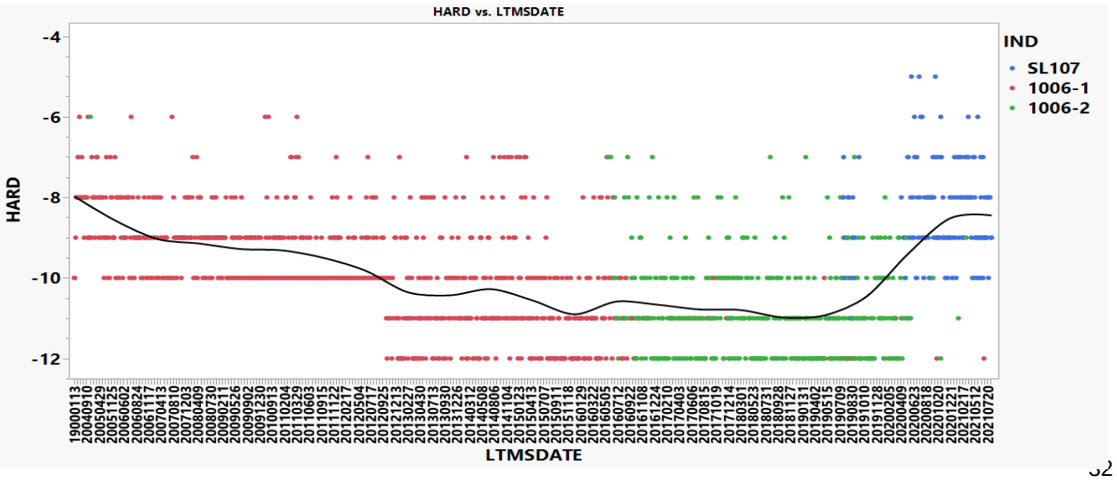
Distributions IND= SL107

HARD



Quantiles		
100.0%	maximum	-5
99.5%		-5
97.5%		-5.725
90.0%		-7
75.0%	quartile	-8
50.0%	median	-8.5
25.0%	quartile	-9
10.0%		-10
2.5%		-10
0.5%		-11
0.0%	minimum	-11

Summary Statistics	
Mean	-8.385135
Std Dev	1.1810502
Std Err Mean	0.0970817
Upper 95% Mean	-8.193279
Lower 95% Mean	-8.576991
N	148



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ADDING UP

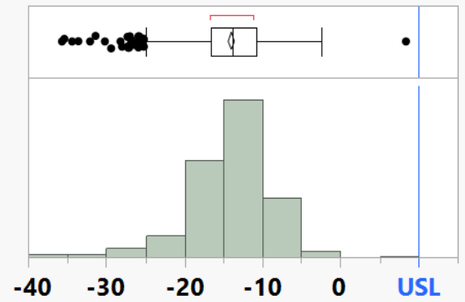
TENS (+10, -TMC 1006)
Proposed Spec Limit (+10, -TMC 1006 or -24 or –SL107-2)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

TENS

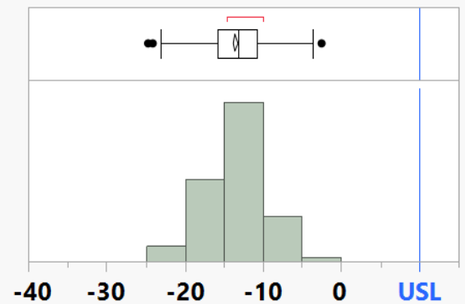


Quantiles		
100.0%	maximum	8.4
99.5%		-3.707
97.5%		-5.8
90.0%		-8.4
75.0%	quartile	-10.8
50.0%	median	-13.7
25.0%	quartile	-16.5
10.0%		-19.8
2.5%		-25.865
0.5%		-33.495
0.0%	minimum	-35.7

Summary Statistics	
Mean	-13.98905
Std Dev	4.8591583
Std Err Mean	0.1704181
Upper 95% Mean	-13.65454
Lower 95% Mean	-14.32356
N	813

