Report of Meeting
L-37-1 Surveillance Panel Conference Call
May 10th , 2023

Attendees:

SwRI -	**Mueller**
Lubrizol -	Venhoff, **Schaup**, Drjla, Ariemma
Afton -	**Sangpeal,** Bell
Intertek -	**Lange,** Portell
TMC -	**Beck**
BASF -	**Goyal,** Caridi
Dana -	**Zyski,** Carr
Cummins-Meritor -	LaBond, **Carter**
Army -	Sattler, **Comfort**
AAM -	**Muransky,** Zarins
Navistar -	Morris
Daimler -	Neal
Fuchs -	Bender, Yucebligic

Voting Members in **BOLD**

1.0 Membership Review

Update last name Louis to Mueller

2.0 Meeting minutes Approval

– February 10th, 2023, ASTM Meeting #208

Motion #1 → Troy Muransky 1st /2nd Wes Venhoff to approve the meeting minutes from the Febuary 10th, 2023, ASTM Meeting. Motion passed unanimously, 11-0-0 (Yes-No-Abstain).

3.0 L-37-1 MnP Coating inspection

- Gears were inspected at Dana and everything was nominal.

4.0 MnP Coated batch Rating Activity

- Removing coating was not deemed useful by raters during the rating activity in March.
- Convergence of ratings was deemed to be due to discussion that occurred between the original ratings and the stripping of the coating.
- A new “version” of rippling was identified.

5.0 Stats group recommendations on 2022 Coated Hardware

- Stats group was hesitant to recommend anything as there is no way to understand the shift that the Rating activity may have on the test moving forward.

6.0 2022 coated hardware approval

- Motion # 2 → **2022 coated hardware approved unanimously, see appendix for motion.**

7.0 Old Business

8.0 New Business

- Nick Schaup to reach out to DANA with an RFQ for new hardware.
- Nick Schaup to continue to look for new hardware options.

9.0 Adjourn

Motion #3 → Caroline Mueller1st /2nd Matt Sangpleal to adjourn. Motion passed unanimously, 11-0-0 (Yes-No-Abstain).

Respectfully submitted,

Nick Schaup
L-37-1 Surveillance Panel Chairman

D02.B0.03

L-37-1 Surveillance Panel Meeting

05/10/2023
15:00 pm – 16:00 pm
Nick Schaup

- Call to Order/Agenda review
- Meeting Minute Approvals
- February 8th, 2023, ASTM Meeting
- Coating Inspection
- Coated hardware rating activity
- Dana Vs Gleason Ripp
- Stats Group Recommendation (MnP)
- MnP Coated batch approval?
- Membership Review
- Old Business
  - ?
- New business
- Adjournment

Meeting Minutes Approval

- February 9th , 2023, ASTM Meeting

Manganese Phosphate Coating Inspection

5/10/23
Coating Applicator: Custom Coatings
Gearset received from Southwest Research Institute Stock

Value Others | Inspire Innovation | Grow Responsibly | Win Together

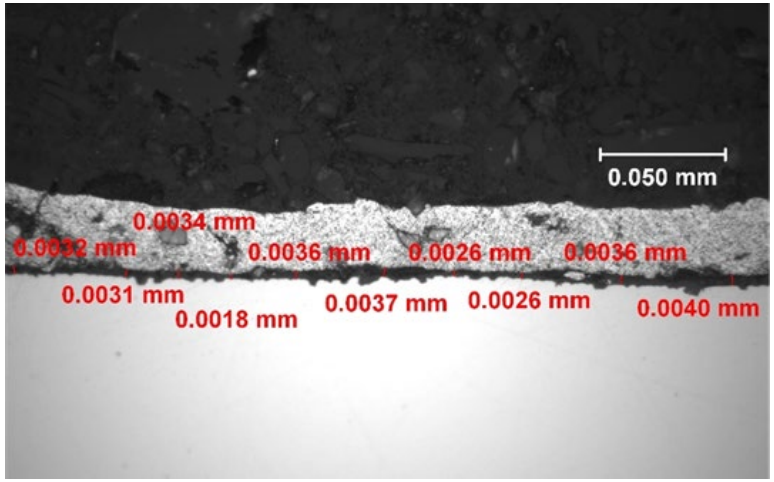
Manganese Phosphate Coating Inspection

Steel Chemistry (SAE 8620)

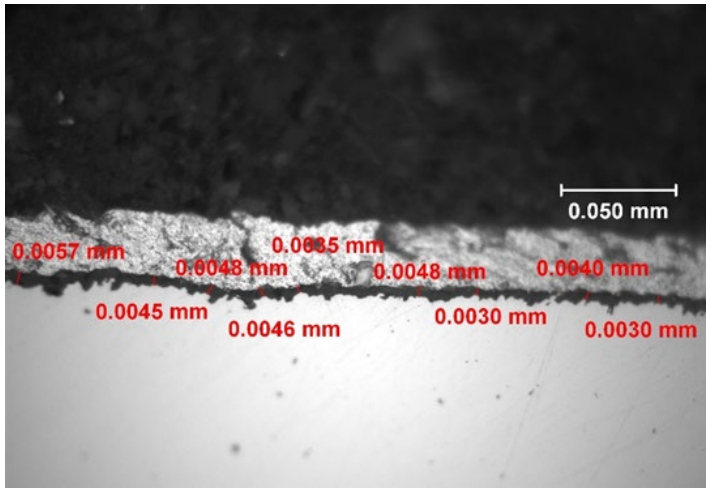
Element %	Ring	Pinion	SAE 8620
Carbon	0.22	0.20	0.18 - 0.23
Manganese	0.88	0.85	0.70 - 0.90
Phosphorous	0.009	0.011	0.030 max
Sulfur	0.014	0.014	0.040 max
Silicon	0.28	0.32	0.15-0.35
Nickel	0.44	0.43	0.40 - 0.70
Chromium	0.55	0.51	0.40 - 0.60
Molybdenum	0.21	0.19	0.15 - 0.25
Copper	0.21	0.25	-
Aluminum	0.032	0.032	-
Tin	0.015	0.012	-
Vanadium	0.003	0.003	-
Niobium	0.001	0.001	-
Zirconium	0.001	0.001	-
Boron	0.0002	0.0001	-
Titanium	0.001	0.001	-
Lead	0.000	0.000	-
Calcium	0.000	0.000	-
Nitrogen	0.007	0.007	-
Arsenic	0.006	0.005	-
Zinc	0.002	0.002	-
Antimony	0.000	0.000	-

Manganese Phosphate Coating Inspection

Ring Gear Average Thickness: 2.2 microns



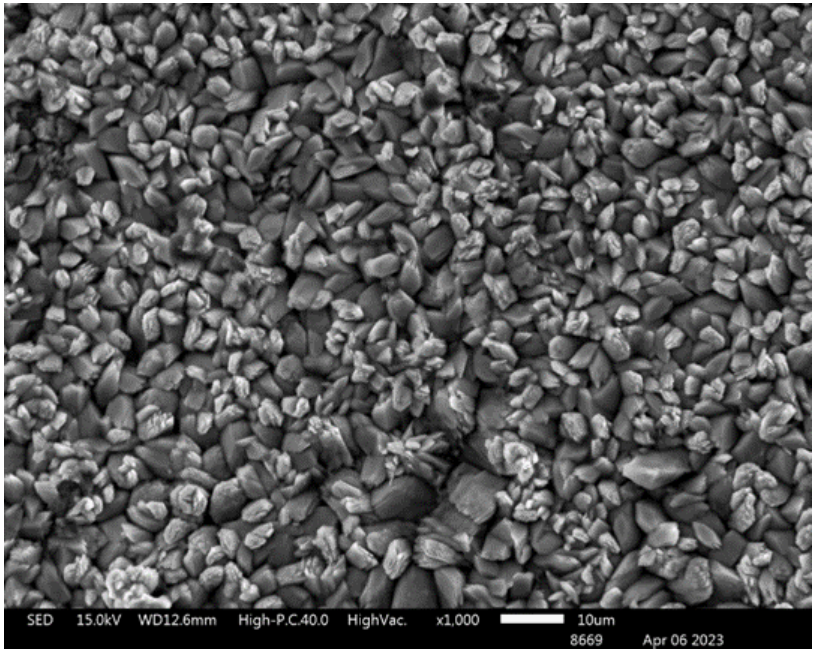
Pinion Gear Average Thickness: 2.7 microns



