

MEETING MINUTES: ROBO SURVEILLANCE PANEL

Meeting: ROBO SP Meeting

Date: January 7, 2021

Location: MS Teams (virtual)

Minutes by: Justin Mills – SP Chair

Actions:

1. Tom Schofield to follow up with labs that have pending TMC 436 runs to donate. (Ideally labs can complete their donate TMC 436 runs prior to next meeting, so we can set limits)
2. Tom Schofield to update limits in LTMS for TMC 434-3 with an effective date of February 1 ,2021.
3. Justin Mills, Matt Schlaff, Tom Schofield, Alan Flamberg to continue to work on dilute NO2 procedure/method.
4. Justin Mills to tentatively schedule the next ROBO SP meeting for April 15, 2021.

Membership and Attendance:

Ace Glass	Dave Lawrence, *Tom Petrocella
Afton	Shelia Thompson, *Jeff Yang, Todd Dvorak
ASTM TMC	*Tom Schofield
Chevron Oronite	*Robert Stockwell
ExxonMobil	*Dennis Gaal
Infineum	Andy Richie, Sapna Eticala
Intertek	Joe Franklin, *Matt Schlaff, *Rachel Stone
Lubrizol	*Aimee Shinhearl
PetroChina	Li Shaohui , Sun Ruihua, Peng Wang, Xiaogang Li, Xu Li
Evonik Oil Additives	*Justin Mills, *Justin Kontra, *Gabriel Walkup
Vanderbilt Chemicals	Al Filho, Ron Hiza
SwRI	Becky Grinfield, Joe De La Cruz, Mike Birke, *Young-Li McFarland
Valvoline	Amol Savant, Kevin Figgatt, Steve Lazzara
Koehler Instruments	Raj Shah, *Vincent Colantuini
Tannas/Savant	Greg Miller, Ted Selby
General Interest	*Alan Flamberg
Guests	*William Monsees (Koehler)

* Denotes attendance

MEETING MINUTES: ROBO SURVEILLANCE PANEL

Summary:

- Meeting convened at 10:04EST on January 7, 2021
- No modifications to agenda
- ASTM Antitrust and Recording Policy reviewed
- Membership review and update
 - Man Hon Tsang of Oronite, Mike Faile of Lubrizol, Bruce Zweitzig of Evonik requested to be removed due to a changes in their roles.
- Meeting minutes from August 13, 2020 SP meeting were accepted (motion made by Tom Schofield and seconded by Alan Flamberg)
- Actions from the August 13th meeting were reviewed. Outstanding actions include:
 - Justin Mills, Matt Schlaff, Tom Schofield to update ASTM D7528 to include dilute NO2.
- ROBO industry statistics
 - The current semester, 2021APR (10/01/20 – 3/31/21), is in progress. As of January 4 (approx. half way through the reporting semester), there were 55 results reported. Since last period, the bias has improved ($Y_i = -0.26$); however the precision is worse than target (pooled $s = 0.3568$).
- TMC reference oils
 - At our August 2020 SP we agreed to explore TMC 436 as a potential replacement for TMC 438-2 or as a new reference oil. Initial data from the donated runs indicates that TMC 436 is a “good, passing” oil with limits comparable to the original TMC 438. The SP agreed that it can replace TMC 438-2 assuming more data is generated to set limits. There are a number of pending donated runs (labs have samples but have not run them yet). Tom Schofield to contact these labs. Expect to have “pending” runs by next SP meeting so we can set limits for TMC 436 and begin using as a reference oil. Below is the statistics on TMC 436:

n	Natural Log Transformed Mean (ln)	Mean in Original Units	s.d. (ln)	95% band in mPa*s, min	95% band in mPa*s, max	95% band (ln), min	95% band (ln), max
11	10.3015	29,777	0.131	23,033	38,496	10.0447	10.5583

- At the October 2019 SP meeting we voted on interim limits for 434-3 with 13 data points. To date (January 4, 2021), there are 22 valid results available for 434-3 providing us with enough datapoints to set final limits. New limits were calculated with and without a bias correction. After some discussion, the SP agreed that we should apply the bias correction in order to remain consistent with precious limit setting. A motion to accept Option #2 (shown below) by was made by Gabriel Walkup and seconded by Tom Schofield:

TMC 434-3	n	Natural Log Transformed Mean (ln)	Mean in Original Units	s.d. (ln)	95% band in mPa*s, min	95% band in mPa*s, max	95% band (ln), min	95% band (ln), max
Option #2	22	10.8172	49,871	0.1389	37,987	65,473	10.5450	11.0894

- After a vote, the motion carried and new limits for TMC 434-3 will be as reflected above. Effective date for new limits will be February 1, 2021.
- Dilute Nitrogen Dioxide
 - Procedure for dilute NO2 continues to be drafted; however, there were several topics which needed to be discussed within the SP before additional progress could be made:
 - Concentration for NO2 – Recommended we confirm tolerances with two suppliers (Airgas and Electronic Fluorocarbons) to ensure we don’t over specify limits and tolerances can be met.
 - Dilute NO2 flow rate – Recommended to be 185ml/min +/-5% for dilute NO2 as well as dry air.
 - Feed duration – Recommended to be 12 hours +/- 15 minutes to allow ample time if manual changeover from dilute NO2 to dry air is required.
- No additional topics
- Next meeting tentatively scheduled on April 15, 2021. Date may be postponed if necessary
- Meeting adjourned.

-End report-

ASTM D7528: Bench Oxidation of Engine Oils by ROBO Apparatus

ROBO Surveillance Panel Meeting

January 7, 2021

Justin Mills

Agenda

- Welcome, ASTM statement
- Review membership of surveillance panel
- Review and approve minutes from previous meetings (see attachment)
- Review and follow-up on actions from August 13th meeting
- Current status of ROBO including statistics
- Reference oil update including
 - TMC 436 status
 - Limits for TMC 434-3
- Dilute nitrogen dioxide update
- Additional topics, if any
- Set next meeting

ASTM Antitrust and Recording Policy

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Electronic recording of ASTM meetings is prohibited.

Membership

Ace Glass	Dave Lawrence, Tom Petrocella
Afton	Shelia Thompson, Jeff Yang , Todd Dvorak
ASTM TMC	Tom Schofield
Chevron Oronite	Man Hon Tsang , Robert Stockwell
ExxonMobil	Dennis Gaal
Infineum	Andy Richie, Sapna Eticala
Intertek	Joe Franklin, Matt Schlaff , Rachel Stone
Lubrizol	Mike Faile , Aimee Shinhearl
PetroChina	Li Shaohui , Sun Ruihua, Peng Wang, Xiaogang Li, Xu Li
Evonik Oil Additives	Justin Mills, Bruce Zweitzig , Gabe Walkup , Justin Kontra
Vanderbilt Chemicals	Al Filho, Ron Hiza
SwRI	Becky Grinfield, Joe De La Cruz, Mike Birke, Yong-Li McFarland
Valvoline	Amol Savant, Kevin Figgatt, Steve Lazzara
Koehler Instruments	Raj Shah, Vincent Colantuini
Tannas/Savant	Greg Miller, Ted Selby
General Interest	Alan Flamberg
Guests	William Monsees (Koehler)

Summary of changes:

1. Man Hon Tsang of Oronite requested to be removed due to a change in role.
2. Mike Faile of Lubrizol requested to be removed due to a change in role.
3. Bruce Zweitzig of Evonik requested to be removed due to a change in role.
4. William Monsees of Koehler attended as a guest.

Motion to accept August 13, 2020 meeting minutes

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Meeting: ROBO SP Meeting
 Date: August 13, 2020
 Location: MS Teams (virtual)
 Minutes by: Justin Mills – SP Chair

Actions:

- Tom Schofield to send 436 samples for those labs wishing to participate in round robin.
 - All labs able to participate should contact Tom.
- Tom to update LTMS and issue information letter to cover approved changes to Section 9 of D7528 method.
- Justin Mills, Matt Schlaff, Tom Schofield, Alan Flamberg to continue to work on dilute NO2 procedure/method.
- Justin Mills to tentatively schedule the next ROBO SP meeting for October 8, 2020.

