MEETING MINUTES: ROBO SURVEILLANCE PANEL

Meeting: ROBO SP Meeting

Date: June 4, 2020

Location: MS Teams (virtual)

Minutes by: Justin Mills – SP Chair

Actions:

1. Tom Schofield to confirm that 436 could be made available for ROBO.
2. Justin Mills, Matt Schlaff, Tom Schofield, Alan Flamberg to continue to work on dilute NO2 procedure/method.
3. Justin Mills to schedule the next ROBO SP meeting in July 23, 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, *Greg Lentz
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
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

* Denotes attendance

MEETING MINUTES: ROBO SURVEILLANCE PANEL

Summary:

- Meeting convened at 10:03EST on June 4, 2020
- No modifications to agenda
- ASTM Antitrust and Recording Policy reviewed
- Membership review and update
  - Joan Souchik of Evonik removed (retired)
  - Greg Lentz of Lubrizol added.
  - Rick Hartman to be removed
  - BASF removed from list (no longer have any members on list)
- Meeting minutes from October 24, 2019 SP meeting were accepted
- Actions from the October 24th meeting were reviewed. Outstanding actions include:
  - Justin Mills to revisit TMC 436 as a potential reference oil for ROBO.
  - Justin Mills, Matt Schlaff, Tom Schofield to update ASTM D7528 to include dilute NO2 (likely in early-2020).
- ROBO industry statistics
  - The 2020MAR (10/01/19 – 3/31/20) semester ended with a slight mild trend; Yi=-0.10. Precision was worse than target but better than previous semester; Pooled s = 0.2723.
  - In current semester there are only 41 data points with indication that test continues to trend mild.
- API Provisional Licensing
  - In response to long backlogs at independent test labs, API invoked provisional licensing on April 1, 2020 for ROBO. Provisional licensing is expected to end August 1, 2020 assuming backlog improves.
  - SP believes queue is just a result of surge in demand, not a test issue. ROBO test continues to be available at 2 independent labs and 3+ dependent labs.
- TMC reference oils
  - Interim limits for 434-3 were set in October 2019. To date, there are only 14 valid results available for 434-3. SP will revisit final limit setting once >20 results are available.
  - At the October 2019 SP meeting it was requested to revisit the potential of using TMC 436 as a reference oil. Justin Mills shared a limited dataset provided by Evonik with only 4 datapoints indicating it runs mild – like the original 438. Before going further with additional screening, the SP needs to confirm how much 436 could be made available for ROBO.
- Dilute nitrogen dioxide
  - Work on alternative procedure for dilute NO2 continues to move at a slow pace; however significant progress has been made thanks to Alan Flamberg and his attempt to write the initial draft. Significant amount of work still required before draft is considered ready for publication/distribution.
- Method housekeeping.
  - A number of method housekeeping items need to be included in next revision of the method. To date the following were collected:
    - Section 9.1.6: If all the required test stand set-up runs meet the current, approved ROBO TMC calibration requirements11 (both operationally and statistically), the TMC will notify the laboratory that it can proceed with calibrating the test stand per 9.2.
      - Footnote 11 needs to be updated: “11 The ROBO TMC Calibration Requirements document is available at: http://www.astmtmc.cmu.edu/ftp/docs/bench/robo/procedure_and_ils/20170713_ROBO_TMC_Calibration_Requirements.pdf”
      - Recommendation: Should reference TMC’s LTMS instead.
    - Section 10.8.2: Volatility calculation makes reference to Note 8.
      - NOTE 8—The significance of the % volatiles parameter is under investigation.
      - Recommendation: Remove note. No longer under investigation.
    - Annex A.2.2.1: …It is a laboratory’s responsibility to keep the on-site reference oil inventory at or above the minimum level specified by the TMC test engineers.
      - Recommendation: Update or remove statement to reflect that TMC manages the inventory.
    - Section 6.11, 10.4. Annex A13.2, A13.4.1: Clarify vacuum measurement methodology.
      - Currently reported as vacuum pressure of 61 kpa. Is it clearer to report as gauge pressure of -61 kPa?