Distributions IND= 1006-2

TENS



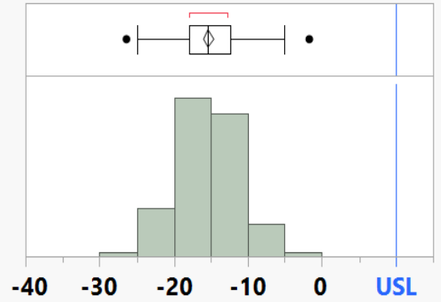
Quantiles		
100.0%	maximum	-2.5
99.5%		-3.7785
97.5%		-6.6825
90.0%		-9
75.0%	quartile	-10.9
50.0%	median	-13.2
25.0%	quartile	-15.825
10.0%		-18.49
2.5%		-21.3725
0.5%		-23.845
0.0%	minimum	-24.7

Summary Statistics	
Mean	-13.49778
Std Dev	3.7078914
Std Err Mean	0.1747917
Upper 95% Mean	-13.15427
Lower 95% Mean	-13.84129
N	450

- SL107

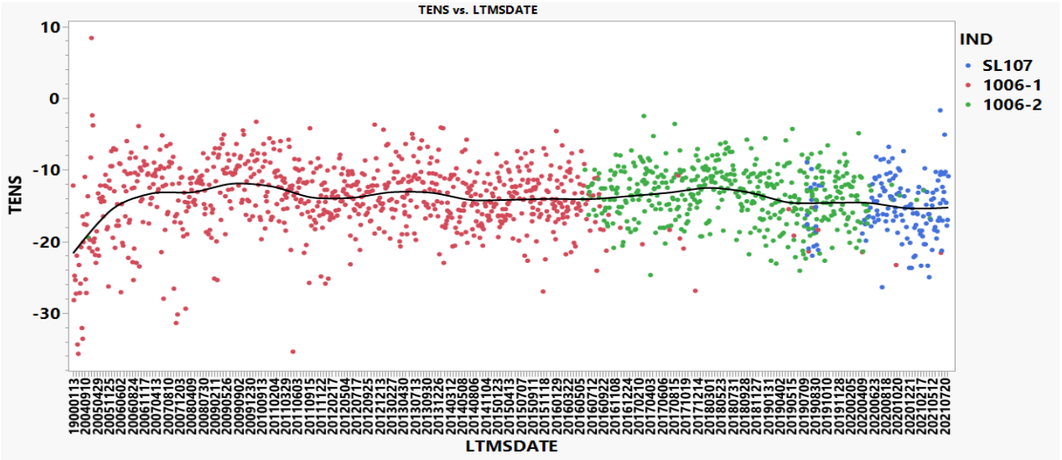
Distributions IND= SL107

TENS



Quantiles		
100.0%	maximum	-1.7
99.5%		-1.7
97.5%		-7.235
90.0%		-10.28
75.0%	quartile	-12.5
50.0%	median	-15.4
25.0%	quartile	-17.9
10.0%		-20.52
2.5%		-23.7
0.5%		-26.4
0.0%	minimum	-26.4

Summary Statistics	
Mean	-15.29257
Std Dev	4.1356932
Std Err Mean	0.3399519
Upper 95% Mean	-14.62074
Lower 95% Mean	-15.96439
N	148



Chevron Oronite

ADDING UP

ELON (+10, -TMC 1006)

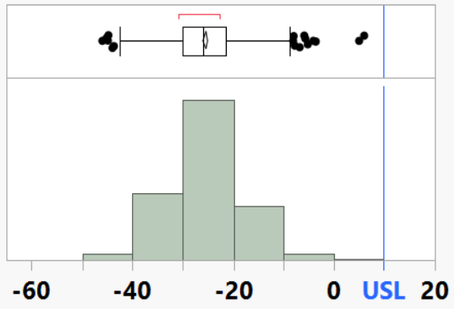
Proposed Spec Limit (+10, -TMC 1006 or -40 or –SL107+14)

Current Option 1 Option 2

- TMC 1006

Distributions IND= 1006-1

ELON

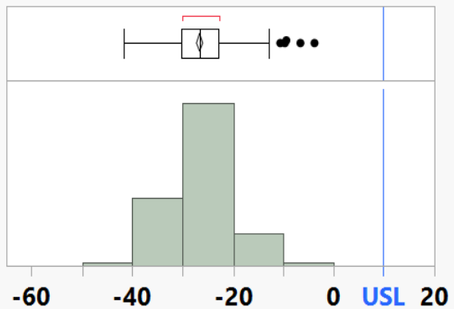


Quantiles		
100.0%	maximum	6
99.5%		-4.177
97.5%		-10.935
90.0%		-16
75.0%	quartile	-21.4
50.0%	median	-25.9
25.0%	quartile	-29.95
10.0%		-33.8
2.5%		-39.93
0.5%		-44.744
0.0%	minimum	-46