Membership and Attendance:

Ace Glass	Dave Lawrence, *Tom Petrocella
Afton	Shelia Thompson, Jeff Yang, Todd Dvorak
ASTM TMC	*Tom Schofield
Chevron Oronite	Man Hon Tsang, *Robert Stockwell
ExxonMobil	Dennis Gaal
Infineum	Andy Richie, Sapna Eticala
Intertek	*Joe Franklin, *Matt Schlaff
Lubrizol	Mike Faile, *Aimee Shinhearl
PetroChina	Li Shaohui, Sun Ruihua, Peng Wang, Xiaogang Li, Xu Li
Evonik Oil Additives	*Justin Mills, *Bruce Zweitzig, *Justin Kontra, Gabriel Walkup
Vanderbilt Chemicals	Al Filho, Ron Hiza
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Valvoline	Amol Savant, Kevin Figgatt, Steve Lazzara
Koehler Instruments	Raj Shah, Vincent Colantuini
Tannas/Savant	Greg Miller, Ted Selby
General Interest	*Alan Flamberg

* Denotes attendance

ASTM D7528 ROBO SP Meeting August 13, 2020

MEETING MINUTES: ROBO SURVEILLANCE PANEL

Summary:

- Meeting convened at 10:32EST on August 13, 2020
- No modifications to agenda
- ASTM Antitrust and Recording Policy reviewed
- Membership review and update
 - Greg Lentz of Lubrizol removed - retired
 - Rachel Stone of Intertek added
- Meeting minutes from June 4, 2020 SP meeting were accepted
- Actions from the June 4th meeting were reviewed. Outstanding actions include:
 - Justin Mills, Matt Schlaff, Tom Schofield to update ASTM D7528 to include dilute NO2.
- ROBO industry statistics
 - The current semester, 2020OCT (4/01/20 – 9/30/20), is in progress. As of July 27, there were 59 datapoints. It is running with mild bias ($Y_i = -0.71$) but closer to target precision than previous semester; pooled $s = 0.2221$.
- API Provisional Licensing
 - API provisional licensing for the ROBO test began April 1, 2020 and ended August 1, 2020
- TMC reference oils
 - As of August 3rd, there are only 16 valid results available for 434-3. Will revisit final limit setting once >20 results are available.
 - TMC still has 20-40 samples of 434-2 in inventory so full usage of 434-3 will not occur until this supply is depleted.
 - Tom Schofield confirmed that ROBO could get access ≥ 1 drum of TMC 436. The SP is interested in investigating this reference oil as a potential replacement for one of our current reference oils (likely 438-2) or as a 4th reference oil.
 - To support this investigation, it was requested that labs donate 436 runs – Intertek and Evonik both volunteered. Any additional labs able to participate should contact TMC and Tom will include 436 samples in their regular oil replenishment. All donated runs will be tracked in the LTMS database. Given the ample supply of our 3 current reference oils, there is no rush for this request and data can be gathered over next several months.
 - Some discussion regarding 438 and subsequent reblands also took place. Alan commented that the original 438 was intended to be a mild oil; however, if the conditions of the test are too severe this oil could perform very poorly. This sensitivity to change made it an ideal reference oil. Unfortunately the blend (TMC 438-2) has significantly broader standard deviation (438-2 s.d. = 0.2596 vs 438 s.d. = 0.2037). In last semester the precision of 438-2 was 0.3634.
- Calibration requirements
 - LTMS
 - Current calibration requirements in LTMS only distinguish between New Laboratory/Test Stand(s) and Existing Laboratory/Test Stand(s). - No distinction between new test stand(s) at new labs or existing labs.
 - Proposal was made to clarify calibration requirements by adding a third category and modifying requirements. A General summary of the changes is provided below, but full proposal can be found in Appendix A:
 - New Laboratory/New Test Stand(s) - Will be required to run all 3 (unblind) reference oils prior to requesting 2 (blind) reference oils.
 - Existing Laboratory/New Test Stand(s) - Will not be required to run 3 (unblind) reference oils prior to requesting 2 (blind) reference oils. Instead new test stands at existing labs can just run 2 (blind) reference oils after their own internal shakedown.
 - Existing Laboratory/Existing Test Stand(s) - No changes to requirements
 - After reviewing the proposal some discussion took place. In general, it seemed that all SP members want to ensure new rigs are properly vetted and agreed that it is good practice to do "shakedown" runs prior to requesting the double-blind calibration oils from the TMC. Some labs utilize an internal standard for setting up new rigs, making the 3-unblind references redundant. In the end it seems that the 2-test calibration should be sufficient to keep "bad" ROBO units out of the system and it is up to

