Sequence VH Surveillance Panel Meeting

Teams

Tuesday, May 8, 2025, 9:00 am – 11:00 am EST

1.0) Attendance

Afton:	B. Campbell, B. Maddock, A. Stone
Exxon	L. Salvi
Ford:	M. Deegan, R. Zdrodowski
GM:	B. Cosgrove
Haltermann Solutions:	E. Hennessy, I. Mathur
Infineum:	J. Anthony
Intertek:	A. Lopez
Lubrizol:	T. Catanese
OHT:	J. Bowden
Oronite:	R. Affinito, R. Stockwell
Shell:	S. Demel, J. Hsu
SwRI:	D. Engstrom, T. Kostan, P. Lang
TMC:	D. Beck, S. Moyer
TEI:	D. Lanctot
Toyota:	V. Deshpande

2.0) Approval of Minutes

- March 4, 2025 meeting minutes voice-approved

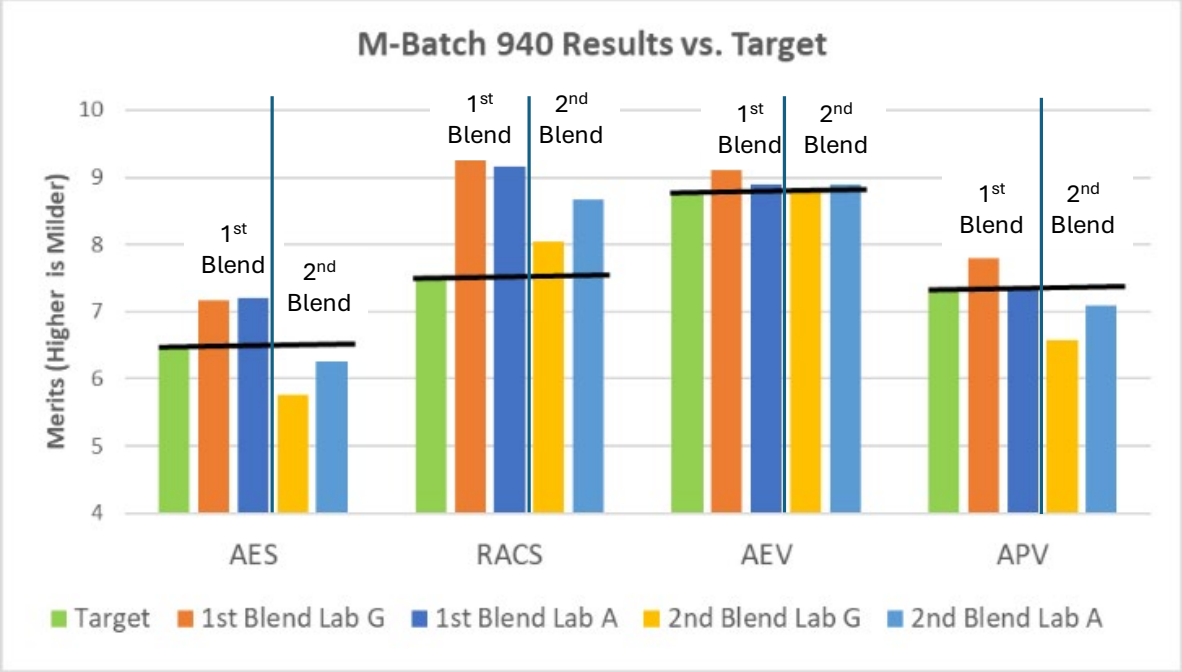
3.0) Fuel Supply Update

3.1) N-Batch Inventory:

- IAR has 12,000 gallons (for 2 months with the low demand) and will run references on N-batch 2 tests in a couple of weeks.
- SwRI estimates 2-3 months of fuel left
- Afton is not running much and has about 5,000 gallons (2-3 months)
- LZ has 4000 gallons and will try another reference in a couple of weeks
- SwRI just passed a reference and will reference another one.
- Afton is letting 1 stand expire

3.0) M-Batch Precision Matrix

3.1) M-000054-1 test results



Description	AES	RACS	ln(10-RAC)	AEV	APV
	Target				
	6.47	7.77	0.8041	8.77	7.35
	M-000054				
1st Blend Lab G	7.17	9.26	-0.3011	9.10	7.80
1st Blend Lab A	7.21	9.16	-0.1744	8.89	7.36
Std. Dev. Lab G	1.43		4.72	0.67	0.92
Std. Dev. Lab A	1.51		4.18	0.24	0.02
	M-000054-1				
2nd Blend Lab G	5.76	8.04	0.6729	8.79	6.57
2nd Blend Lab A	6.25	8.67	0.2852	8.90	7.10
Std. Dev. Lab G	-1.45		-0.56	0.04	-1.59
Std. Dev. Lab A	-0.45		-2.22	0.27	-0.51

Note: Standard deviations > abs(1.5) are in red

3.2) Fuel Dilution Discussion

- SwRI presentation on fuel dilution
  - SwRI doesn't see a correlation between fuel dilution and severity.
  - It is expected that results are within a standard deviation of expected result
- Afton's presentation:
  - AES severity is same as N-batch
  - RAC is milder
  - AEV is on target
  - APV is severe
    - High APV severity shows that RACS parts have low varnish
  - M-Batch fuel dilution and severity continues to trend high
- Ford is concerned with high fuel dilution
  - Tolerated high fuel dilution in N-batch because we had no choice
  - Prefer to start at lower fuel dilution
  - High fuel dilution may cause excessive engine wear
    - SwRI and IAR have not observed high engine wear due to high fuel dilution, including low viscosity oil.
- Afton has observed that deposit distribution has changed over time.
- SwRI thinks the critical parameter ratings are acceptable.
- IAR believes we should go back to the fuel that resulted in 13% fuel dilution.
- The 2 940 were further away from target than these results.
- Adjusting the fuel may move us farther from target.
- IAR
  - 1) Continue to run this fuel to get more data and let SAs catchup.
  - 2) This fuel is running more severe than the N-batch is now.
- Haltermann asked for direction from Ford on how to move the fuel dilution.
  - Haltermann will move the fuel dilution to satisfy Ford and the panel.
  - Ford asked what needs to change in the fuel to get us back to same sludge and varnish distribution.
  - IAR showed the 1011-1 results and made the following observations,
    - Iron concentration levels are normal
      - IAR has not observed engine wear with low viscosity oils
    - OSC clogging is high
    - The engine did not require an oil add until 120 hours due to high fuel dilution.
  - Ford asked for AES values over time from VG to VH.
- Haltermann showed slides describing the heavy ends of the fuel.

