ASTM Engine Oil Gelation Test (EOGT) WK86363 Update

EOFT and EOWTT Surveillance Panel Meeting

Oct 31, 2024

Yong-Li McFarland, Chair

Afton Method and Original EOGT Results

- Savant update: *videos to be uploaded to ASTM collaboration area – no update*
- SwRI update: *try running with serrated tip and running at 10,000 rpm for 60 sec – see slides, need some Oil K volumes and flow rates for data comparison*
- Afton update: *to run 10,000 rpm, check on which samples (recent) used, will take video, will send out updated procedure; -noted recent aliquot not as strong of gel compared to older aliquot of Oil F; 0.3 ml/s flow rate using 10,000 rpm, still preferred 18G tool, will run recent aliquot sample with 10K rpm, and another 10K rpm with 20 g water, and Oil K with 10K rpm. Mixing slowly is better performing.*
- ISP update: *none*
- Intertek update: *set up to run and will have data, photos/video of the runs next week- 5 oil F and 2 oil K tests run, see slides for result-aliquot from original sample. Will plan to run Oil F and K with 10K rpm, and if another sample, run 10k rpm with 20 g water.*
- Valvoline update: *to analyze Oil F bottom layer composition-filtered to get some SEM info; if have time to try modified CO2 with adding additional water (10mL) and shearing to look for gel; ran latest version Afton at 45C and got 1ml/s for Oil F and made gel, questions on temp control, will review data in Root Cause group, want to discuss more on shearing tool used at ISP- no update*

- *Labs to share volumes, flow rates at times for Oil F and K as more tests are run*