Summary Statistics	
Mean	-25.4599
Std Dev	7.1111559
Std Err Mean	0.2493991
Upper 95% Mean	-24.97036
Lower 95% Mean	-25.94944
N	813

Distributions IND= 1006-2

ELON



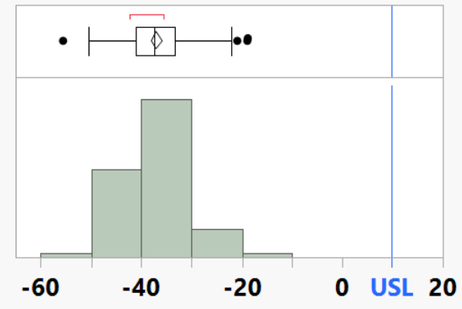
Quantiles		
100.0%	maximum	-3.8
99.5%		-7.314
97.5%		-14.455
90.0%		-19
75.0%	quartile	-22.9
50.0%	median	-26.6
25.0%	quartile	-30.4
10.0%		-34.98
2.5%		-39.1175
0.5%		-40.7725
0.0%	minimum	-41.6

Summary Statistics	
Mean	-26.64178
Std Dev	6.0379488
Std Err Mean	0.2846316
Upper 95% Mean	-26.0824
Lower 95% Mean	-27.20115
N	450

- SL107

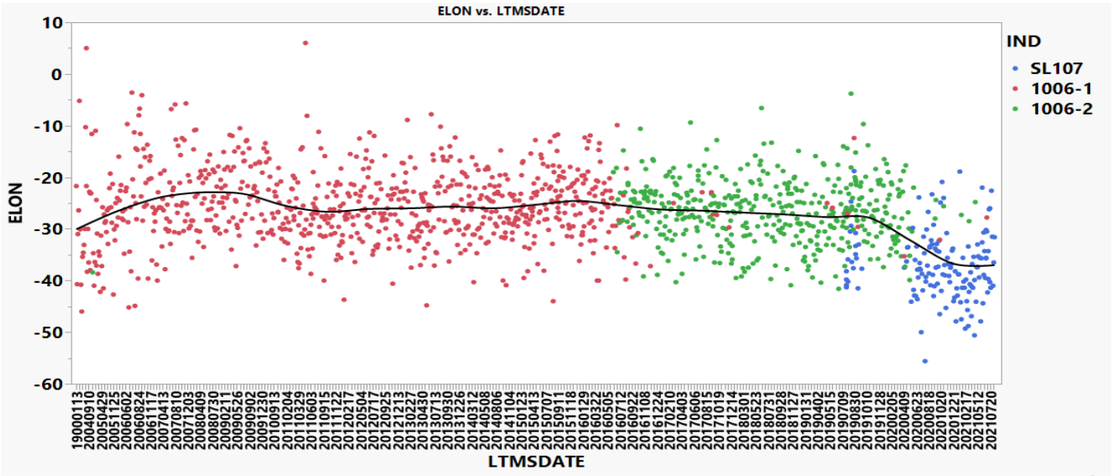
Distributions IND= SL107

ELON



Quantiles		
100.0%	maximum	-18.8
99.5%		-18.8
97.5%		-21.6975
90.0%		-29.38
75.0%	quartile	-33.425
50.0%	median	-37.5
25.0%	quartile	-41.1
10.0%		-44.11
2.5%		-49.4925
0.5%		-55.6
0.0%	minimum	-55.6

Summary Statistics	
Mean	-37.03649
Std Dev	6.4416919
Std Err Mean	0.5295038
Upper 95% Mean	-35.99006
Lower 95% Mean	-38.08291
N	148



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ADDING UP

After discussion will someone make a motion to accept:
Option 1 Fixed Limits
or
Option 2 Variable Limits
or
Propose another option
As a path forward for HD elastomer testing

Thank you

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ADDING UP®