3.3) M000054 fuel adjustment discussion

- Haltermann went through the attached presentation to explain how the fuel was adjusted in the tank before adding additional components to the pilot batch.
    - Higher washed and unwashed gums
    - Heavier fuel components
    - The result is 97.1% of M000054 with 2.9% of the adjustment cocktail in the full tank and add 0.3% of a different component to pilot batch that was shipped to the labs as M000054-1.
    - Toyota asked if both the 2.9% and 0.3% added sludge producing compounds.
    - Haltermann stated the components added the tank big batch were mostly to produce sludge and the 0.3% added to the pilot batch mostly increased fuel dilution.

3.4) Fuel dilution vs. severity discussion

- M000054-1 AES was more severe than the SP believed was acceptable (RACS was mild, AEV and APV were on target)
- The high fuel dilution value was the major SP complaint about M000054-1.
- There was a discussion about shutting the next tests with M000054-2 down before completion if the FD48 value was higher than 20%.
    - IAR was for shutting the tests down early in the interest of saving time if high dilution was the rejection criteria.
    - Oronite, Afton, Infineum, SwRI were for letting the test finish due to the expense of starting the test and getting more data from the fuel.
    - IAR deferred to the rest of the group to finish the tests, regardless of the preliminary fuel dilution numbers.

3.5) M000054-2 precision matrix test plan

- Afton asked if Lab D is waiting until the Lab A RO931 and Lab G RO1011-1 tests are completed and approved.
    - The Chair and Ford requested IAR, SwRI, and Afton to run a test on M000054-2.
    - IAR recommended we should run complete tests G2 1011-1 and A2 931, review the data before deciding on running more precision matrix tests.
    - No consensus on Afton running a test for the first row of the test matrix.

Motion by I. Mathur makes a motion to test the full batch, M000054-2, as Runs A2 931, G2 1011-1.
Motion Seconded by A. Lopez

Chair calls for a vote:

Afton:	B. Maddock	Approve
Exxon:	L. Salvi	Approve
Ford:	R. Zdrodowski for M. Deegan	Approve
GM:	T. Cushing	Not present
Haltermann:	I. Mathur for E. Hennessy	Approve
IMTS:	D. Passmore	Not present

Infineum:	J. Anthony	Approve
Intertek:	A. Lopez	Approve
Lubrizol:	T. Catanese	Approve
OHT:	J. Bowden	Waive
Oronite:	R. Stockwell	Approve
Shell:	J. Hsu	Approve
SwRI:	D. Engstrom	Approve
TMC:	D. Beck	Waive
Toyota:	V. Despande	Not present

Motion carries with 10 Approve and 2 Waive votes

Precision Matrix with Lab B

A1	A2	G1	G2	D	B
940	931	940	1011-1	1011-1	931
1011-1	1011-1	931	931	931	1011-1
931	-	1011-1	-	1011-1	931

Precision Matrix without Lab B

A1	A2	G1	G2	D
940	931	940	1011-1	931
931	1011-1	1011-1	931	1011-1
1011-1	931	931	1011-1	931

3.6) M000054-2 test schedule

- Haltermann has M-000054-2 fuel blended.
  - Fuel will be delivered when Lab A and Lab G are ready to accept the deliveries.
  - Lab A and Lab G requested 2,000 gallons each, which is good for 2 VH tests each.
- Afton does not want the pilot batch fuel to be picked up from the labs and returned to the M000054-2 fuel tank.
  - Oronite agrees that the fuel is not to be put back in the tank after any fuel from the tank is delivered for testing.
- Haltermann will give Lab A and Lab G directions on how to dispose of the remaining pilot batch fuel.

3.7) M-Batch Fuel Precision Matrix Test Dates

- Batch M-000054-0: RO940 Lab A (176849-VH) and Lab G (176844-VH) January 2025
- Batch M-000054-1: RO940 Lab A (175651-VH) and Lab G (175644-VH) April 2025

- Batch M-000054-2: RO931 Lab A (193860-VH), RO1011-1 Lab G (188657-VH) May 2025

4.0) Old Business

- Lab B failed the latest VH calibration test.
- Lab B is going to pay for their VH tests on the M-batch fuel and offer the data for the precision matrix even if the stand is not calibrated.
- SwRI believes that Lab B data from an uncalibrated stand can be included if the data meets statistical requirements.

5.0) New Business

W. Hairston has joined Haltermann Carless and will send his contact information to the SP when his email is assigned.

6.0) Meeting Adjourned

- Meeting adjourned at 10:45 am EST
- The next meeting will be scheduled after Lab A and Lab G have scheduled M000054-2 tests.