ASTM D7528 ROBO SP Meeting August 13, 2020

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- individual labs to identify their own best practice for vetting their rigs prior to requesting the double-blind calibration oils from the TMC.
- Joe Franklin made a motion to approve the new acceptance criteria for the LTMS as proposed (see Appendix A). The motion was seconded by Matt Schlaff and vote took place with one vote allowed per company:

Affirmative	Negative	Abstain
Matt Schlaff (Intertek)	Alan Flamberg (general interest)	Tom Schofield (TMC)
Aimee Shinhearl (Lubrizol)		Tom Petrocella (Ace Glass)
Mike Birke (SwRI)		Robert Stockwell (Oronite)

- By majority vote, the motion carried. Alan Flamberg withdrew his negative after additional discussion.
- ASTM D7528-17a
 - Corresponding changes to the D7528-17a method were also reviewed. Primary changes included adding "9.2 New Test Stand at Existing Laboratory Calibration" as well as updating the TMC LTMS reference in Footnote 11. The proposal for Section 9 changes can be found in Appendix B.
 - Joe Franklin made a motion to produce an information letter detailing changes to Section 9 as proposed in Appendix B. The motion was seconded by Alan Flamberg and a vote took place:

Affirmative	Negative	Abstain
Matt Schlaff (Intertek)		
Aimee Shinhearl (Lubrizol)		
Mike Birke (SwRI)		
Robert Stockwell (Oronite)		
Tom Schofield (TMC)		
Tom Petrocella (Ace Glass)		
Alan Flamberg (general interest)		

- By majority vote, the motion carried. An information letter will be issued with an effective date of 30 days.
- Dilute nitrogen dioxide
 - Due to timing, this topic was not covered in detail. Instead Justin will work with a smaller workgroup to determine tolerances for dilute NO2 (concentration, duration, flow rate). Work group likely to include Justin Mills, Alan Flamberg, Matt Schlaff, and Tom Schofield; however, it is open to anyone that would like to participate. Recommendations will then be shared with entire SP at future meeting.
- Calibration and reporting
 - The LTMS and D7528 method do not explicitly state whether a test needs to start or finish by end of calibration date to be considered valid. Consensus from SP is that test just needs to start before end of calibration date.
 - Tom proposed the following language to be added to the D7528 method: "Qualified Non-Reference Test Runs On Calibrated Test Stands—A non-reference test is considered to be run on a calibrated test stand if started at least one-hour before the calibration expiration period, and is within the allowed number of runs between calibrations specified by the LTMS calibration requirements."
 - General consensus is that this wording should be sufficient; however due to timing no vote was taken and this topic will be revisited at next meeting.
- Next meeting tentatively scheduled on October 8, 2020. Date may be postponed if no progress is made on agenda items.
- Meeting adjourned at 12:10

ASTM D7528 ROBO SP Meeting August 13, 2020

Actions from August 13th meeting

- Tom Schofield to send 436 samples for those labs wishing to participate in round robin.
 - All labs able to participate should contact Tom.
- Tom to update LTMS and issue information letter to cover approved changes to Section 9 of D7528 method.
- Justin Mills, Matt Schlaff, Tom Schofield, Alan Flamberg to continue to work on dilute NO₂ procedure/method.