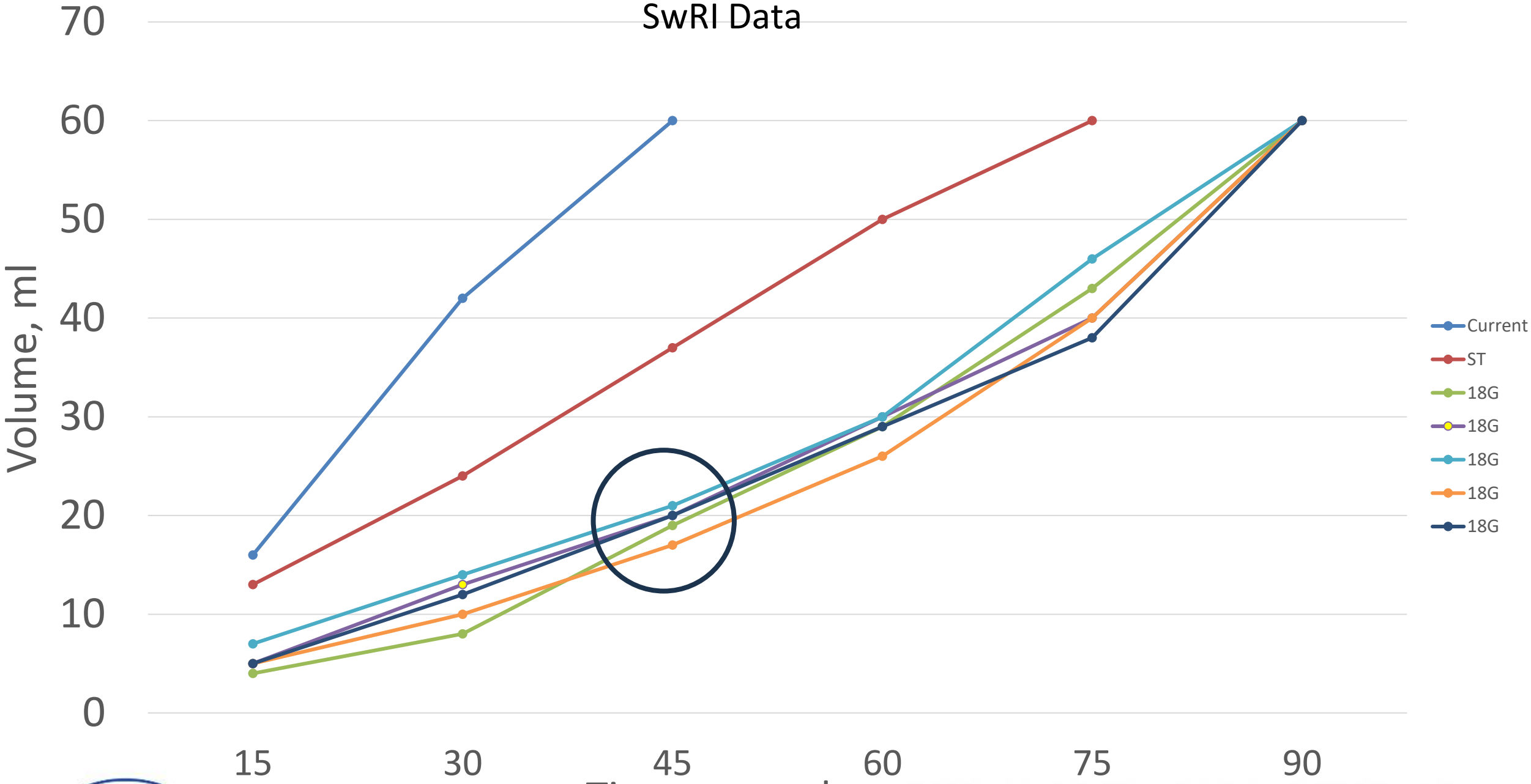
SwRI Experiment Setup

- All Samples
  - Controlled 45°C±3
  - Slow Rotation, 1 rotation every 10-15 secs. Held just off the bottom of jar. (consider moving up to middle portion)

- First Sample
  - Other steps by method

- Remaining Samples
  - 10k rpm only
  - 60/90 secs

SwRI Data



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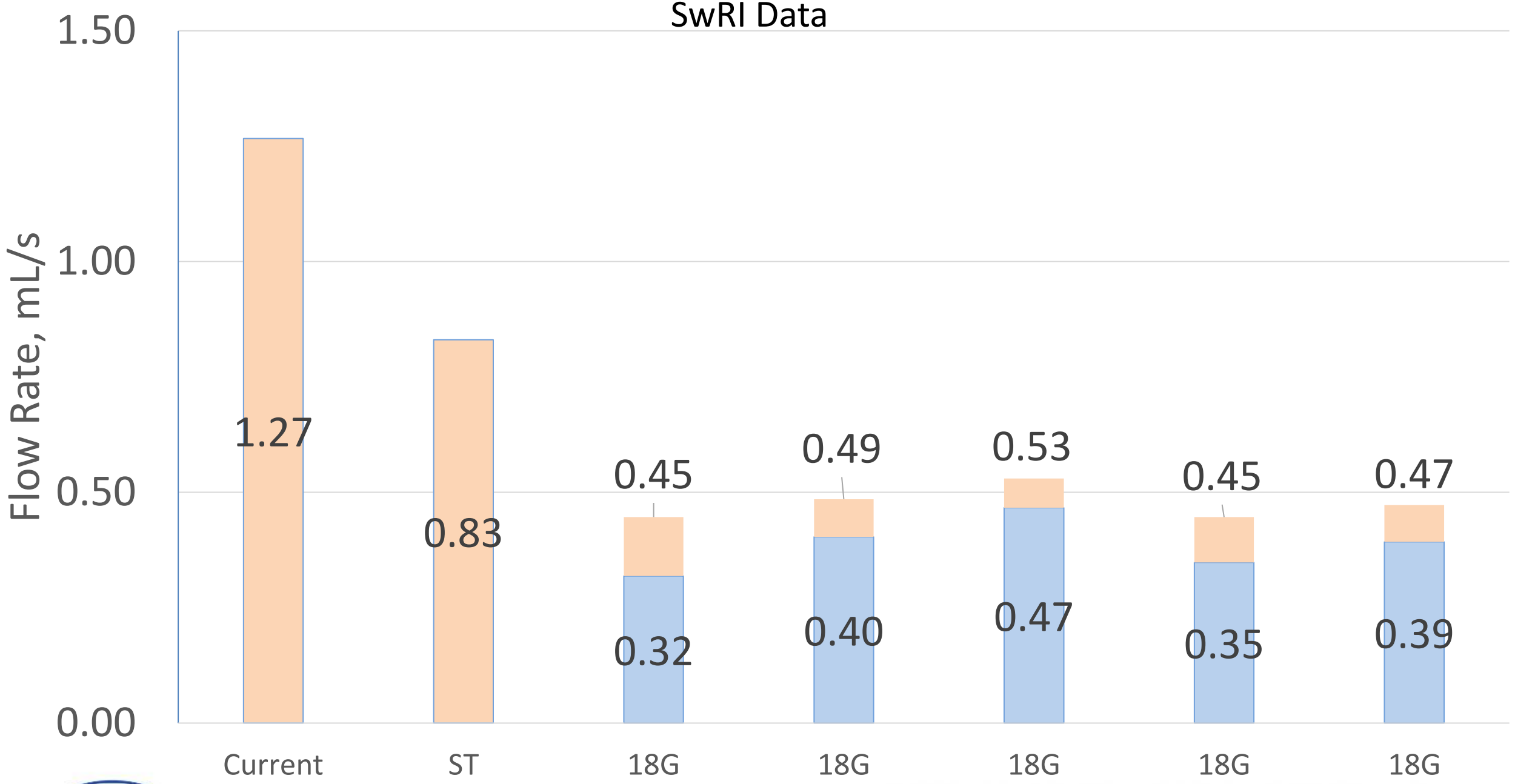
SwRI Data