M-000054-2 Fuel Approval Matrix

May 2025

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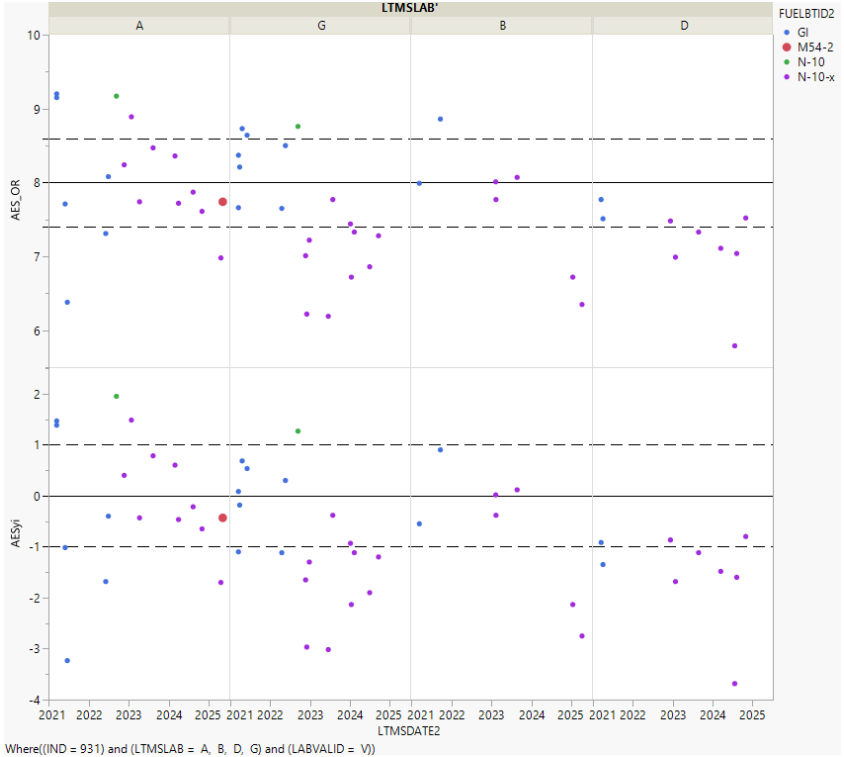
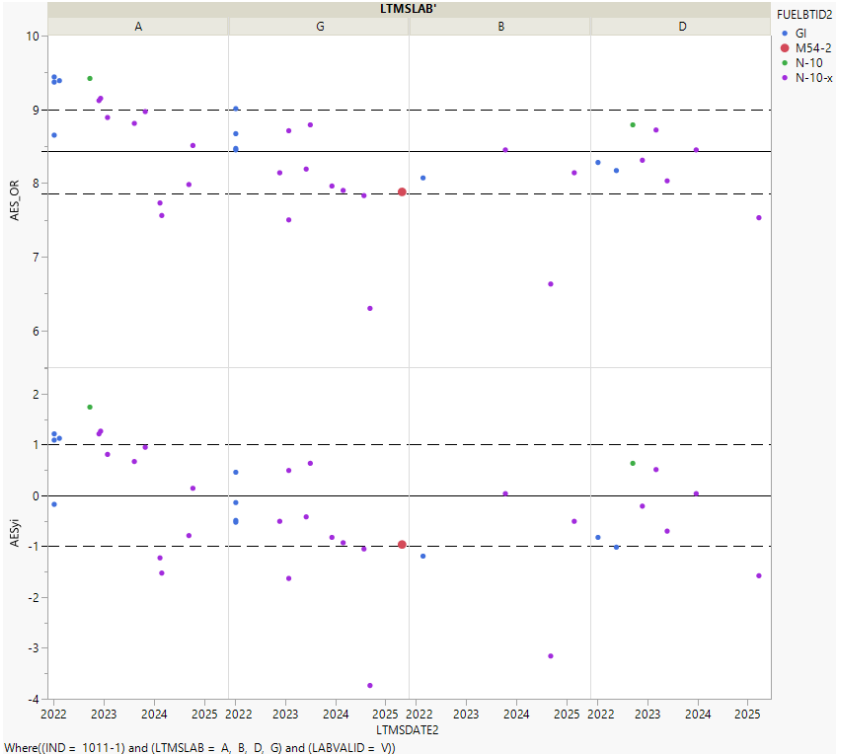
M-000054-2 Fuel Approval Matrix - AES





931

1011-1

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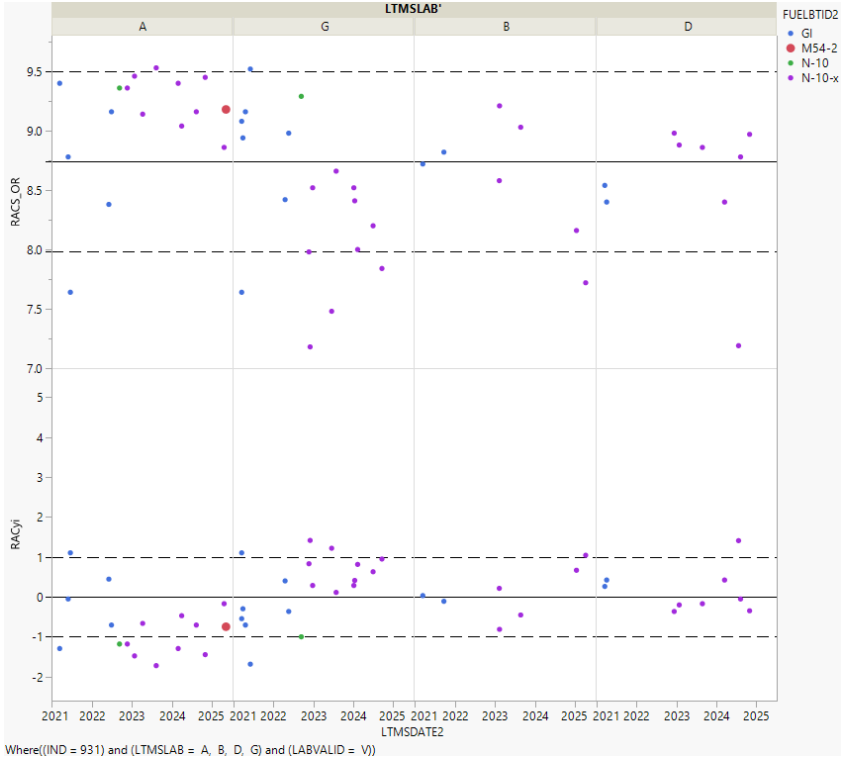
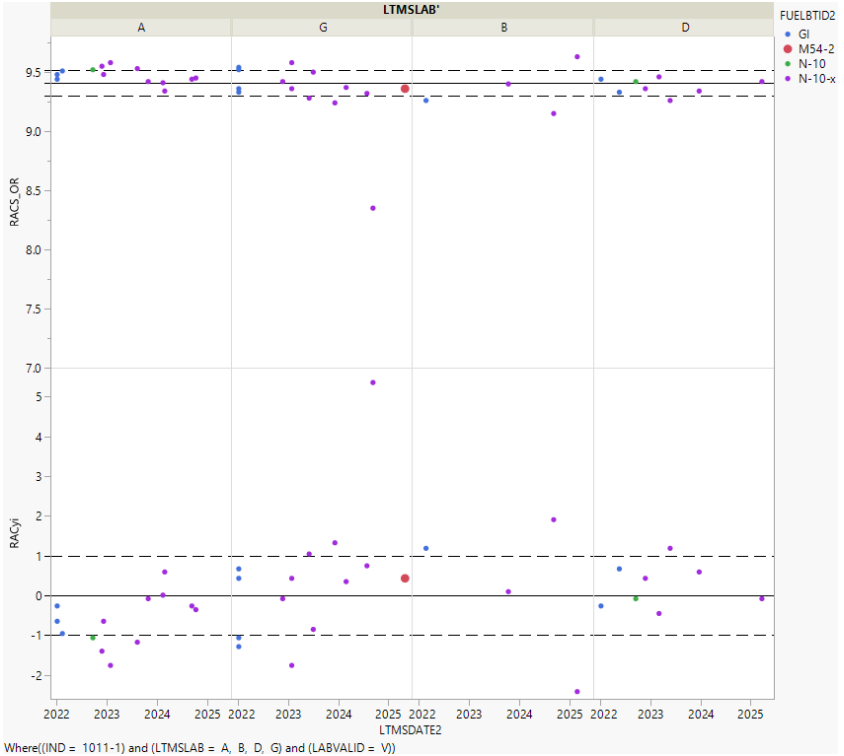
M-000054-2 Fuel Approval Matrix - RAC