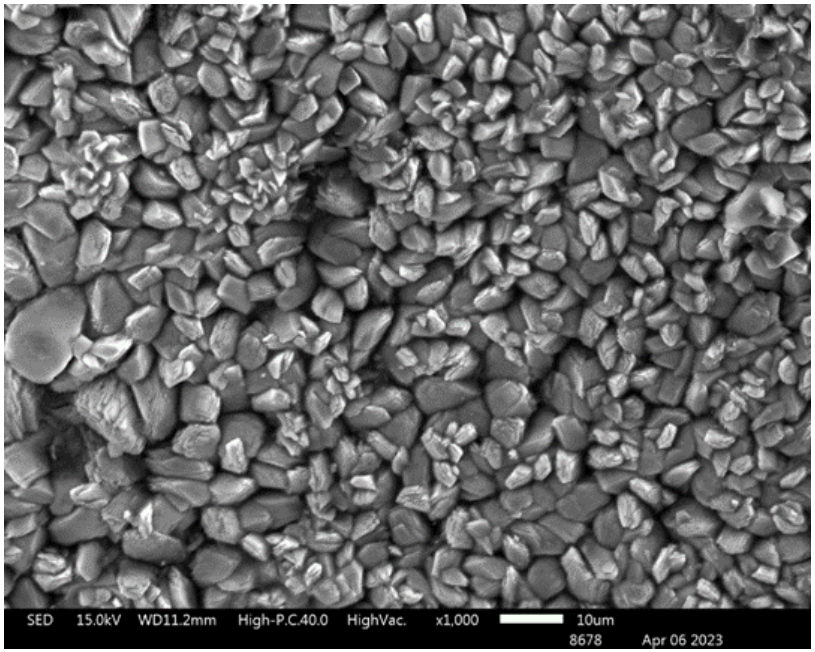
- Cross-section wrapped with aluminum foil for contrast

Manganese Phosphate Coating Inspection

Ring Gear Average Crystal Size: 4.5 microns

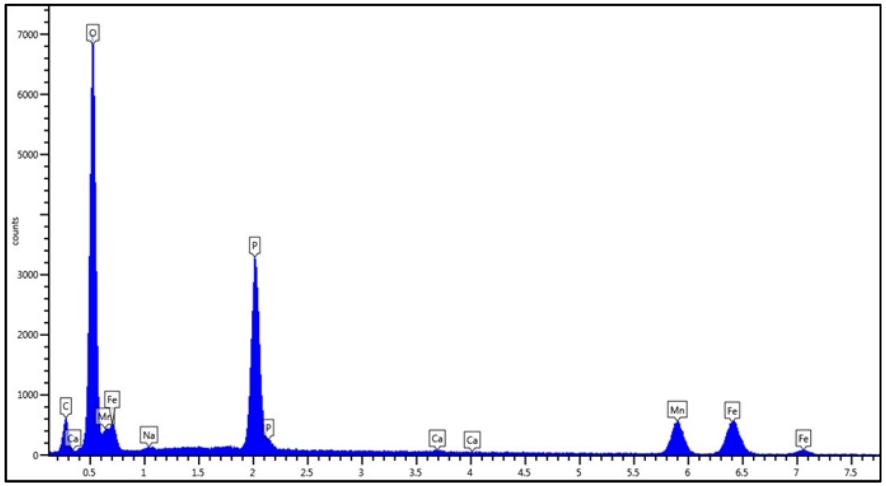


Pinion Gear Average Crystal Size: 3.5 microns

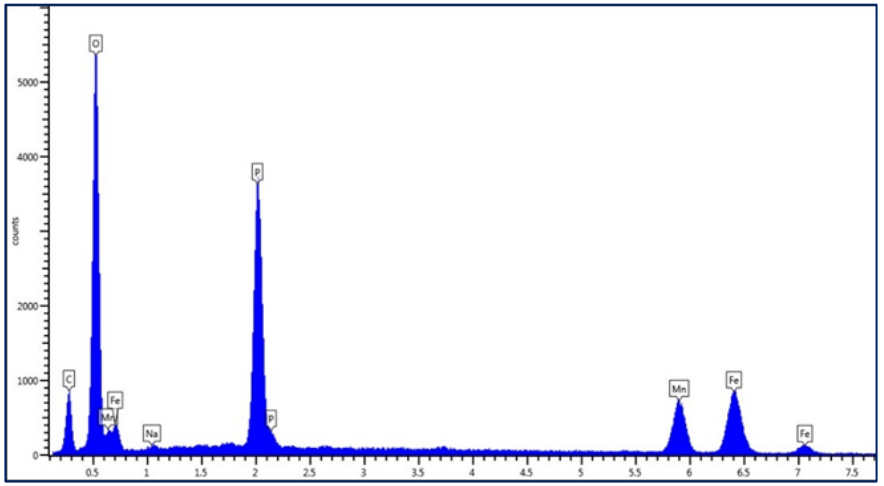


Manganese Phosphate Coating Inspection

Ring Gear Coating Chemistry



Pinion Gear Coating Chemistry

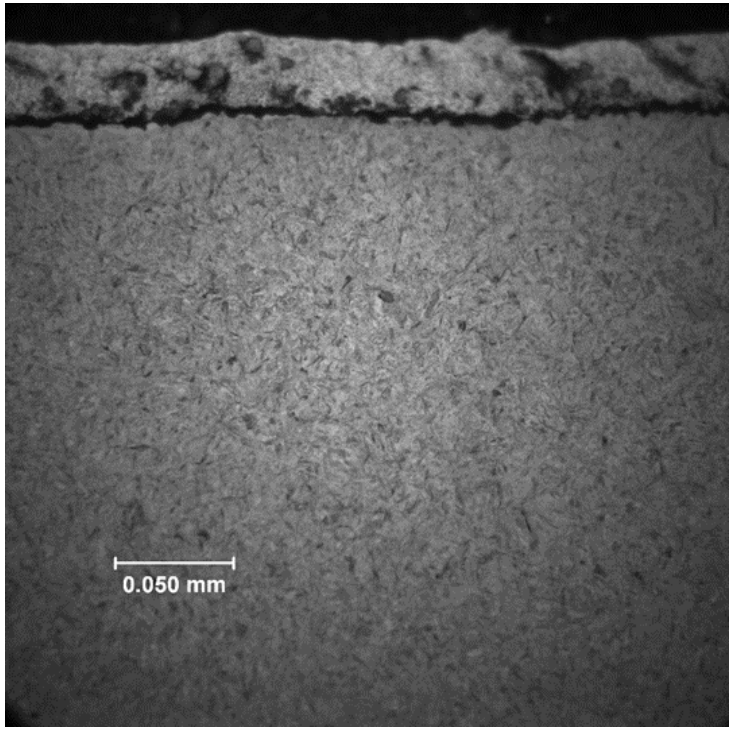


- Chemistry collected using energy dispersive spectroscopy (EDS)

Manganese Phosphate Coating Inspection

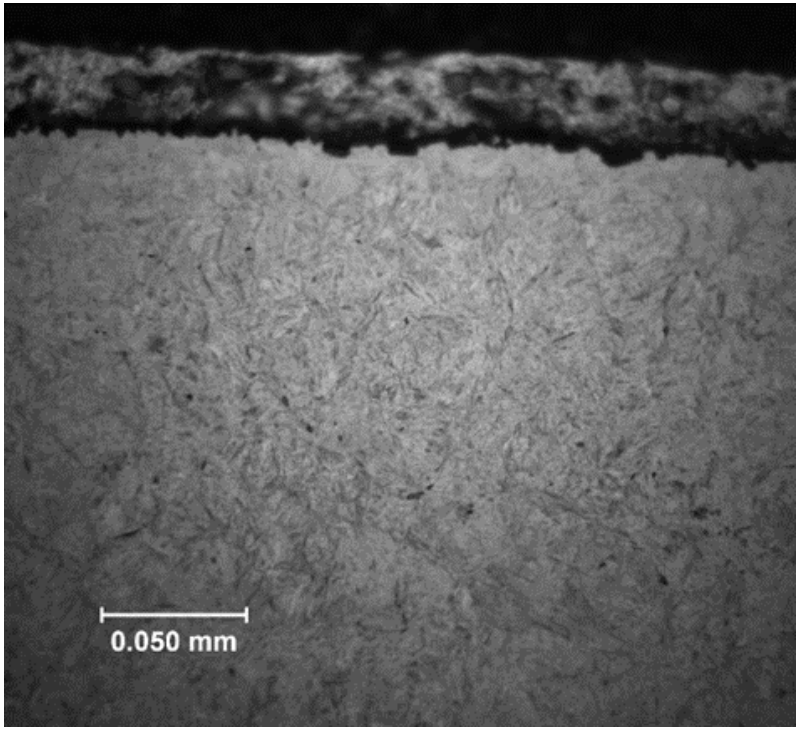
Ring Gear Pitting

No excessive pitting noted



Pinion Gear Pitting

No excessive pitting noted



- Cross-section wrapped with aluminum foil for contrast

L-37-1 March 2023 MnP Coated Rating Activity

May 10, 2023

Hardware Update Summary

- Post February 2023 Meeting:
  - Panel saw concerns with L-37-1 rating of MnP Coated hardware due to results of round robin experiment conducted in December 2022/January 2023.
  - Inconsistency with RIPP on this new hardware. An investigation during the January 2023 gear rating workshop indicated that the MnP coating could be impacting the ratings
  - An additional rating activity took place in March 2023 to explore if stripping this coating improved the rating process.