Current status of ROBO

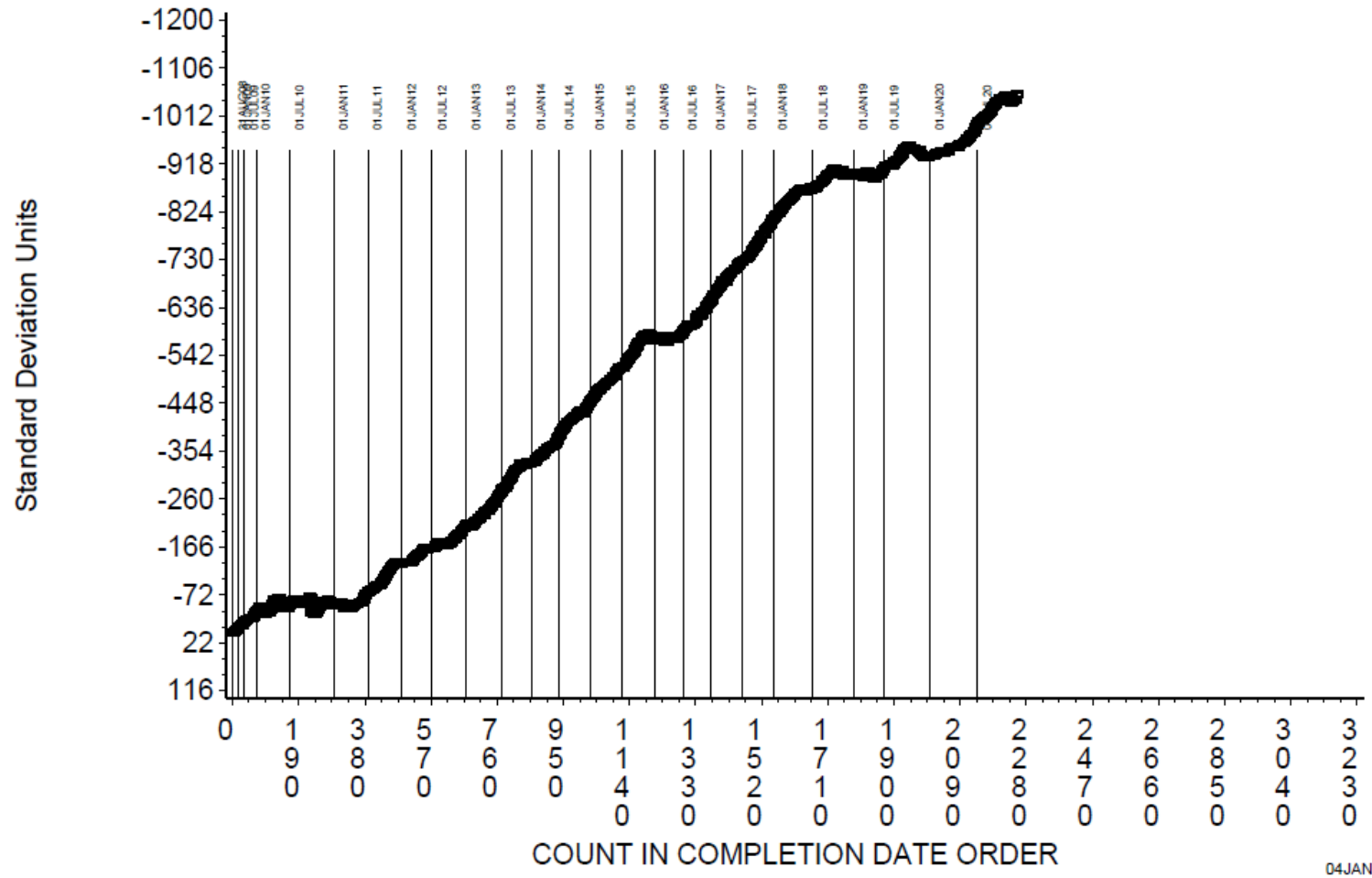
ROBO Industry Statistics

Period	N-size	Degrees of Freedom	Pooled s	Mean Δ/s	Comments
Current Targets	49	46	0.1945	-----	
4/1/17 through 9/30/17	99	95	0.2220	-0.76	
10/1/17 through 3/31/18**	90	86	0.2376	-0.91	Period statistics with and without seven suspect results from two rigs
10/1/17 through 3/31/18**	83	79	0.2076	-0.74	
4/1/18 through 9/30/18	126	122	0.2184	-0.49	Period statistics with and without one extreme result included
4/1/18 through 9/30/18	125	121	0.1958	-0.53	
10/1/18 through 3/31/19	100	96	0.2738	0.04	
4/1/19 through 9/30/19	95	91	0.2492	-0.32	
10/1/19 through 3/31/20	158	153	0.2723	-0.10	
4/1/20 through 9/30/20	119	113	0.2264	-0.76	
10/1/20 through 3/31/21	55	51	0.3568	-0.26	

- Versus previous period (2020OCT), the test is running less mild, but is also less precise.