931

1011-1

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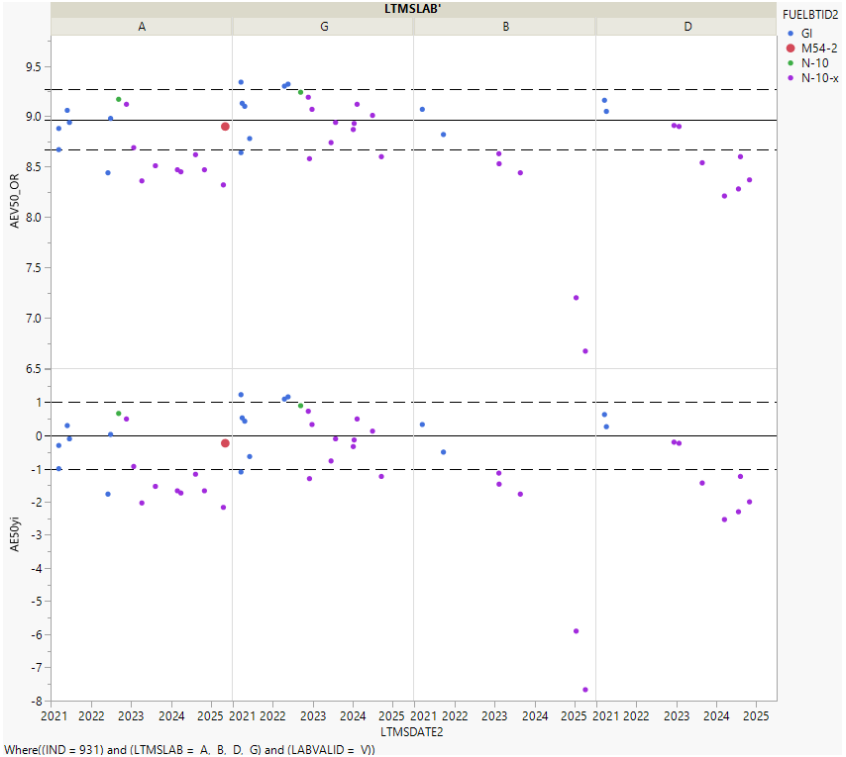
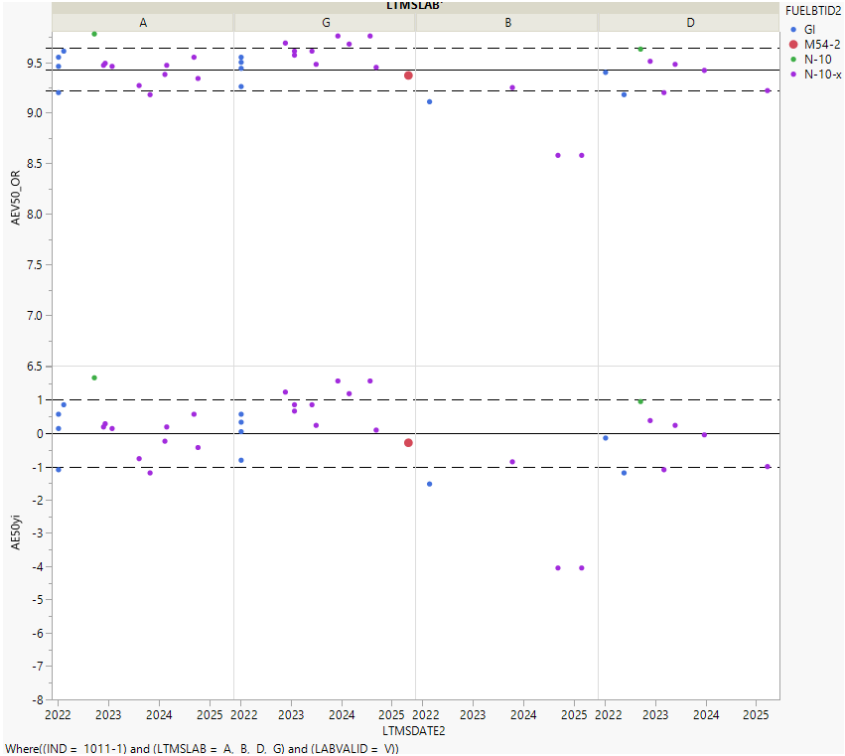
M-000054-2 Fuel Approval Matrix - AEV