Results of March 2023 Rating Activity

- A rating activity was conducted in March 2023 to determine if removing the MnP coating before rating a pinion was beneficial.
  - A rater from each of the four test labs was present
  - Day 1 of the activity involved all raters rating the parts, parts were stripped after, then stripped parts were re-rated on day 2.

Results of March 2023 Rating Activity

- Ratings were compared between day 1 and day 2 rating activities
- Day 2 results were slightly more severe than day 1 and standard deviations were tighter than day 1 data.

- The consensus from the raters was that this shift was not due to the removal of the MnP coating
- **The group agreed that removing the MnP coating was not beneficial for rating.**

- The shift between day 1 and day 2 was more likely due to raters adjusting after the group discussion held after the day 1 activity.

Results of March 2023 Rating Activity

- During a group discussion, the raters determined that there was a new surface distress that was causing disagreement if it should be considered rippling.

- The current rating aids (Manual 21) were developed using the previous L-37 Dana hardware. The distress being seen on the new Gleason hardware does not completely agree with what is being shown in the rating aids.

Results of March 2023 Rating Activity

- While a goal of this rating activity was to determine if stripping the MnP coating would be beneficial, another goal was to determine the cause of the variability seen in RIPP ratings noticed during the previous round robin exercises.

- There was still a great deal of benefit in holding this activity and the rater group discussions.

Results of March 2023 Rating Activity

Path Forward:

- Two pinions with this questionable RIPP distress are to be sent to LRI reviewers to determine the level of concern.
- At future gear rating workshops, continue rating activities and discussions with Gleason parts.
- If Gleason will be the hardware supplier going forward, then the rating aids can be updated.

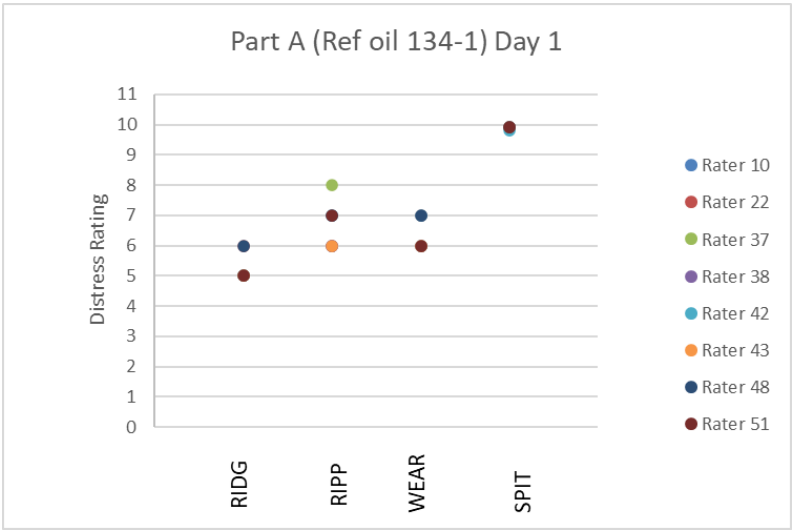
Results of March 2023 Rating Activity

A Program of ASTM International

Test Monitoring Center
203 Armstrong Drive, Freeport, PA 16229, USA
www.astmtmc.org
412-365-1000

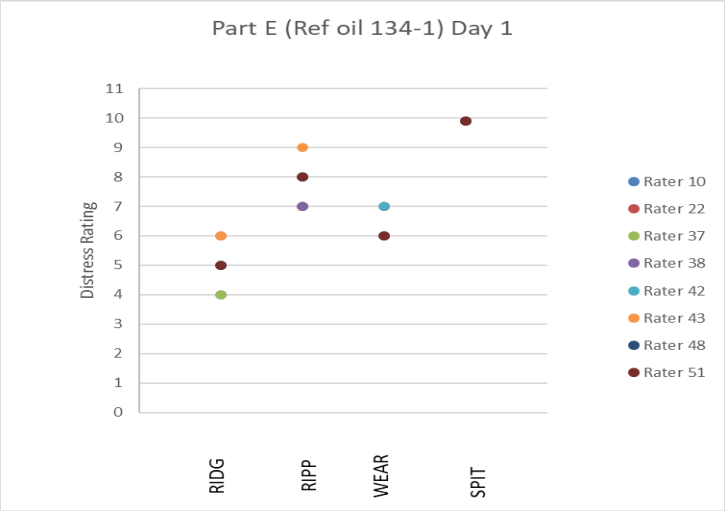
Test Monitoring Center
http://astmtmc.cmu.edu
A Program of ASTM International

Results of Rating Activity



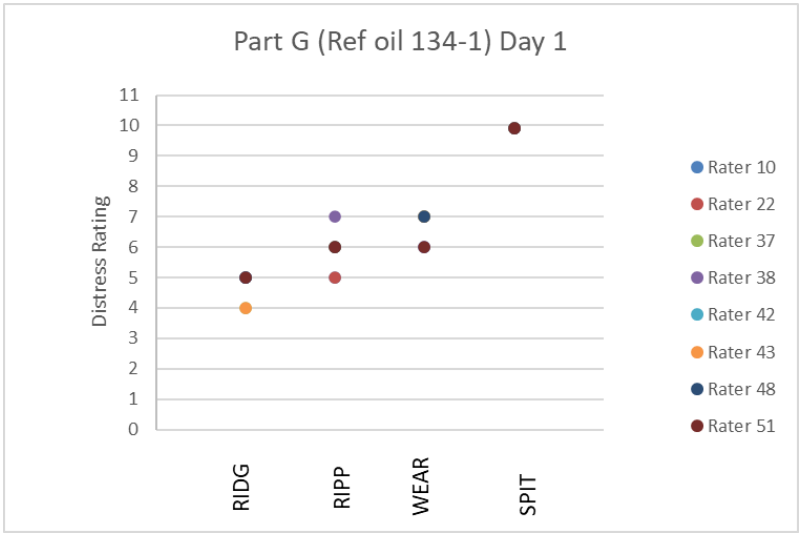
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
A	145422-L371	RIDG	5	5.25	0.463	5	Not Rated
		RIPP	6	6.63	0.744	7	
		WEAR	6	6.38	0.518	6	
		SPIT	9.9	9.89	0.035	9.9	

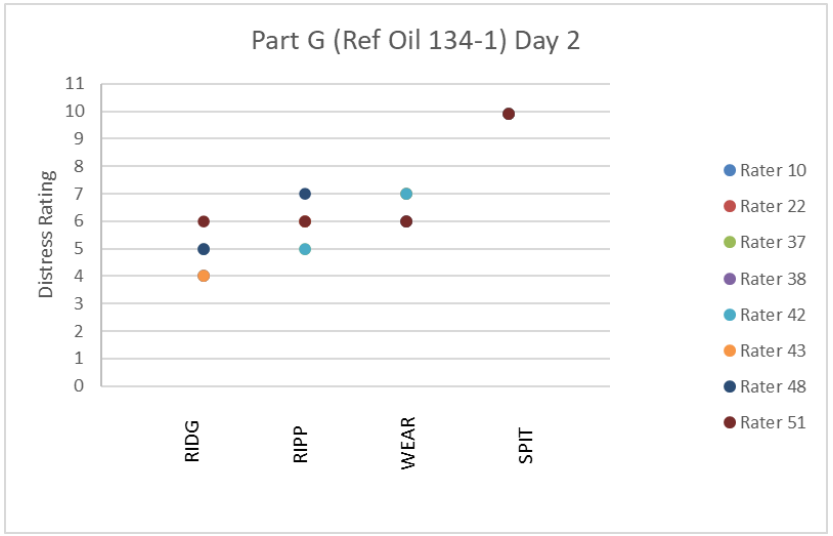
Results of Rating Activity



Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
E	149918-L7371	RIDG	5	5.00	0.756	5	Not Rated
		RIPP	8	7.75	0.707	8	
		WEAR	6	6.25	0.463	6	
		SPIT	9.9	9.9	0.000	9.9	