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SwRI Update

- First Sample
  - Broke down in last 5 secs.
  - Did separate into 3 layers, as noted when gelling was viable.
- ST Blade
  - Gelling occurred but not as substantially.
- 18G Blade
  - First 45s of funnel, sample retains gelling. After 45s, sample quickly thins
  - Separation is observed within 15 mins.

- Over time, on the EOT sample a thicker layer formed on top of the water layer: gel to emulsion
- Record how long to separate
- Will run at 14K speed and another run add 20 g water for 2nd addition

EOGT AFTON METHOD
OIL F (CMIR-182325) FLOW RATE VOLUMES

Intertek Data

Time, seconds	Test 1, 40C (10/17/2024)	Test 2, 40C (10/17/2024)	Test 3, 45C (10/21/2024)	Test 4, 45C (10/21/2024)	Test 5, 45C (10/21/2024)
15	16	18	8	37	13
30	35	37	15	58	30
45	44	49	23	67	39
60	55	58	31		48
75	60	67	39	-	56
90	67	71	41	-	63
105	-	-	53	-	70
120	-	-	60	-	
135	-	-	67	-	

- Using oils from EOGT Large Volume Version
- All oils homogenized per Afton Method Version 7.1 (7,000 rpm for 30 seconds & 14,000rpm for 90 seconds)
- 40C oils stored for 1 day
- 45C oils stored for 3 days

EOGT AFTON METHOD
OIL F (CMIR-182325) FLOW RATE RESULTS

Intertek Data

Time (seconds)	Flow Rate Equation	Test 1, 40C (10/17/2024)	Test 2, 40C (10/17/2024)	Test 3, 45C (10/21/2024)	Test 4*, 45C (10/21/2024)	Test 5, 45C (10/21/2024)
15	$V_{15}/_{15}$	1.07	1.20	0.53	2.47	0.87
30	$V_{30}/_{30}$	1.17	1.23	0.50	1.93	1.00
45	$V_{45}/_{45}$	0.98	1.09	0.51	1.49	0.87
60	$V_{60}/_{60}$	0.92	0.97	0.52	-	0.80
75	$V_{75}/_{75}$	0.80	0.89	0.52	-	0.75
90	$V_{90}/_{90}$	0.74	0.79	0.46	-	0.70
105	$V_{105}/_{105}$	-	-	0.50	-	0.67
120	$V_{120}/_{120}$	-	-	0.50	-	
135	$V_{135}/_{135}$	-	-	0.50	-	