931



1011-1

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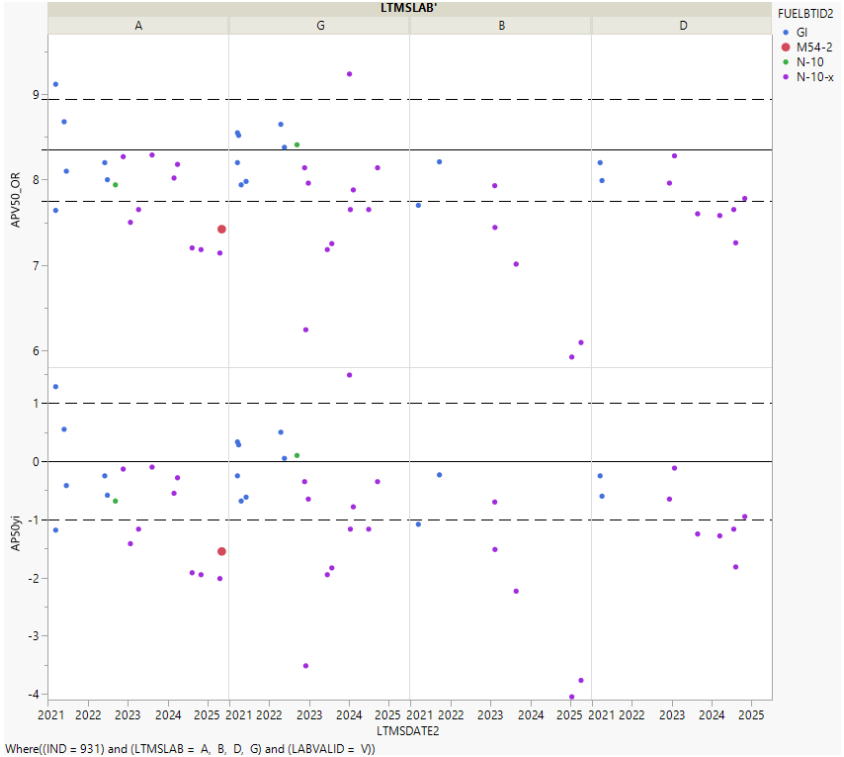
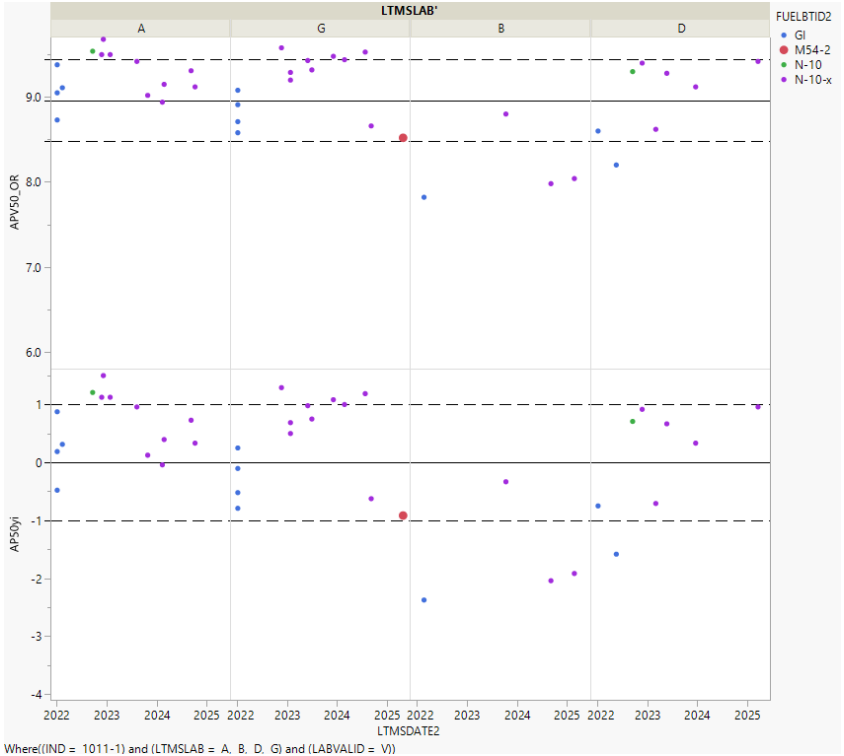
M-000054-2 Fuel Approval Matrix - APV



931



1011-1

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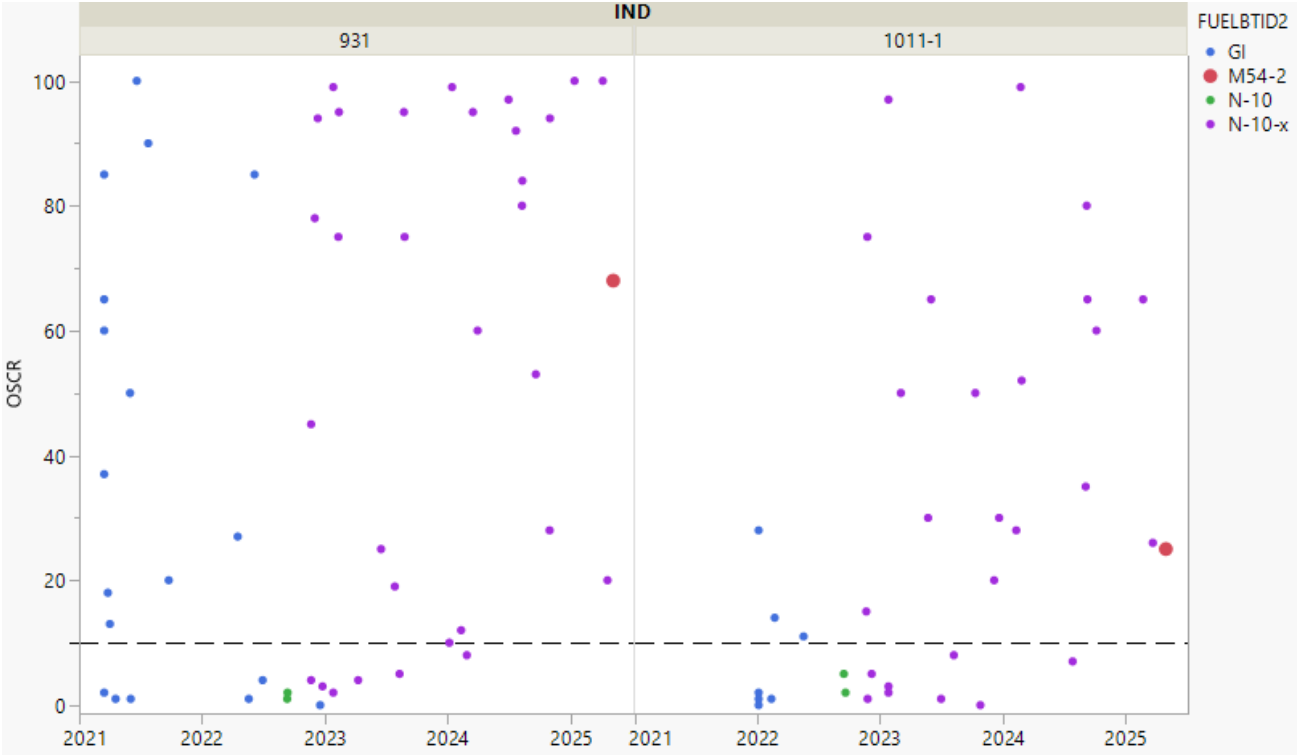
M-000054-2 Fuel Approval Matrix - OSCR