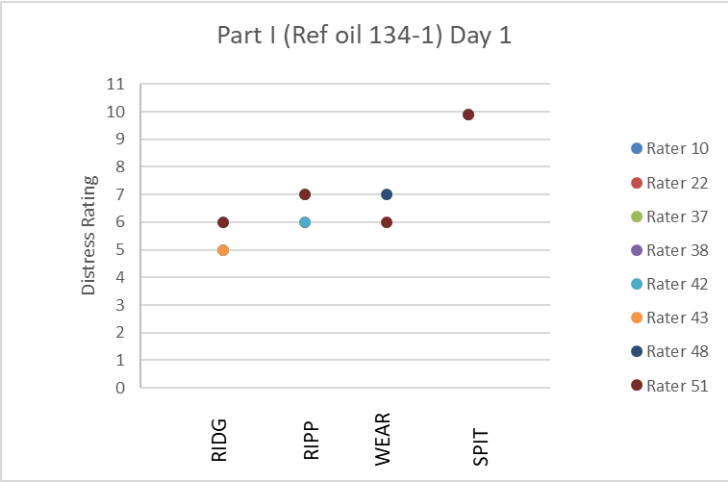
Results of Rating Activity





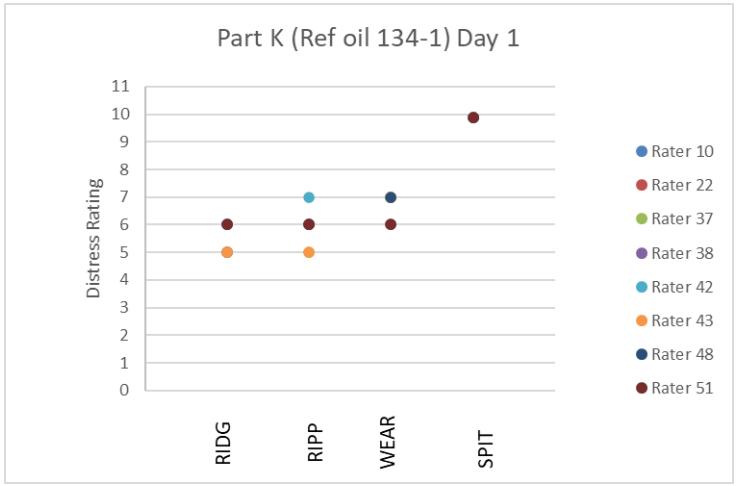
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Average	Day 2 std.	Day 2 Rounded Average
G	166124-L371	RIDG	5	4.75	0.463	5	4.63	0.744	5
		RIPP	5	5.875	0.641	6	5.88	0.641	6
		WEAR	7	6.625	0.518	7	6.38	0.518	6
		SPIT	9.9	9.9	0.000	9.9	9.90	0.000	9.9

Results of Rating Activity



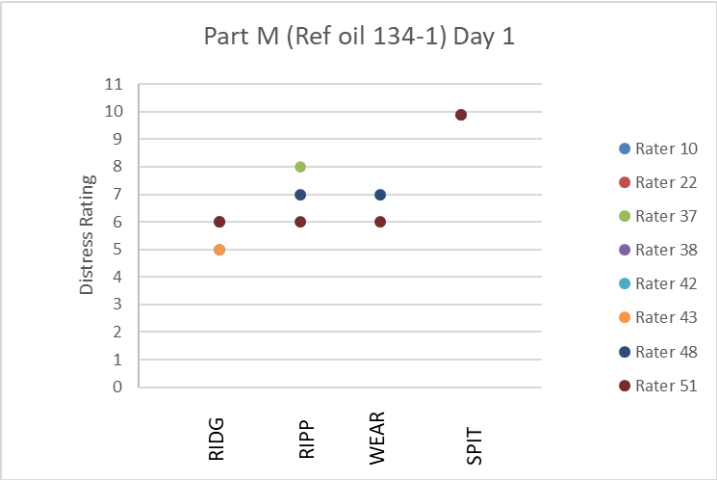
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
I	145421-L371	RIDG	5	5.38	0.518	5	Not Rated
		RIPP	6	6.63	0.518	7	
		WEAR	6	6.50	0.535	6	
		SPIT	9.9	9.90	0.000	9.9	

Results of Rating Activity



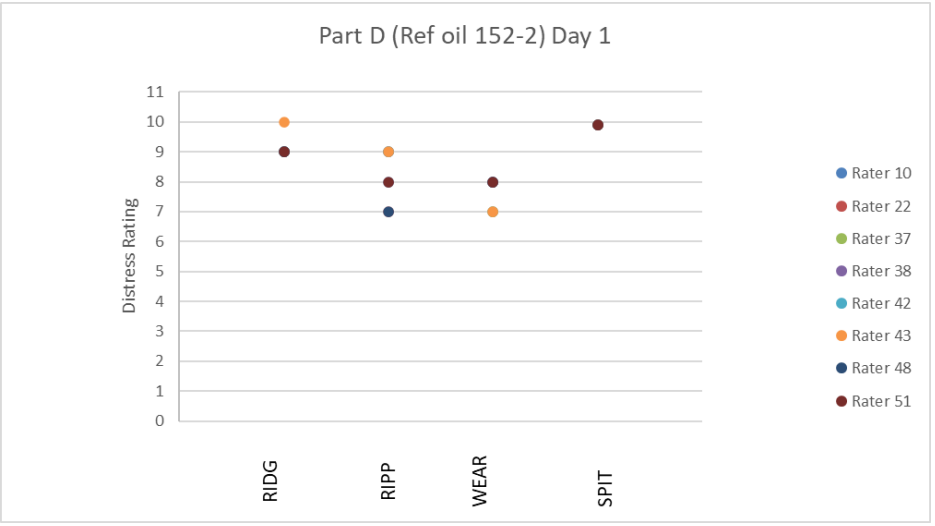
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
K	154666-L371	RIDG	6	5.50	0.535	6	Not Rated
		RIPP	6	5.88	0.641	6	
		WEAR	7	6.63	0.518	7	
		SPIT	9.9	9.90	0.000	9.9	

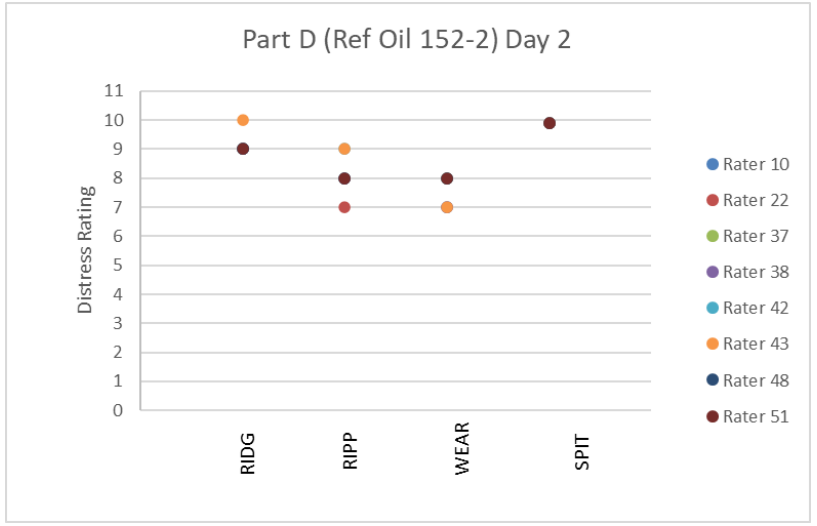
Results of Rating Activity



Rating ID	Testkey		Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
M	145432-L371	RIDG	5.63	0.518	6	Not Rated
		RIPP	6.75	0.707	7	
		WEAR	6.50	0.535	6	
		SPIT	9.90	0.000	9.9	