- Upcoming ASTM D02.B0.07
  - Justin shared the slide he intends to present at upcoming D02.B0.07

ASTM D7528: ROBO
Summary for D02.B0.07

Status	Test Aspect	Comments
✓	Method	Test method is in good standing ▪ ASTM D7528-17a was published in October 2017. Revision planned for 2020. ▪ Monitored by the TMC
✓	Parts Availability	All ROBO hardware and test materials are available ▪ Nitrogen dioxide, the primary catalyst for ROBO, is available from multiple suppliers ▪ Alternative with dilute nitrogen dioxide expected to be approved in 2020 as well.
✓	Reference Oils	All current reference oils are in good supply at TMC: ▪ In last semester, limits were finalized for TMC 438-2 and interim limits were set for TMC 434-3
✓	Test Availability	In response to long backlogs at independent test labs, API invoked provisional licensing on April 1, 2020 for ROBO. ▪ Queue is a result of high utilization ▪ ROBO test is available at 2 independent labs and 3+ dependent labs
✓	Severity and Precision	▪ In last semester (Oct 2019 – Mar 2020) precision was slightly worse than target and test ran with a slight mild bias (-0.10) ▪ In current semester (n=41) precision is on target, but test is running mild (-0.58).

20 ROBO Update for ASTM D02.B0.07

  -
- Next meeting tentatively scheduled on July 23, 2020. Date may be postponed if no progress is made on agenda items.
- Meeting adjourned

-End report-

ASTM D7528: Bench Oxidation of Engine Oils by ROBO Apparatus

ROBO Surveillance Panel Meeting

June 4, 2020

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 October 24th meeting
- Current status of ROBO (including discussion on provisional licensing for ROBO in ILSAC GF-6 and API SP)
- Reference oil update
- Dilute nitrogen dioxide update
- Review slide to be shared at upcoming D02.B0.07 meeting
- Additional topics, if any
- Set next meeting

ASTM Antitrust and Recording Policy

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It is ASTMs policy, and the policy of each of its committees and subcommittees, to conduct all business and activity in full compliance with international, federal and state antitrust and competition laws. The ASTM Board of Directors has adopted an antitrust policy which is found in Section 19 of ASTM Regulations Governing Technical Committees. All members need to be aware of and compliant with this policy. The Regulations are accessible on the ASTM website http://www.astm.org/COMMIT/Regs.pdf).

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**
Lubrizol	**Mike Faile, Aimee Shinhearl**, **Greg Lentz**
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**

Summary of changes:

1. Joan Souchik of Evonik removed (retired)
2. Greg Lentz of Lubrizol added.
3. Rick Hartman to be removed
4. BASF removed from list (no longer have any members on list)

Motion to accept October 24, 2019 meeting minutes

MEETING MINUTES: ROBO SURVEILLANCE PANEL

Meeting: ROBO SP Meeting

Date: October 24, 2019

Location: Skype meeting

Minutes by: Justin Mills – SP Chair

Actions:

1. Justin Mills to revisit TMC 436 data and assess whether or not it could be used as a ROBO reference oil.
2. Tom Schofield to incorporate new limits for TMC 438-2 and 434-3 into LTMS.
3. Justin Mills to revisit TMC 436 as a potential reference oil for ROBO.
4. Justin Mills, Matt Schlaff, Tom Schofield to update ASTM D7528 to include dilute NO2 (likely in early-2020).
5. Justin Mills to schedule the next ROBO SP meeting in Q1 2020.

Membership and Attendance:

Ace Glass	Dave Lawrence, *Tom Petrocella
Afton	*Shelia Thompson, Jeff Yang, Todd Dvorak
ASTM TMC	*Tom Schofield
BASF	
Chevron Oronite	Man Hon Tsang, Robert Stockwell
ExxonMobil	Dennis Gaal
Infineum	Andy Richie, Sapna Eticala
Intertek	Joe Franklin, *Matt Schlaff, *Rachel Stone (guest)
Lubrizol	*Mike Faile, *Aimee Shinhearl, Rick Hartman
PetroChina	Li Shaohui , Sun Ruihua, Peng Wang, Xiaogang Li, Xu Li
Evonik Oil Additives	*Justin Mills, *Bruce Zweitzig, *Joan Souchik, *John Maxwell, 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

* Denotes attendance

MEETING MINUTES: ROBO SURVEILLANCE PANEL

Summary:

- Meeting convened at 10:04EST on October 24, 2019
- No modifications to agenda
- ASTM Antitrust and Recording Policy reviewed
- Membership review and update
  - Gabriel Walkup to replace John Maxwell at Evonik
- Meeting minutes from August 8, 2019 SP meeting were accepted
  - Motion made by Bruce Zweitzig and seconded by Mike Faile.
- Actions from the August 8th meeting were reviewed
  - Outstanding actions include:
    - Justin Mills and Matt Schlaff to draft procedure for introducing dilute NO2. Additionally, SP members were encouraged to review the current D7528 method and provide feedback on best approach to drafting the alternative method. (addressed in later notes)
    - Justin Mills to review request to change SCFM level from 0.6 to 1.0 in Section 10.3.2.1 (addressed in later notes)
- ROBO industry statistics
  - The 2019OCT (4/1/19 – 9/30/19) semester recently ended with a slight mild trend; Yi=-0.31. Precision was worse than target but better than previous semester; Pooled s = 0.2491.
  - There is not enough data to make an assessment on current semester (n=3).
- Reference Oil 438-2
  - At the February 11th SP meeting we agreed to track # of 438-2 runs in ROBO LTMS. Once >20 runs are reached, new limits will be calculated and proposed to SP. To date, there are 19 valid runs available - the SP agreed this was enough.
  - Upon review of the limits, there was concern voiced over the overlap of MRV ranges on the current reference oils. After some discussion the SP agreed to revisit this topic at a future SP meeting. In addition, Justin Mills took an action to revisit TMC 436 data to see if that could be a suitable alternative one day.
  - Proposals for new limits were discussed. The SP agreed that it would be appropriate to apply a bias correction factor to the new limits – just as we did previously for 434-2 and 438-2 (interim limits) limit setting.
  - Matt Schlaff made a motion to approve the limits as defined by Option #2 in Slide #11 with an effective date of November 1, 2019. The motion was seconded by Tom Schofield. No one opposed and the motion carried.

TMC 438-2		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	19	10.5158	36,894	0.2516	22,181	61,365	10.007	11.0246
Option #2	Average Yi from TMC statistics (Yi = -0.3316)		10.5404	37,813		22,734	62,894	10.0316	11.0492

  - Tom Schofield will update the LTMS accordingly and issue a technical memo next week.
- Reference Oil 434-3
  - To date, 13 ROBO runs with 434-3 have been completed. The SP agreed this was enough data to set interim limits.
    - 2 of the 13 runs exhibited yield stress, but the SP agreed that the yield stress was not a critical parameter for this reference oil.
  - Proposals for new limits were discussed. The SP agreed that it would be appropriate to apply a bias correction factor to the new limits – just as we did previously for 434-2 and 438-2 (interim limits) limit setting.
  - Justin Mills made a motion to approve the limits as defined by Option #2 in Slide #13 with an effective date of November 1, 2019; as well as to remove the EOT yield stress requirement for 434-3 in the LTMS. The motion was seconded by Mike Faile. No one opposed and the motion carried.

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	13	10.7833	48,209	0.1342	37,060	62,711	10.5203	11.0483
Option #2	Average Yi from TMC statistics (Yi = -0.3091)		10.8411	51,078		39,285	66,443	10.5781	11.1041

  - Tom Schofield will update the LTMS accordingly and issue a technical memo next week.
  - Transition from 434-2 to 434-3 in TMC's reference oil assignments will occur when inventory of 434-2 is depleted.

MEETING MINUTES: ROBO SURVEILLANCE PANEL

  - Permanent limits will be reviewed once >20 runs with 434-3 are complete.
- Dilute nitrogen dioxide
  - Justin Mills, Matt Schlaff, and Tom Schofield will revise the method in early-2020. Revision will likely need to be face-to-face.
- Method housekeeping.
  - In the next revision of the method the following changes are recommended:
    - Update Footnote 8 in Section 9.1.6 to reference new LTMS document: http://www.astmtmc.cmu.edu/ftp/docs/bench/robo/procedure_and_ils/20170713_ROBO_TMC_Calibration_Requirements.pdf"
    - Remove Note 8 in Section 10.8.2
  - A request to change flow rate limit from 0.6 SCFM to 1.0 SCFM in 10.3.2.1 was reviewed. After some discussion, it was suggested that labs check their system for leaks because <0.6 SCFM should be achievable. If <0.6 SCFM is still not achievable, we can revisit at a later SP meeting.
- Additional topics
  - Intertek is evaluating alternative flow meters to King Instrument Co.,7520 Series, Order number 2C-17. The method specifies an air flow of 2.0 SCFM +/- 0.1 SCFM in Section 6.11, but this meter only has increments of 0.2 SCFM. Matt Schlaff will share his findings at the next SP meeting.
- Next meeting will be scheduled in Q1 2020. Actual date will be determined when method revision is complete or enough data is available to set final limits for 434-3.
- Meeting adjourned

-End report-

Actions from October 24th meeting

- ☒ Tom Schofield to incorporate new limits for TMC 438-2 and 434-3 into LTMS.
- ☐ Justin Mills to revisit TMC 436 as a potential reference oil for ROBO.
  - *To be discussed in later slides.*
- ☐ Justin Mills, Matt Schlaff, Tom Schofield to update ASTM D7528 to include dilute NO2 (likely in early-2020).
  - *To be discussed in later slides.*
- ☒ Justin Mills to schedule the next ROBO SP meeting in Q1 2020.