EOGT AFTON METHOD
OIL F (CMIR-182325) FLOW RATE RESULTS

Intertek Data

Time (seconds)	Flow Rate Equation	Test 1, 40C (10/17/2024)	Test 2, 40C (10/17/2024)	Test 3, 45C (10/21/2024)	Test 4*, 45C (10/21/2024)	Test 5, 45C (10/21/2024)
15	$V_{15}/_{15}$	1.07	1.20	0.53	2.47	0.87
30	$V_{30} - V_{15}/_{15}$	1.27	1.27	0.47	1.40	1.13
45	$V_{45} - V_{30}/_{15}$	0.60	0.80	0.53	0.60	0.60
60	$V_{60} - V_{45}/_{15}$	0.73	0.60	0.53	-	0.60
75	$V_{75} - V_{60}/_{15}$	0.33	0.60	0.53	-	0.53
90	$V_{90} - V_{75}/_{15}$	0.47	0.27	0.13	-	0.47
105	$V_{105} - V_{90}/_{15}$	-	-	0.80	-	0.47
120	$V_{120} - V_{105}/_{15}$	-	-	0.47	-	
135	$V_{135} - V_{120}/_{15}$	-	-	0.47	-	
	Average Flow Rates	0.74 mL/s	0.79 mL/s	0.50 mL/s	1.49 mL/s	0.67 mL/s

EOGT AFTON METHOD
OIL K (CMIR-182324) FLOW RATE VOLUMES

Intertek Data

Time (seconds)	Test 1, 40C (10/18/2024)	Test 2, 40C (10/18/2024)
15	10	10
30	20	19
45	28	27
60	37	35
75	44	43
90	52	51
105	59	57
120	65	64
135	70	69

- All oils homogenized per Afton Method Version 7.1 (7,000 rpm for 30 seconds & 14,000rpm for 90 seconds)
- 40C oils stored for 1 day

EOGT AFTON METHOD
OIL K (CMIR-182324) FLOW RATE RESULTS

Intertek Data

Time (seconds)	Flow Rate Equation	Test 1, 40C (10/18/2024)	Test 2, 40C (10/18/2024)
15	$V_{15}/_{15}$	0.67	0.67
30	$V_{30}/_{30}$	0.67	0.63
45	$V_{45}/_{45}$	0.62	0.60
60	$V_{60}/_{60}$	0.62	0.58
75	$V_{75}/_{75}$	0.59	0.57
90	$V_{90}/_{90}$	0.58	0.57
105	$V_{105}/_{105}$	0.56	0.54
120	$V_{120}/_{120}$	0.54	0.53
135	$V_{135}/_{135}$	0.52	0.51