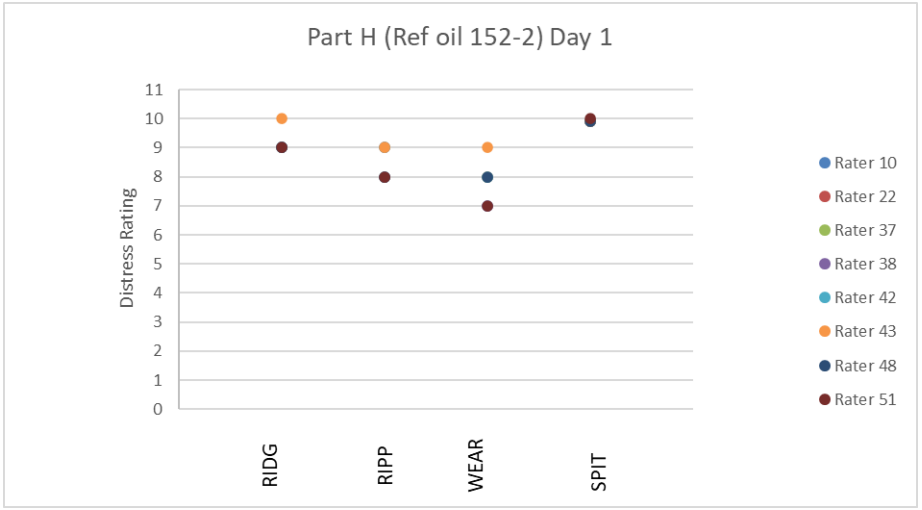
Results of Rating Activity





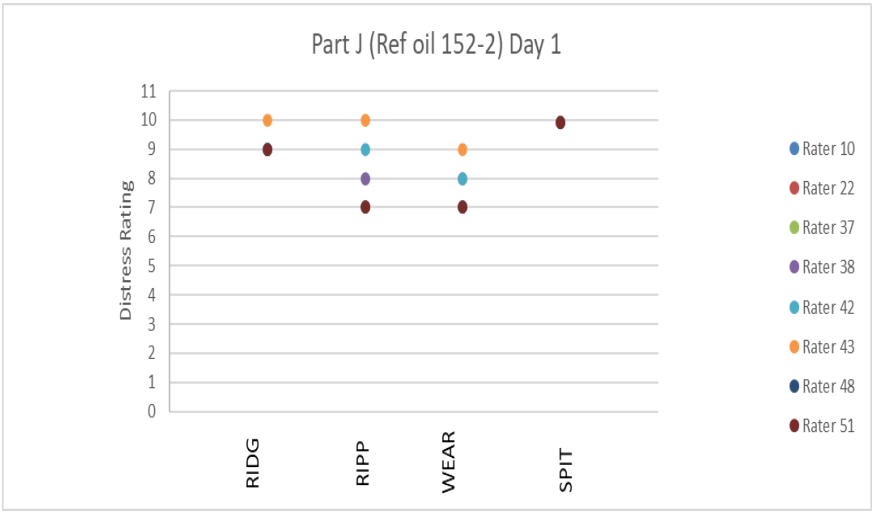
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Average	Day 2 std.	Day 2 Rounded Average
D	161097-L371	RIDG	9	9.13	0.35	9	9.13	0.354	9
		RIPP	8	8.13	0.83	8	8.13	0.641	8
		WEAR	7	7.50	0.53	8	7.63	0.518	8
		SPIT	9.9	9.90	0.00	9.9	9.90	0.000	9.9

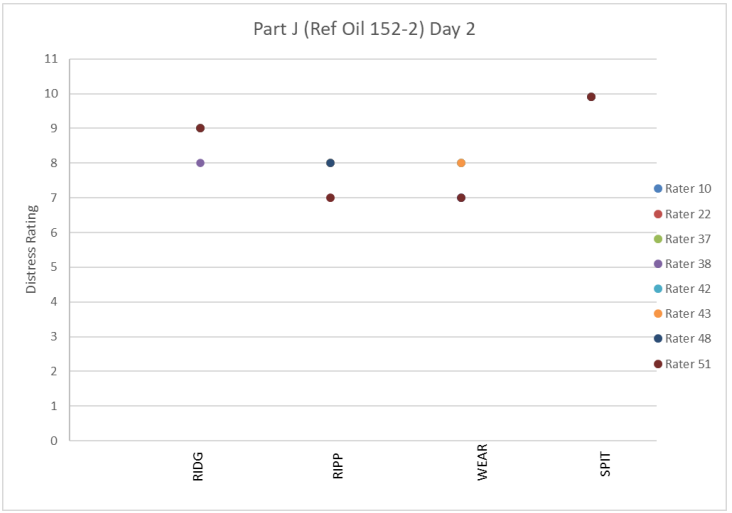
Results of Rating Activity



Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
H	156588-L371	RIDG	9	9.13	0.354	9	Not Rated
		RIPP	7	8.38	0.518	8	
		WEAR	8	7.75	0.707	8	
		SPIT	9.9	9.91	0.035	9.9	

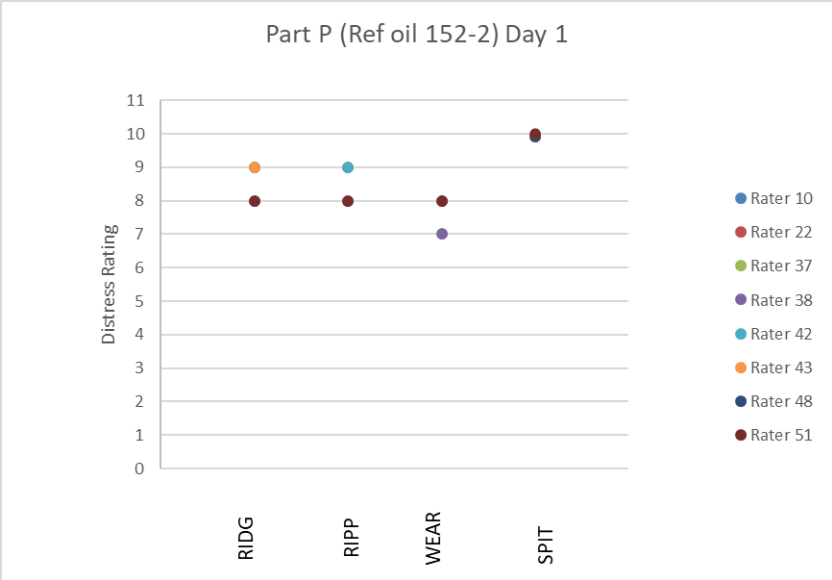
Results of Rating Activity





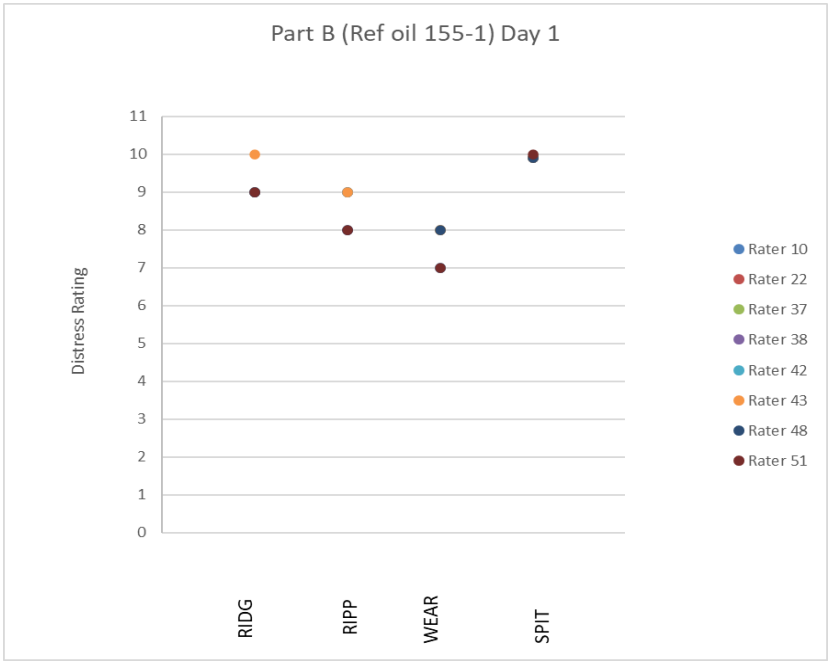
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Average	Day 2 std.	Day 2 Rounded Average
J	149926-L371	RIDG	9	9.13	0.354	9	8.88	0.354	9
		RIPP	8	7.88	1.126	8	7.63	0.518	8
		WEAR	8	7.50	0.756	8	7.50	0.535	8
		SPIT	9.9	9.90	0.000	9.9	9.90	0.000	9.9

Results of Rating Activity



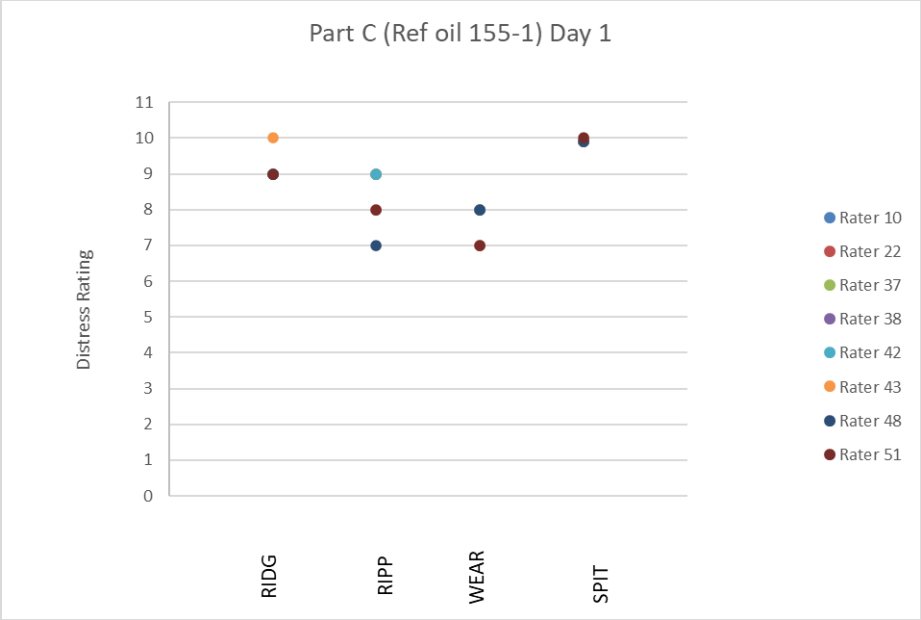
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
P	163284-L371	RIDG	9	8.63	0.518	9	Not Rated
		RIPP	10	8.50	0.535	8	
		WEAR	9	7.63	0.518	8	
		SPIT	9.9	9.91	0.035	9.9	