Source: <http://www.astmtmc.cmu.edu/ftp/refdata/bench/robo/data/statistics.txt> (Jan04-2021)

CUSUM severity analysis



04JAN21:08:41

Source: <http://www.astmtmc.cmu.edu/ftp/refdata/bench/robo/plots/mrv%20INDUSTRY.pdf> (Jan04-2021)

Reference oils

TMC reference oils

Current limits

Oil	n	Natural Log Transformed Mean (ln)	Mean in Original Units	s.d. (ln)	95% band in mPa's Min ¹	95% band in mPa's Max ¹	95% Bands Min (ln)	95% Bands Max (ln)
434-1	13	10.6599	42,612	0.1672	30,706	59,136	10.3322	10.9876
434-2	36	² 10.9284	² 55,737	0.1551	² 41,126	² 76,008	² 10.6244	² 11.2386
434-3	13	² 10.8411	² 51,078	0.1342	² 39,265	² 66,443	² 10.5781	² 11.1041
435	15	11.4895	97,685	0.2952	³ 60,000	173,546	³ 11.0021	12.0642
435-1	22	11.0416	62,420	0.20295	⁴ 44570	92910	⁴ 10.7048	11.4394
438	14	10.2676	28,785	0.2037	19,308	42,912	9.8683	10.6669
438-2	19	² 10.5404	² 37813	0.2596	² 22,734	² 62,894	² 10.0316	² 11.0492

¹ 95% bands in mPa's are listed for information purposes only, the transformed values will be used to judge acceptance in all cases.

² A bias adjustment has been applied to the mean of reference oils 434-2, 434-3 and 438-2 to account for biases observed in the TMC reference data during the periods that each oil target dataset was generated. The 95% confidence range reflects the inclusion of the bias adjustments.

³ The minimum value for Reference oil 435 is fixed at 60,000 (11.0021 in transformed units) and not a true 95% minimum as calculated from the statistics.

⁴ The minimum value for reference oil 435-1 is based on -1.66 standard deviations from the target mean (to match the range previously approved for oil 435 min), so is not actually a 95% confidence range. A 95% confidence range would use 1.96 standard deviations from target mean.

- At the October 2019 SP meeting we voted on interim limits for 434-3 with 13 data points. To date (January 4, 2021), there are 22 valid results available for 434-3. Recommend we finalize limits **today**.
- At our August 2020 SP we agreed to explore TMC 436 as a potential replacement for TMC 438/438-2 or as a new reference oil.
 - Initial data suggests it may be a “good, passing” oil.

TMC 436

Evaluation as a new reference oil → alternative to replace 438-2?

METHOD	IND	TESTKEY	DTCOMP	APPARATS	MRVTEMP	MRVYSEOT	MRV	MRVti	VAL	VOLEOT	PVIS	
ROBO	436			AM3	<35	-30	16,000	9.6803			95.1	Outlier
ROBO	436			AM3	<35	-30	25,900	10.1620			71.5	
ROBO	436			AM4	<35	-30	28,200	10.2471			70.7	
ROBO	436			AM4	<35	-30	26,200	10.1735			92.1	
ROBO	436	158276-ROBO	20200918	AM2	<35	-30	26000	10.1659	AG	48	72.7	
ROBO	436	158277-ROBO	20200925	AM2	<35	-30	28500	10.2577	AG	49	80.4	
ROBO	436	158156-ROBO	20201001	A4	<35	-30	27900	10.2364	AG	46	75.9	
ROBO	436	158157-ROBO	20201001	A6	<35	-30	36900	10.516	AG	51	92.8	
ROBO	436	158158-ROBO	20201003	A1	<35	-30	37800	10.5401	AG	54	116.3	
ROBO	436	158333-ROBO	20201014	B2	<35	-30	31000	10.3417	AG	47	86.5	
ROBO	436	158334-ROBO	20201016	B2	<35	-30	31600	10.3609	AG	47	84.4	
ROBO	436	158335-ROBO	20201023	B2	<35	-30	30200	10.3156	AG	46	80.5	

n	Natural Log Transformed Mean (ln)	Mean in Original Units	s.d. (ln)	95% band in mPa*s, min	95% band in mPa*s, max	95% band (ln), min	95% band (ln), max
11	10.3015	29,777	0.131	23,033	38,496	10.0447	10.5583