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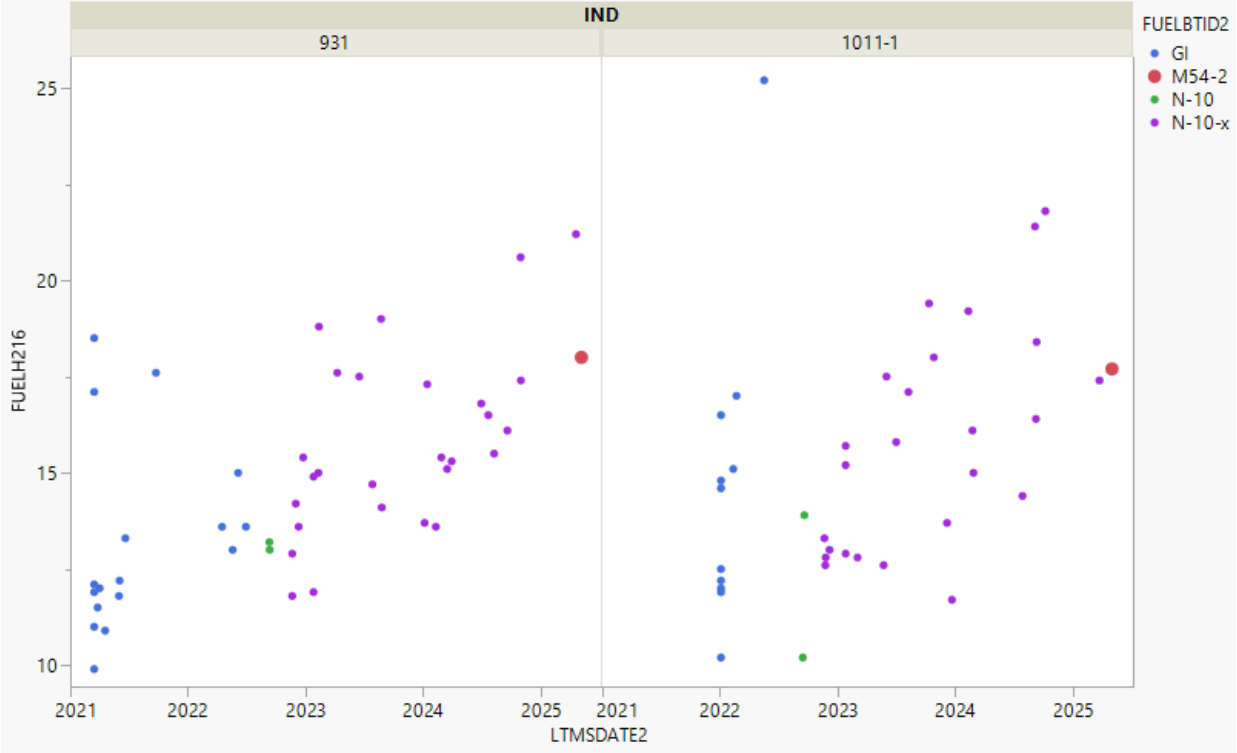
M-000054-2 Fuel Approval Matrix – Fuel Dilution



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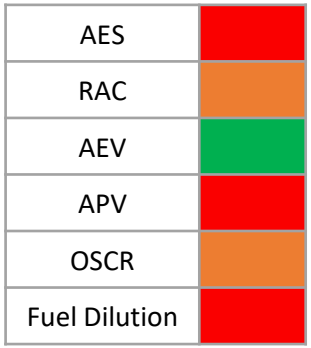
M-000054-2 Fuel Approval Matrix – Afton's perspective

- The results are too severe, don't discriminate, and fuel dilution is high

- Average Engine Sludge (AES)
  - Both ROs have overlapping targets. Results within each lab are in-line with N-10-x and severe
- Rocker Arm Cover Sludge (RAC)
  - In-line with N-10-x and slightly mild
  - Sludge distribution has changed to lower in the engine
- Average Engine Varnish (AEV)
  - Pleasantly on-target
  - Varnish distribution has changed to mild baffles and severe pistons
- Average Piston Varnish (APV)
  - Severe of target, severe of N-10-x results
- Oil Screen Clogging Rating (OSCR)
  - Poorly controlled, in-line with previous fuel batches
- Fuel Dilution
  - Near all-time high



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M-000054-1 Fuel Approval Matrix rejected as too severe

April 2025

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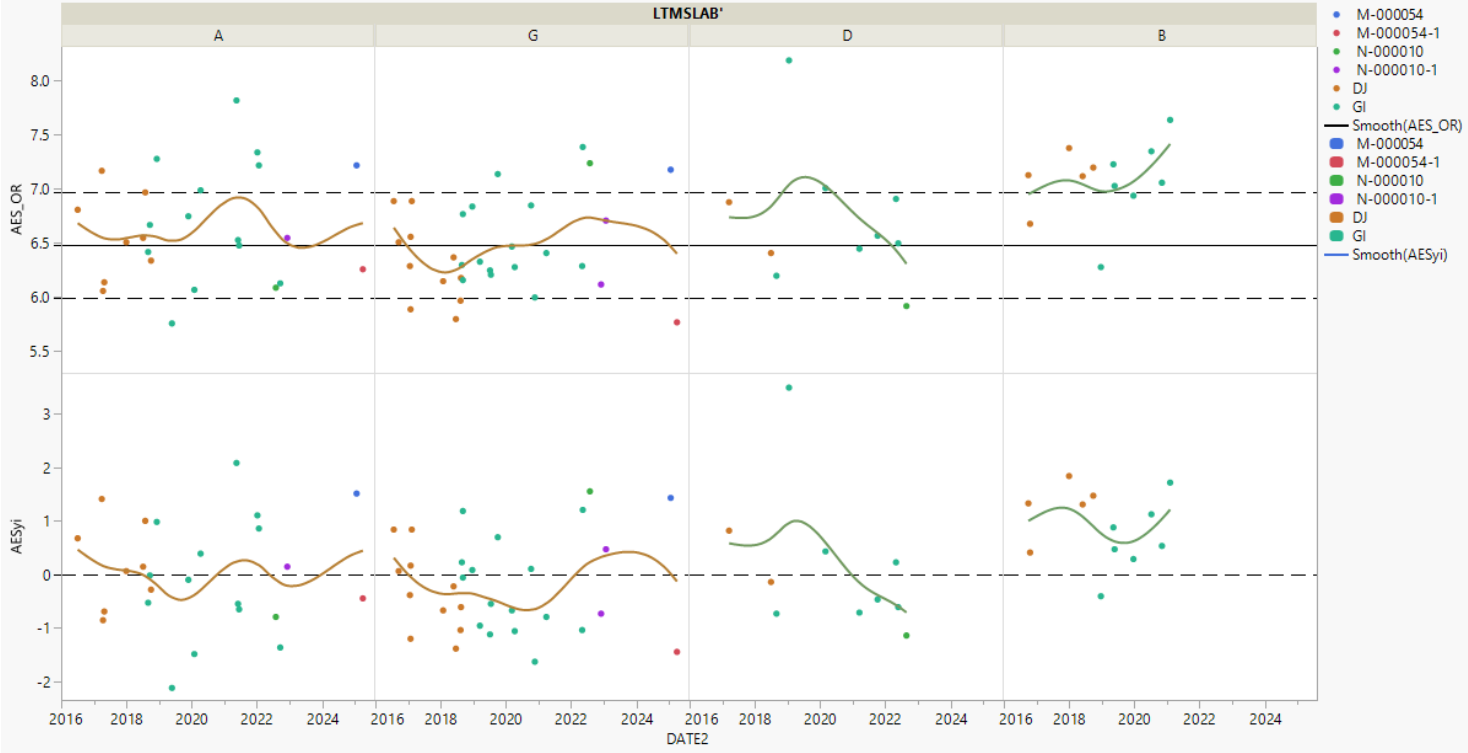
M-000054-1 Fuel Approval Matrix – AES 940 only