Results of Rating Activity



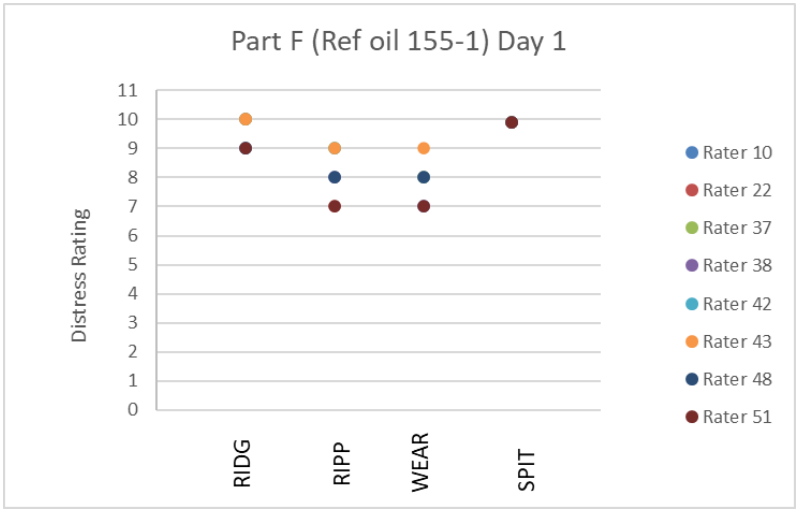
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
B	161103-L371	RIDG	9	9.13	0.354	9	Not Rated
		RIPP	8	8.50	0.535	8	
		WEAR	7	7.50	0.535	8	
		SPIT	9.9	9.91	0.035	9.9	

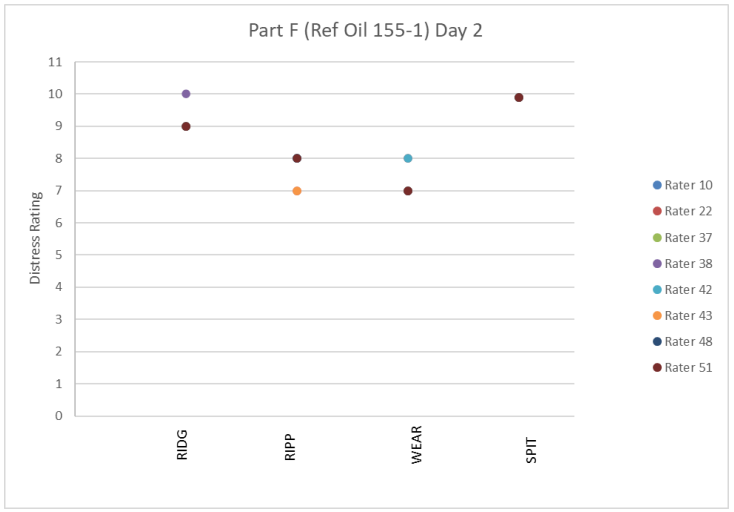
Results of Rating Activity



Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
C	141941-L371	RIDG	9	9.13	0.354	9	Not Rated
		RIPP	8	8.38	0.744	8	
		WEAR	8	7.63	0.518	8	
		SPIT	9.9	9.91	0.035	9.9	

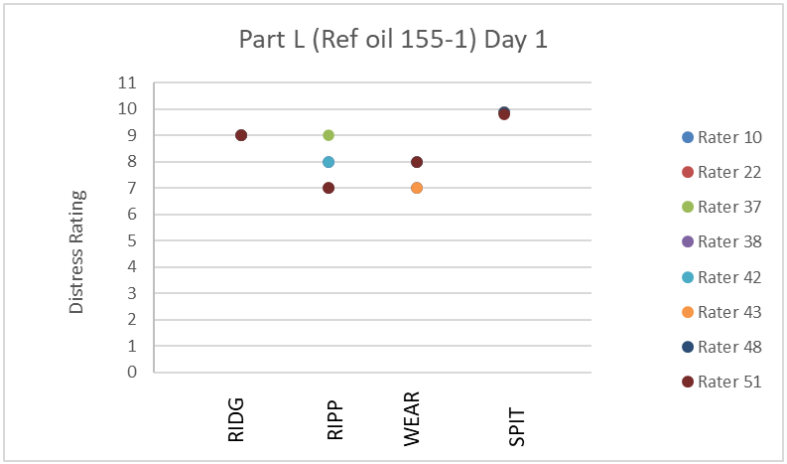
Results of Rating Activity





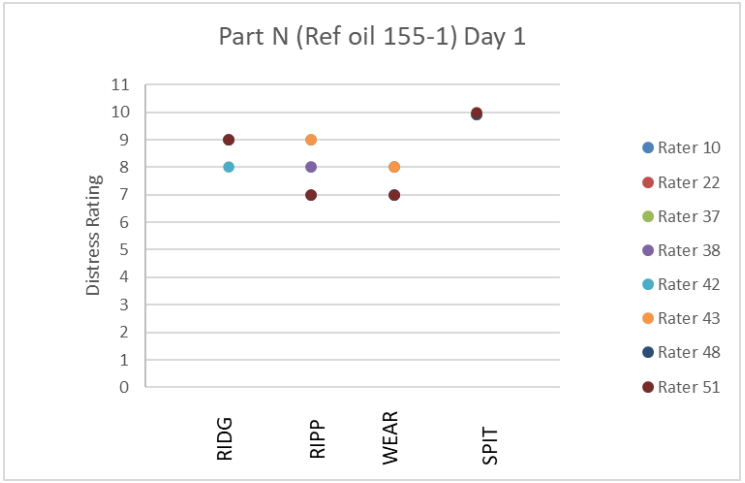
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Average	Day 2 std.	Day 2 Rounded Average
F	141942-L371	RIDG	9	9.50	0.535	10	9.13	0.354	9
		RIPP	7	8.13	0.835	8	7.75	0.463	8
		WEAR	8	7.75	0.707	8	7.25	0.463	7
		SPIT	9.9	9.90	0.000	9.9	9.90	0.000	9.9

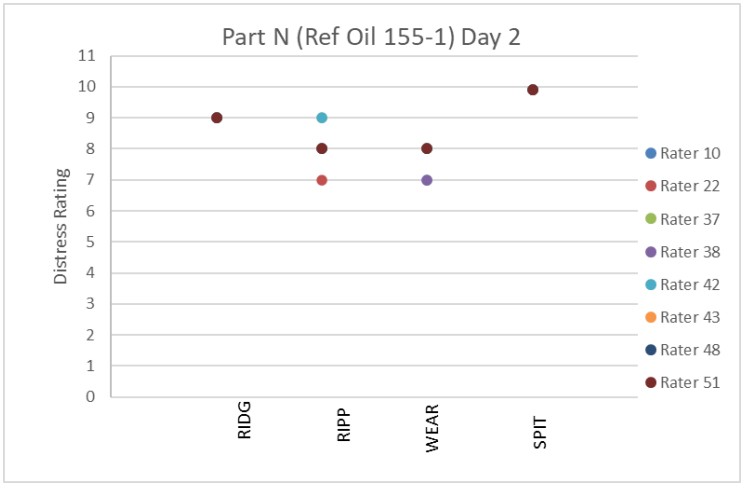
Results of Rating Activity



Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
L	166132-L371	RIDG	10	9.00	0.000	9	Not Rated
		RIPP	7	7.63	0.744	8	
		WEAR	8	7.50	0.535	8	
		SPIT	9.9	9.89	0.035	9.9	