Oil	n	Natural Log Transformed Mean (ln)	Mean in Original Units	s.d. (ln)	95% band in mPa*s, Min ¹	95% band in mPa*s, Max ¹	95% Bands Min (ln)	95% Bands Max (ln)
434-1	13	10.6599	42,612	0.1672	30,706	59,136	10.3322	10.9876
434-2	36	² 10.9284	² 55,737	0.1551	² 41,126	² 76,008	² 10.6244	² 11.2386
434-3	13	² 10.8411	² 51,078	0.1342	² 39,265	² 66,443	² 10.5781	² 11.1041
435	15	11.4895	97,685	0.2932	³ 60,000	173,546	³ 11.0021	12.0642
435-1	22	11.0416	62,420	0.20295	⁴ 44,570	92,910	⁴ 10.7048	11.4394
438	14	10.2676	28,785	0.2037	19,308	42,912	9.8683	10.6669
438-2	19	⁻ 10.5404	⁻ 37,813	0.2596	⁻ 22,734	⁻ 62,894	⁻ 10.0316	⁻ 11.0492

TMC 434-3

Setting final limits

METHOD	IND	TESTKEY	DTCOMP	APPARATS	MRVTEMP	MRVYSEOT	MRV	MRVti	VAL	VOLEOT	PVIS	
ROBO	434-3	145003-ROBO	20190503	B2	-30	<35	51900	10.8571	AG	49	93.7	
ROBO	434-3	145005-ROBO	20190505	B2	-30	<35	50800	10.8357	AG	49	96.3	
ROBO	434-3	145004-ROBO	20190508	B4A	-30	<35	43100	10.6713	AG	46	75.7	
ROBO	434-3	145006-ROBO	20190519	B4A	-30	<35	39600	10.5866	AG	44	66.7	
ROBO	434-3	145028-ROBO	20190531	A5	-30	<70	43100	10.6713	AG	43	72.6	
ROBO	434-3	145021-ROBO	20190607	AM4	-30	<35	55700	10.9277	AG	48	97.2	
ROBO	434-3	145029-ROBO	20190627	A3	-30	<35	42800	10.6643	AG	47	84.1	
ROBO	434-3	145051-ROBO	20190630	G1	-30	<35	58000	10.9682	AG	49	125.4	
ROBO	434-3	145053-ROBO	20190717	G6	-30	<35	51800	10.8551	AG	44	99.4	
ROBO	434-3	145052-ROBO	20190816	G3	-30	<35	45900	10.7342	AG	41	124	
ROBO	434-3	145030-ROBO	20190822	A5	-30	<35	42000	10.6454	AG	44	72.4	
ROBO	434-3	145022-ROBO	20190925	AM2	-30	<35	60000	11.0021	AG	51	123.4	
ROBO	434-3	150459-ROBO	20200102	G7	-30	<35	52800	10.8743	AC	43	85.2	
ROBO	434-3	150297-ROBO	20200415	B4A	-30	<35	34700	10.4545	OC	43	60.3	
ROBO	434-3	150298-ROBO	20200429	B2	-30	<35	45400	10.7233	AC	46	86.6	
ROBO	434-3	150460-ROBO	20200529	G9	-30	<35	44000	10.6919	AC	42	78.4	
ROBO	434-3	150461-ROBO	20200628	G2	-30	<35	47000	10.7579	AC	42	80.7	
ROBO	434-3	145054-ROBO	20200906	G1	-30	<35	38600	10.561	OC	43	83	
ROBO	434-3	150464-ROBO	20200925	G5	-30	<35	49900	10.8178	AC	43	79.5	
ROBO	434-3	154373-ROBO	20201001	A15	-30	<35	48400	10.7873	AC	47	84.4	
ROBO	434-3	152803-ROBO	20201007	G1	-30	<35	51600	10.8513	AC	46	129.8	
ROBO	434-3	152802-ROBO	20201009	G4	-30	<35	41100	10.6238	AC	41	94.4	
ROBO	434-3	152804-ROBO	20201106	G3	-30	<35	82500	11.3206	OC	51	159.1	Outlier
ROBO	434-3	152805-ROBO	20201113	G9	-30	<35	74000	11.2118	OC	52	160.4	Outlier