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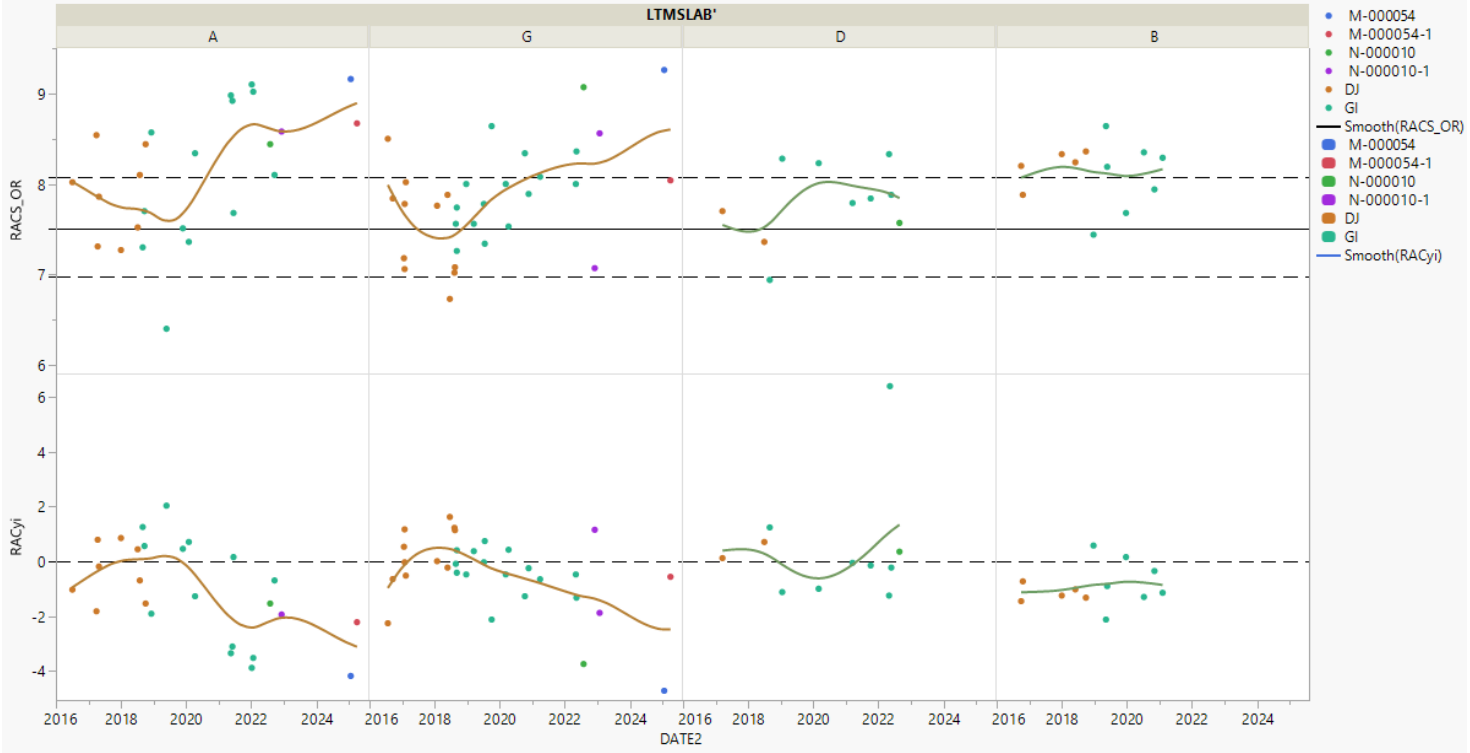
M-000054-1 Fuel Approval Matrix – RAC 940 only