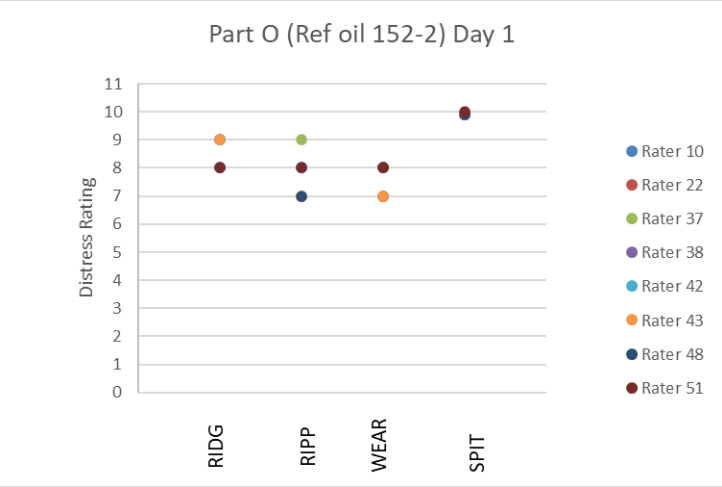
Results of Rating Activity

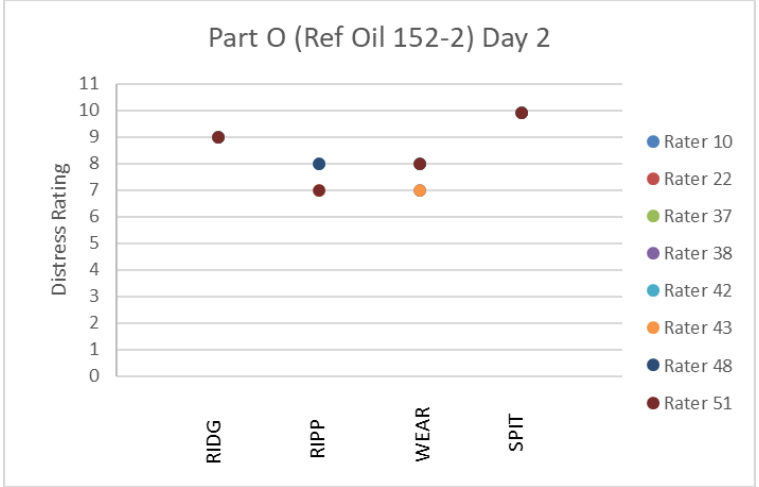




Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Average	Day 2 std.	Day 2 Rounded Average
N	145423-L371	RIDG	9	8.88	0.354	9	9.00	0.000	9
		RIPP	8	8.00	0.926	8	8.13	0.641	8
		WEAR	7	7.38	0.518	7	7.75	0.463	8
		SPIT	9.9	9.91	0.035	9.9	9.90	0.000	9.9

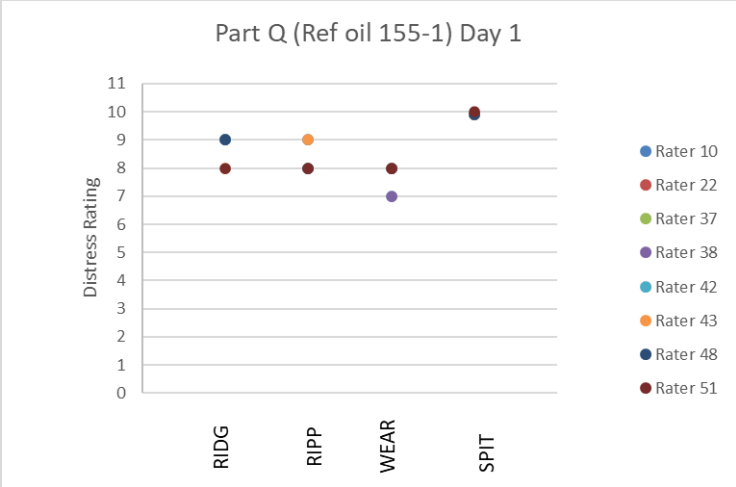
Results of Rating Activity





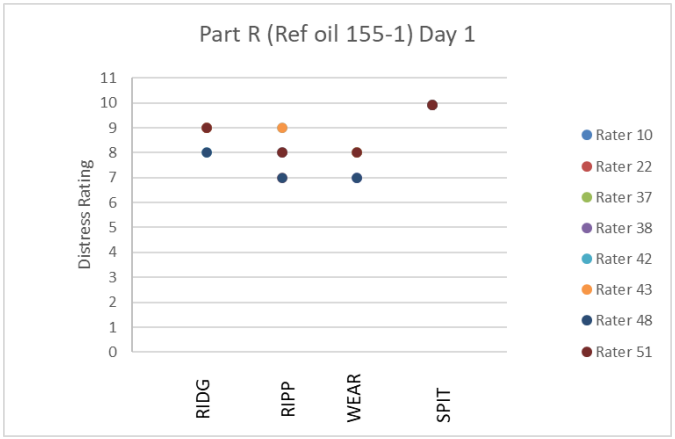
Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Average	Day 2 std.	Day 2 Rounded Average
O	154669-L371	RIDG	9	8.63	0.518	9	9.00	0.000	9
		RIPP	7	7.75	0.707	8	7.63	0.518	8
		WEAR	8	7.50	0.535	8	7.63	0.518	8
		SPIT	9.9	9.91	0.035	9.9	9.90	0.000	9.9

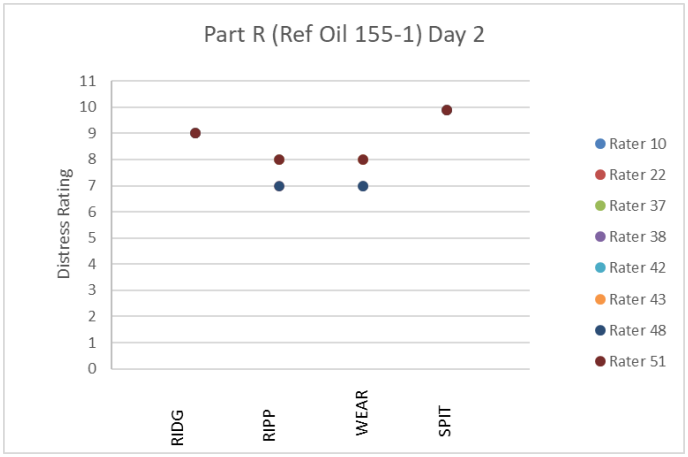
Results of Rating Activity



Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Rounded Average
Q	163291-L371	RIDG	9	8.75	0.463	9	Not Rated
		RIPP	10	8.38	0.518	8	
		WEAR	9	7.75	0.463	8	
		SPIT	9.9	9.91	0.035	9.9	

Results of Rating Activity





Rating ID	Testkey		Original Rating	Day 1 average	Day 1 std.	Day 1 Rounded Average	Day 2 Average	Day 2 std.	Day 2 Rounded Average
R	177223-L371	RIDG	8	8.75	0.463	9	9.00	0.000	9
		RIPP	8	8.00	0.756	8	7.75	0.463	8
		WEAR	8	7.63	0.518	8	7.50	0.535	8
		SPIT	9.9	9.90	0.000	9.9	9.90	0.000	9.9

L37-1 04-2021 MnP Coated Hardware Introduction

May 10, 2023

Data Analyst Group

- Todd Dvorak, Infineum
- Jo Martinez, Chevron Oronite
- Ricardo Affinito, Chevron Oronite
- Martin Chadwick, Intertek
- Travis Kostan, SwRI
- Dylan Beck, TMC
- Sean Moyer, TMC
- Amanda Stone, Afton/New Market

Goals & Data Concerns

	A	B	D	G	Total
Approval Runs on 04-2021	**7**	**3**	**5**	**7**	**22**
134-1	3		1	3	7
152-2	1	1	2	1	5
150-1	3	2	2	3	10

- 22 valid runs were conducted on 04-2021 MnP Coated hardware to introduce new hardware and compare against previous 04-2014 results.
  - Goal to establish reference acceptance criteria and determine if there is a bias resulting from the hardware change that may need to be corrected for candidates (Correction Factor).
- After completion of the matrix it was determined that the coating on the new hardware resulted in differences in rating values between raters and a rating workshop was conducted.
- Initial review of the data from the TMC and SP found potential bias issues and concerns with the appropriate method to accept reference tests on this hardware going forward.

Rating Workshop & Data Issues

- 18 sets of hardware from the matrix runs were collected and reviewed by eight raters from the four different labs that participated in the matrix.
- All 18 sets were initially rated by all raters and then discussed.
  - Discussions after the initial ratings found interpretation differences between raters and a consensus interpretation was agreed to.
- After the discussions, the coating was removed from the hardware and additional ratings were conducted to determine if removing the coating would make the rating process more consistent.
  - It was agreed that removing the coating did not offer any improvement over the already agreed on changes.

Data Set Assumptions

- After review of the data and discussions with the TMC the following assumptions were made.
- The rating workshop averages are the best estimate we have of the expected severity going forward.
  - These ratings were conducted before the changes agreed by the raters but the ratings on 7 sets of hardware after the coating was removed support that the average ratings should be similar.
- We don't have an estimate of the expected variability going forward due to the rating changes but should expect it to be larger than the variability of the 8 rater averages.
  - Keeping that in mind and given the nature of whole number rating values it is reasonable to assume that a result on either side of an average that is not exactly a whole number is a reasonable expectation.