TMC 434-3

Statistics with and without correction factor applied to account for bias

TMC 434-3		n	Natural Log Transformed Mean (ln)	Mean in Original Units	s.d. (ln)	95% band in mPa*s, min	95% band in mPa*s, max	95% band (ln), min	95% band (ln), max
Option #1	No bias correction. Outliers removed.	22	10.7528	46,761	0.1389	35,618	61,390	10.4806	11.0250
Option #2	Average Yi from TMC statistics (Yi = -0.3556). Outliers removed.		10.8172	49,871		37,987	65,473	10.5450	11.0894
Current limits for TMC 434-3		13	10.8411	51,078	0.1342	39,265	66,443	10.5781	11.1041
Current limits for TMC 434-2		36	10.9284	55,737	0.1551	41,126	76,008	10.6244	11.2386
Current limits for TMC 434-1		13	10.6599	42,612	0.1672	30,706	59,136	10.3322	10.9876

- The ROBO test is running mild during the periods 434-3 data was collected. Average Yi= -0.3556
- Applying correction factor has minor impact to overall range; nevertheless, we should apply it if we wish to remain consistent with previous reference oil limit setting.

➤ Recommend we approve Option #2.

Dilute NO₂

Dilute nitrogen dioxide

Next steps

Path forward to implement dilute NO₂ as an alternative to pure NO₂ is the following:

- 1) **Demonstrate equivalence to the SP** → Based on the available data, SP feels confident that dilute NO₂ and concentrated NO₂ yield comparable results.
- 2) Develop a procedure for dilute NO₂ → Initial draft completed, but now still requires further review editing. Many thanks to Alan for preparing first draft.
 - **Need to determine appropriate tolerances for NO₂ concentration, feed rate, feed time.**
- 3) Approve by SP → Seek approval after procedure is written.
- 4) Issue information letter allowing use of dilute NO₂ as an alternative
- 5) Ballot the recommended changes at ASTM

For the method

- In current method for concentrated NO₂, the maximum range for NO₂ is 1.9 – 2.1ml.
- With dilute NO₂ the concentration, feed rate, and duration will all affect the amount of NO₂ introduced.
 - One of the largest factors in the amount of NO₂ introduced is going to be duration. Currently the method allows the concentrated NO₂ to be fully consumed within with 12+/-1hours (11-13 hours). If the same tolerances are applied to dilute NO₂ this could impact the amount of NO₂ introduced by +/- 9%.
 - Higher or lower concentration of NO₂ doesn't have as much of an impact on total NO₂ introduced.
- Examples:

	Concentrated	Dilute (ideal)	Dilute (higher conc.)	Dilute (lower conc.)	Dilute (more time)	Dilute (less time)
NO ₂ pure, ml	2.0ml +/- 0.1ml (5%)					
NO ₂ in air, %		1.13	1.19 (+5%)	1.07 (-5%)	1.13	1.13
NO ₂ duration, hours	12 +/- 1 hour	12	12	12	13 (+1hr)	11 (-1hr)
Dry air, ml/min	185 ml +/- ?	185	185	185	185	185
NO ₂ "liquid equivalent"	1.9 – 2.1	1.98	2.08	1.87	2.14	1.81

Any Additional Topics?

Next Meeting

- Suggestions for next SP meeting?
 - April ?

March 2021							^	v
Su	Mo	Tu	We	Th	Fr	Sa		
28	1	2	3	4	5	6		
7	8	9	10	11	12	13		
14	15	16	17	18	19	20		
21	22	23	24	25	26	27		
28	29	30	31	1	2	3		
4	5	6	7	8	9	10		

April 2021							^	v
Su	Mo	Tu	We	Th	Fr	Sa		
28	29	30	31	1	2	3		
4	5	6	7	8	9	10		
11	12	13	14	15	16	17		
18	19	20	21	22	23	24		
25	26	27	28	29	30	1		
2	3	4	5	6	7	8		

--Next meeting tentatively scheduled for April 15--