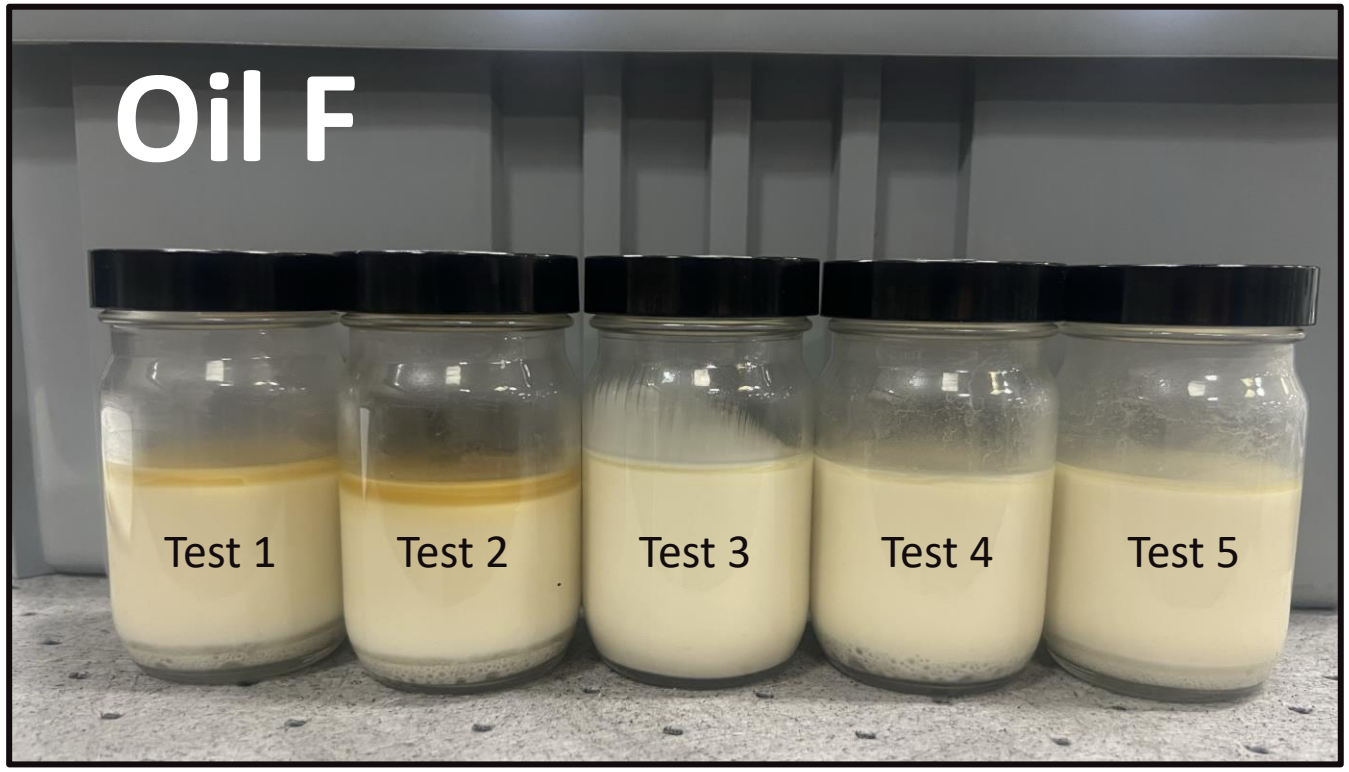
EOGT AFTON METHOD
OIL K (CMIR-182324) FLOW RATE RESULTS

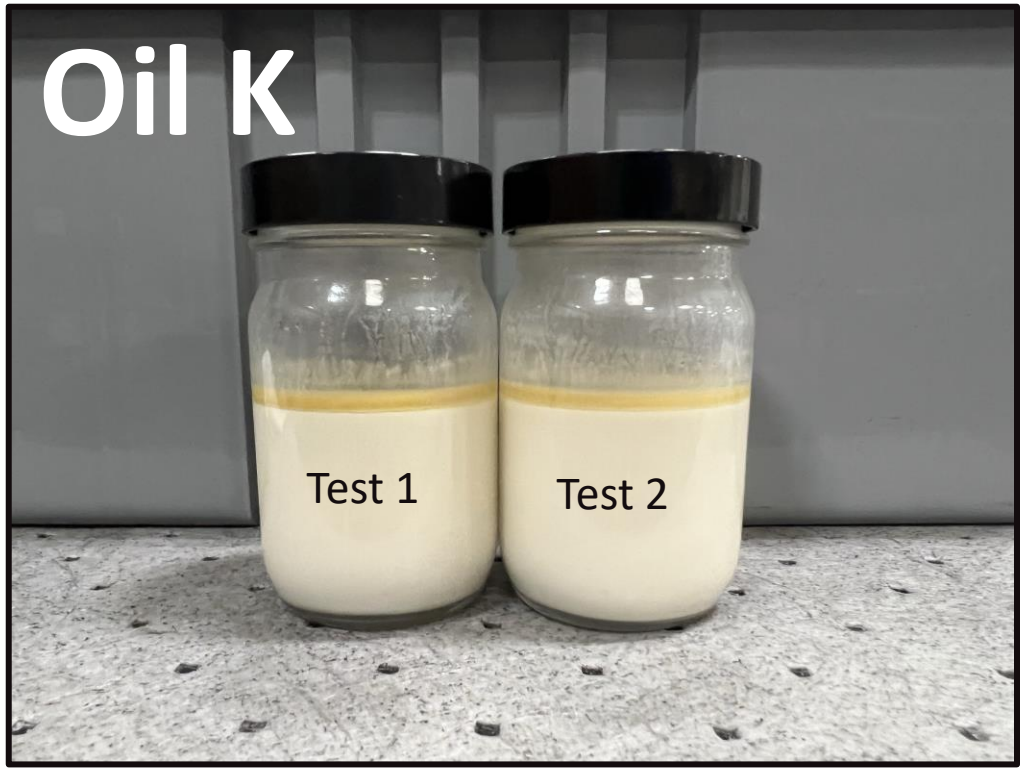
Intertek Data

Time (seconds)	Flow Rate Equation	Test 1, 40C (10/18/2024)	Test 2, 40C (10/18/2024)
15	$V_{15}/_{15}$	0.67	0.67
30	$V_{30} - V_{15}/_{15}$	0.67	0.60
45	$V_{45} - V_{30}/_{15}$	0.53	0.53
60	$V_{60} - V_{45}/_{15}$	0.60	053
75	$V_{75} - V_{60}/_{15}$	0.47	0.53
90	$V_{90} - V_{75}/_{15}$	0.53	0.53
105	$V_{105} - V_{90}/_{15}$	0.47	0.40
120	$V_{120} - V_{105}/_{15}$	0.40	0.47
135	$V_{135} - V_{120}/_{15}$	0.33	0.33
	Average Flow Rates	0.52 mL/s	0.51 mL/s

AFTON METHOD IMAGES
OIL F AND OIL K-END OF ANALYSIS

Intertek Data





Notes:

- Images taken 10/22/2024
- Test 1 and 2 separation occurred immediately after flow rates were measured.
- Test 4 and 5 separation observed on 10/22/2024, less than 24 hours after flow rates were measured.

intertek

Total Quality. Assured.

EOGT Workshop

- Attendees (16 in-person):
  - Valvoline: 2 in-person
  - Intertek: 3 In-person
  - Afton: 2 in-person
  - Chevron Oronite: 1in-person
  - SwRI: 4 in-person
  - Infineum: 1 in-person
  - Ford: 1 In-person
  - Lubrizol: 2 in-person
- Where: SwRI, San Antonio, TX
- When: Oct 28-29, 2024
- What: Review Afton EOGT method
- To Do: participants to let Yong-li know names of attending and participating individuals; Yongli to send out location/hotel info/map

EOGT Workshop Tentative Agenda

- Saturday Oct 26: SwRI prep acetic acid solution
- Sunday Oct 27: SwRI mix 2 Oil F and acid solutions
- Oil F samples to order 12 Oil F samples

Date/time	Item
Monday 8:30 AM	Introductions – B171 LCR
9:00 AM	Afton show sample prep – Lab