Path Forward

- Option 1: Rerun the matrix now that the rating issues have been addressed and evaluate the data. No guarantee the outcome will be different.
- Option 2: Establish acceptance bands based on agreed upon assumptions and continue to evaluate as more data is collected.
  - Current data suggests that the difference between 134-1 (severe RO) and 152-2 & 155-1 (mild RO's) is smaller than on the previous hardware batch for RIPP, WEAR, and RIDG.
  - The smaller delta between the oils and the rating scale make it difficult to suggest any correction factors although there does appear to be a shift severe for 152-2 & 155-1 for RIPP and, to a lesser extent, for WEAR.

RIPP

RIPP	134/134-1	152-2	155-1
Current Target	7.4	9.3	8.7
Current s	1.6	0.5	0.7
Current LL	4.52	8.4	7.44
Current UL	10.28	10.20	9.96
Contiguous Mode	7	9	9
Contiguous Range	5 - 9	9 - 10	7 - 10
RWS Average	6.58	8.13	8.14
RWS vs. Target	-0.82	-1.17	-0.56
RWS vs. Mode	-0.42	-0.87	-0.86
RWS Range	**5 - 8**	**7 - 9**	**7 - 9**
Current Range	5 - 10	9 - 10	8 - 9

- A correction factor of +1 can be considered based on the original oil targets and new hardware estimated performance.
- It is difficult to recommend this given the unknown effect of the rating changes on future tests.
- If the people most familiar with the test and rating issues choose to adopt a +1 correction the assumptions used for this review support it.

Contiguous Data on 04-2014 Hardware

WEAR

WEAR	134/134-1	152-2	155-1
Current Target	6.8	8.2	7.9
Current s	0.9	0.7	0.8
Current LL	5.18	6.94	6.46
Current UL	8.42	9.46	9.34
Contiguous Mode	6	8	8
Contiguous Range	5 - 8	7 - 9	7 - 9
RWS Average	6.48	7.58	7.59
RWS vs. Target	-0.32	-0.62	-0.31
RWS vs. Cont. Mode	+0.48	-0.42	-0.41
RWS Range	**6 - 7**	**7 - 8**	**7 - 8**
Current Range	6 - 8	7 - 9	7 - 9

Contiguous Data on 04-2014 Hardware

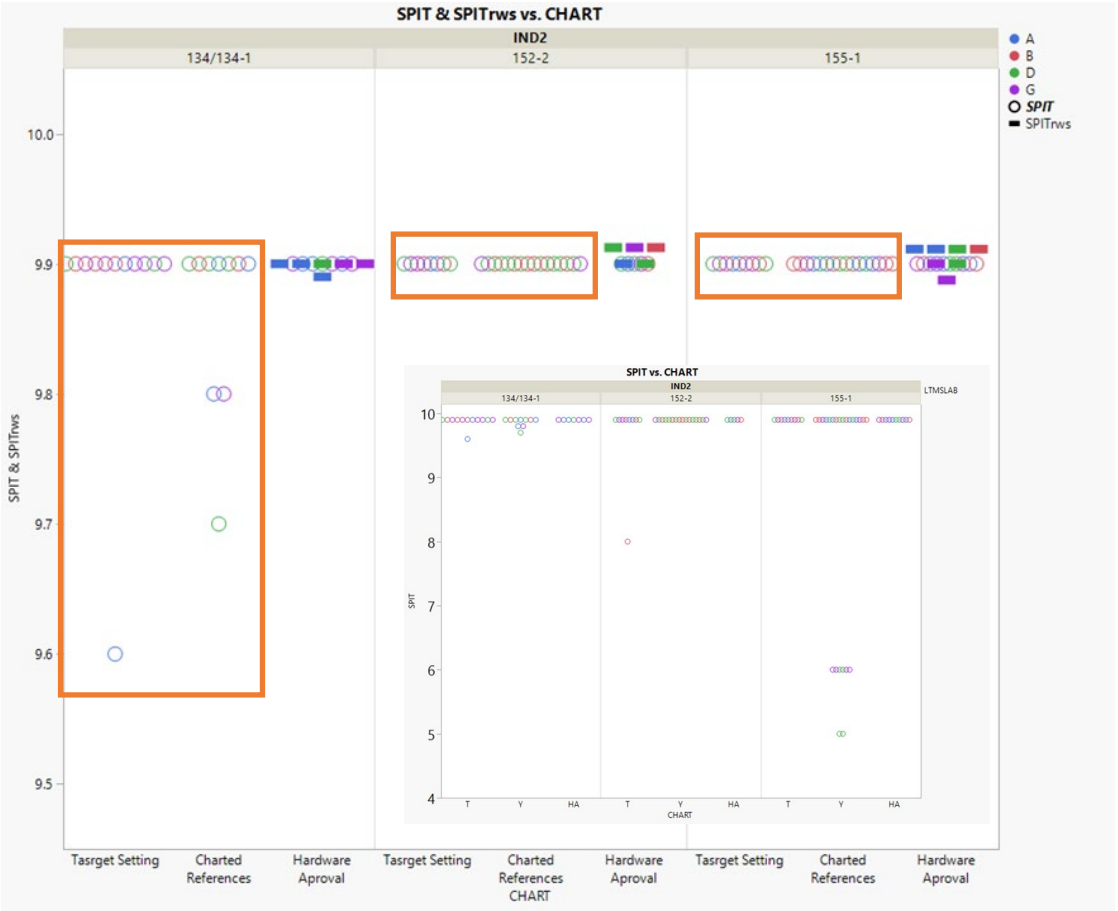
RIDG

RIDG	134/134-1	152-2	155-1
Current Target	6.1	9.7	9.3
Current s	2.4	0.5	1
Current LL	1.78	8.80	7.50
Current UL	10.42	10.60	11.10
Contiguous Mode	5	10	10
Contiguous Range	4 - 6	9 - 10	9 - 10
RWS Average	5.25	8.93	9.02
RWS vs. Target	-0.85	-0.77	-0.28
RWS vs. Cont. Mode	+0.25	-1.07	-0.98
RWS Range	**4 - 6**	**8 - 10**	**8 - 10**
Current Range	2 - 10	9 - 10	8 - 10

Contiguous Data on 04-2014 Hardware

SPIT

SPIT	134/134-1	152-2	155-1
Current Target	9.9	9.7	9.9
Current s	0.1	0.6	0.0
Current LL	9.72	8.62	9.90
Current UL	10.08	10.78	9.90
Contiguous Mode	9.9	9.9	9.9
Contiguous Range	9.6 - 9.9	9.9 Only	9.9 Only
RWS Average	9.90	9.91	9.90
RWS vs. Target	0.00	0.21	0.00
RWS vs. Cont. Mode	0.00	+0.01	0.00
RWS Range	**9.8 - 9.9**	**9.9 - 10.0**	**9.8 - 10.0**
Current Range	9.8 - 10.0	8.7 - 10.0	9.9 Only



Contiguous Data on 04-2014 Hardware

Recommendation if Hardware Accepted

- Adopt reference acceptance bands for 04-2021 MnP coated hardware.

	134-1	152-2	155-1
RIPP*	5 - 8	7 - 9	7 - 9
WEAR	6 - 7	7 - 8	7 - 8
RIDG	4 - 6	8 - 10	8 - 10
SPIT	9.8 - 9.9	9.9 - 10.0	9.8 - 10.0

** If +1 CF adopted increase ranges by 1*

- For future reference attempts on MnP Coated hardware if the reference is unacceptable conduct a second on MnP Coated hardware. If it is also unacceptable conduct the next reference on uncoated hardware.
- Evaluate again after additional data is available.

2022 MnP Coated Hardware approval?

- Vote or postpone?

Membership Review

Rob Banas	ExxonMobil
Allen Comfort	US Army
Troy Muransky	AAM
Matt Sangpeal	Afton
Arjun Goyal	BASF
Amy Zyski	Dana
Dylan Beck	TMC
Jason Carter	Cummins - Meritor
Anthony Lange	Intertek
Nick Schaup	Lubrizol
Caroline Mueller	SwRI
Rebecca Warden	Oranite

Total Voting Members = 12

Old Business

- ?

New Business

Adjourn

Effective Date: 5/10/2023

Motion to approve 22 coated hardware acceptance bands show in snip Below as well as extend reference period by three tests: Troy Muransky

Without correction factors, testing* and re-rates^ to be completed by LRI 210 and targets to be re-assessed.

*One test on each reference oil per lab in the next two months

^Re-rates are to be done on non-stripped hardware approval runs

	134-1	152-2	155-1
RIPP*	5 - 8	7 - 9	7 - 9
WEAR	6 - 7	7 - 8	7 - 8
RIDG	4 - 6	8 - 10	8 - 10
SPIT	9.8 - 9.9	9.9 - 10.0	9.8 - 10.0

Passed Unanimously