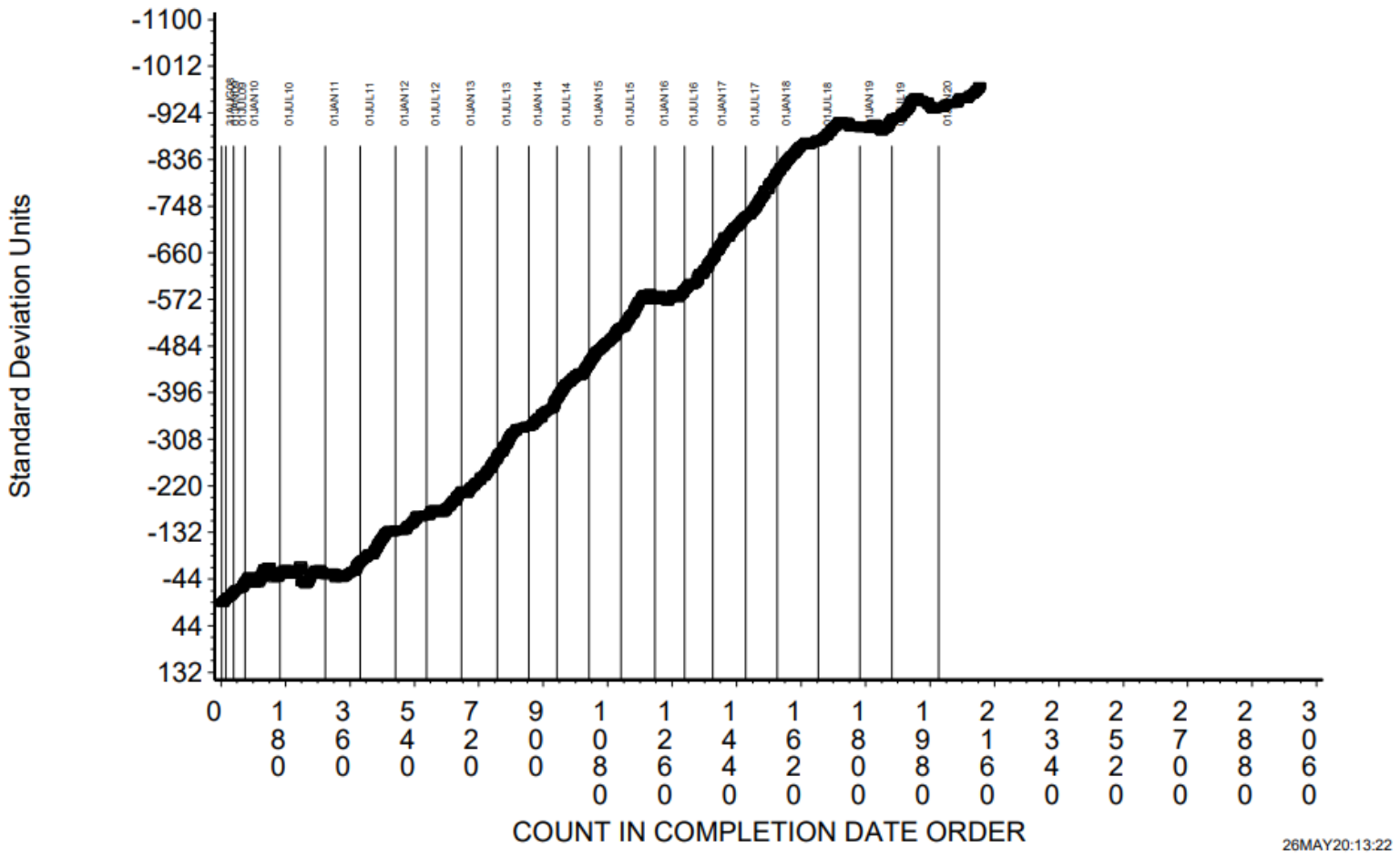
Current status of ROBO

ROBO Industry Statistics

Period	N-size	Degrees of Freedom	Pooled s	Mean Δ/s	Comments
Current Targets	49	46	0.1945	------	
10/1/16 through 3/31/17	78	75	0.2771	-0.91	
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	41	36	0.2122	-0.58	

Source: http://www.astmtmc.cmu.edu/ftp/refdata/bench/robo/data/statistics.txt (6/01/2020)

CUSUM severity analysis



Source: http://www.astmtmc.cmu.edu/ftp/refdata/bench/robo/plots/mrv%20INDUSTRY.pdf (5/27/20)

API Provisional Licensing

- In response to long backlogs at independent test labs, API invoked provisional licensing on April 1, 2020 for ROBO.
  - Applies to current and upcoming categories including GF-6A, GF-B, API SP.
  - Expected to close August 1, 2020
- What does this mean?
  - Oil marketers can apply for API licenses without ROBO results now, but will still be required to submit ROBO results within 6 months.
    - If oil market fails ROBO or does not submit results within 6 months, the provisional license will be cancelled.
  - Likely will not impact the total number of ROBOs needed to support API / ILSAC categories; however testing will be spread out over more time.