9:45 AM	Afton show shearing using Oct 27 samples - Lab
10:30 AM	Review data – B171 LCR
11:30 AM	Lunch
12:30	Participants try sample prep / review steps – Lab
2:00 PM	Participants practice shearing – Lab
3:30 PM	Finish

Date/time	Item
Tuesday 9:00 AM	Afton show sample prep – Lab
9:45 AM	Afton show shearing using Oct 28 samples - Lab
10:30 AM	Review data – B171 LCR
11:30AM	Lunch
12:30	Participants try sample prep / review steps – Lab
2:00 PM	Participants practice shearing – Lab
3:00 PM	Finish

Action Items and Next Meeting

- Root Cause group to consider if pH was root cause for lack of differentiation in original EOGT method; ask labs to run pH or TBN on fresh EOT sample (ISP, Intertek)
- Group to review TBN results on fresh and EOT samples.
- Any other labs wanting to participate in ILS, please let Yong-Li know.
- Afton and Savant to request new Oil F and K from TMC and repeat Afton method
- Valvoline to run modified original EOGT and possibly Afton method
- SwRI to run additional Afton Method tests and collect flow time volumes
- Savant, SwRI, Afton to share videos of blending step, starting after water addition
- *Yuliza to bring IKA homogenizer for workshop*
- *Rob will be coming in Mon afternoon*

- Next Meeting: Monday Nov 4 at 9AM CDT for 1 hr ?

Thank you for your support!

Participants		
Method Development (11)	Oil Donations (9)	Testing Labs (7)
Afton ExxonMobil Ford Infineum Intertek ISP Lubrizol Oronite Savant SwRI TMC	Afton Ford Infineum Lubrizol OH Technologies (donate filters only) Oronite Subaru TMC (collection, shipping only) Toyota	Afton Intertek ISP Savant SwRI TMC (monitoring system only) Valvoline