Reference oils

TMC reference oils
Current limits

D7528 (ROBO) Aged Oil MRV Acceptance Bands, mPa·s and ln(mPa·s)

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]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 final limits for 438-2 and interim limits for 434-3
- To date, there are only 14 valid results available for 434-3. Will revisit final limit setting once >20 results are available.
- SP asked to revisit TMC 436 as a potential reference oil

Source: http://www.astmtmc.cmu.edu/ftp/docs/ltms/ltms.pdf 05-2020 version

TMC 434-2
Inventory is critically low

From April 2019 meeting.

- Levels of 434-2 have become critically low
  - 7.5 gallons remaining = 9-10 months based on current consumption rate
- Replacement oil is needed
  - Reblend is available (434-3), but it may be more severe based on IIIH's experience.
- Alternatively we could introduce TMC 436 as a replacement, but data from Evonik suggests that it may be more mild.

IND	APPARATS	PVIS	MRVTEMP	MRVYSEOT	MRV
436	AM3	**71.5**	-30	<35	**25,900**
436	AM4	**70.7**	-30	<35	**28,200**
436	AM4	**92.1**	-30	<35	**26,200**
436	AM3	**95.1**	-30	<35	**16,000**

Only 4 datapoints available for 436 from Evonik. Should we evaluate further? Potential replacement for TMC 438-2 or as a 4th reference oil.

Dilute NO_2

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.
- ☐ 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

Input needed from SP for method revision

- Purity of NO2: 1.13% +/- ?
  - Do we need to provide calculation in appendix or is it sufficient to say they are equivalent in footnote?
- Addition of NO2:
  - Rate: 185 ml/min +/- ?
  - Duration: 12 hours +/- ?
- Safety: Do we need a separate statement? Should we imply that dilute NO2 is safer?
- Reporting: Will need to designate if using concentrated or dilute NO2 on report forms.
- Calibration requirements: 1 or 2 test calibration to switch from concentrated to dilute (or vice versa)?

Method Housekeeping

Method housekeeping

- Section 9.1.6: *If all the required test stand set-up runs meet the current, approved ROBO TMC calibration requirements[11] (both operationally and statistically), the TMC will notify the laboratory that it can proceed with calibrating the test stand per 9.2.*
  - Footnote 11 needs to be updated: "11 The ROBO TMC Calibration Requirements document is available at: http://www.astmtmc.cmu.edu/ftp/docs/bench/robo/procedure_and_ils/20170713_ROBO_TMC_Calibration_Requirements.pdf"
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  - Currently reported as vacuum pressure of 61 kpa. Is it clearer to report as gauge pressure of -61 kPa?

Any other items? – Please let me know so I can add them to the list.

Slides to be shared at upcoming D02.B0.07 teleconference

ASTM D7528: ROBO
Summary for D02.B0.07

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	Method	Test method is in good standing ▪ ASTM D7528-17a was published in October 2017. Revision planned for 2020. ▪ Monitored by the TMC
	Parts Availability	All ROBO hardware and test materials are available ▪ Nitrogen dioxide, the primary catalyst for ROBO, is available from multiple suppliers ▪ Alternative with dilute nitrogen dioxide expected to be approved in 2020 as well.
	Reference Oils	All current reference oils are in good supply at TMC: ▪ In last semester, limits were finalized for TMC 438-2 and interim limits were set for TMC 434-3
	Test Availability	In response to long backlogs at independent test labs, API invoked provisional licensing on April 1, 2020 for ROBO. ▪ Queue is a result of high utilization ▪ ROBO test is available at 2 independent labs and 3+ dependent labs
	Severity and Precision	▪ In last semester (Oct 2019 – Mar 2020) precision was slightly worse than target and test ran with a slight mild bias (-0.10) ▪ In current semester (n=41) precision is on target, but test is running mild (-0.58).

Any Additional Topics?

Next Meeting

- Suggestions for next SP meeting?
  - **Thursday - July 16, 2020?**
  - **Thursday – July 23, 2020?**