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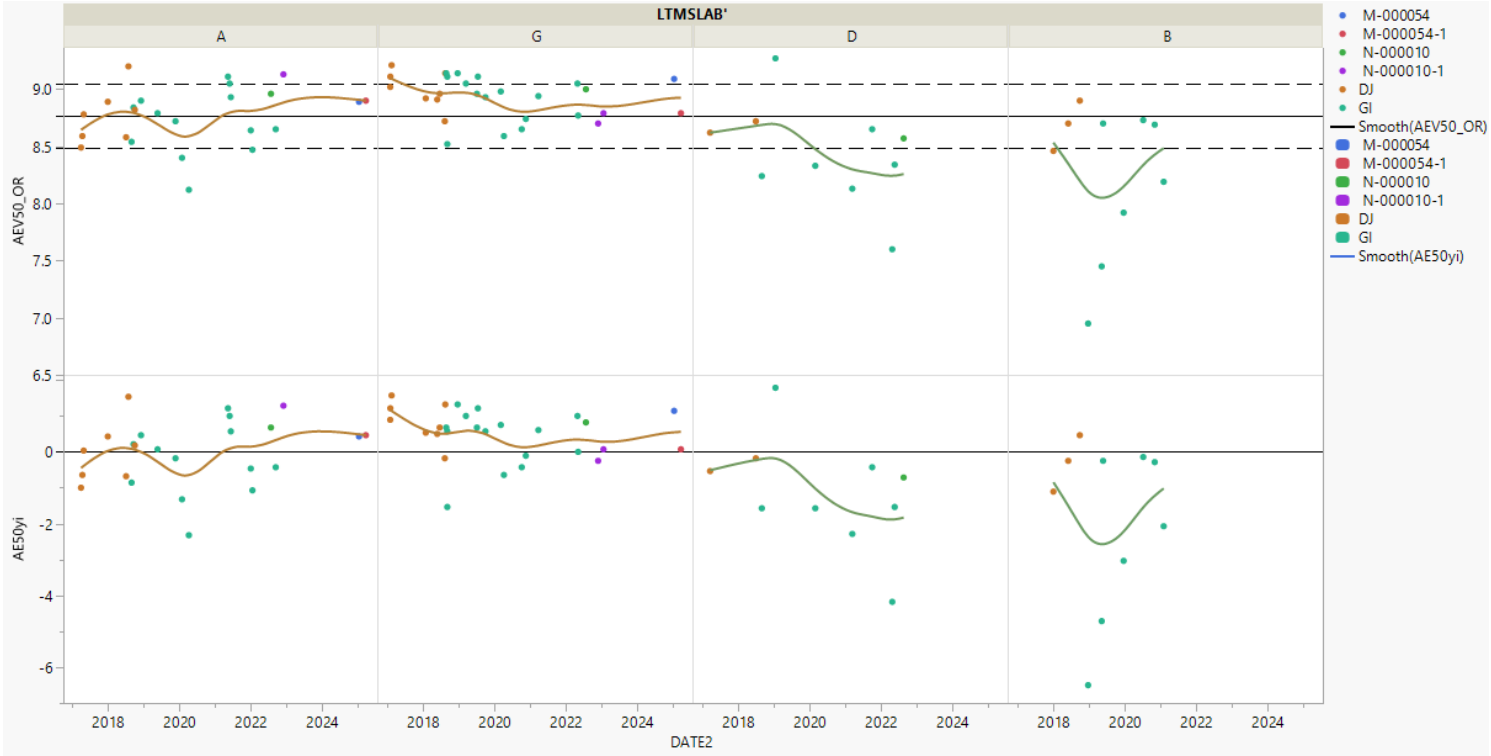
M-000054-1 Fuel Approval Matrix – AEV 940 only



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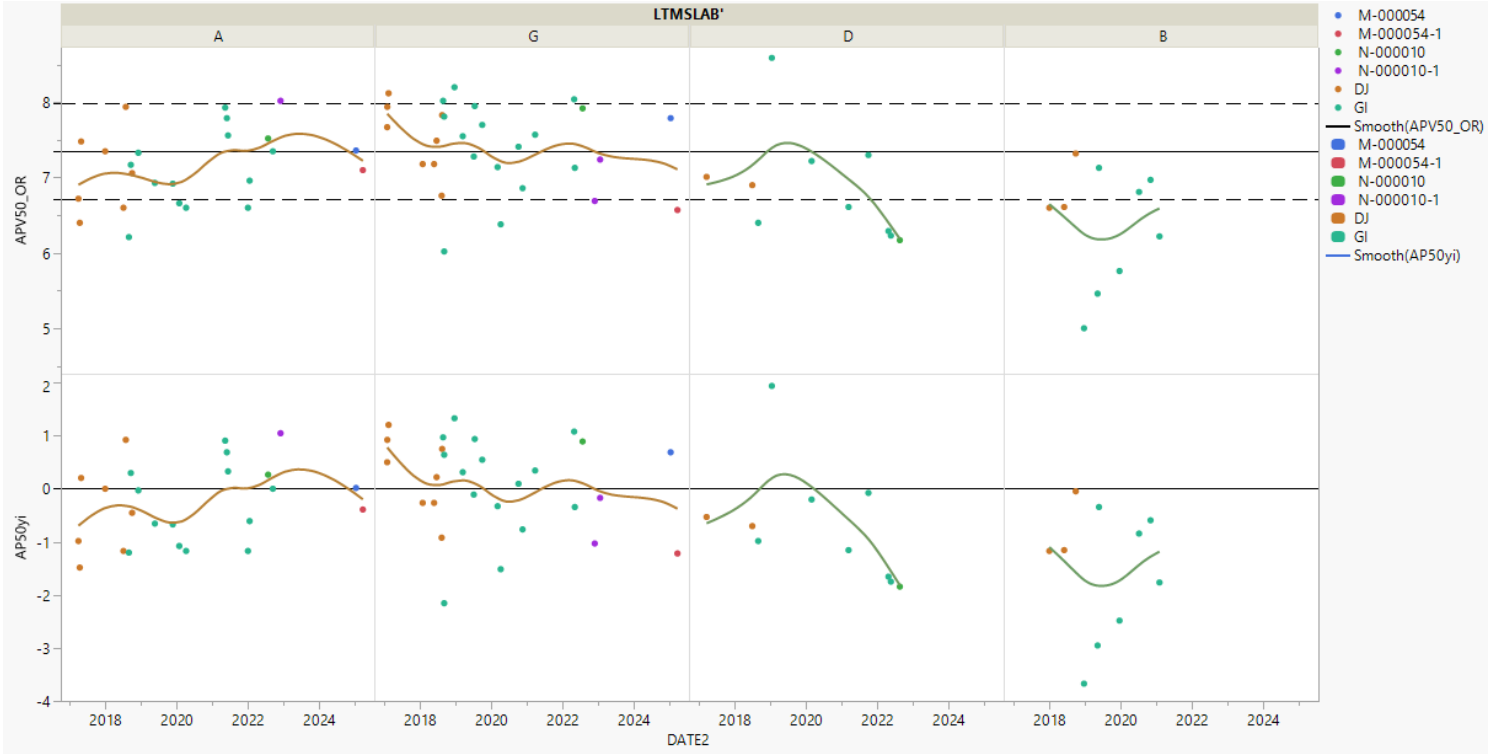
M-000054-1 Fuel Approval Matrix – APV 940 only



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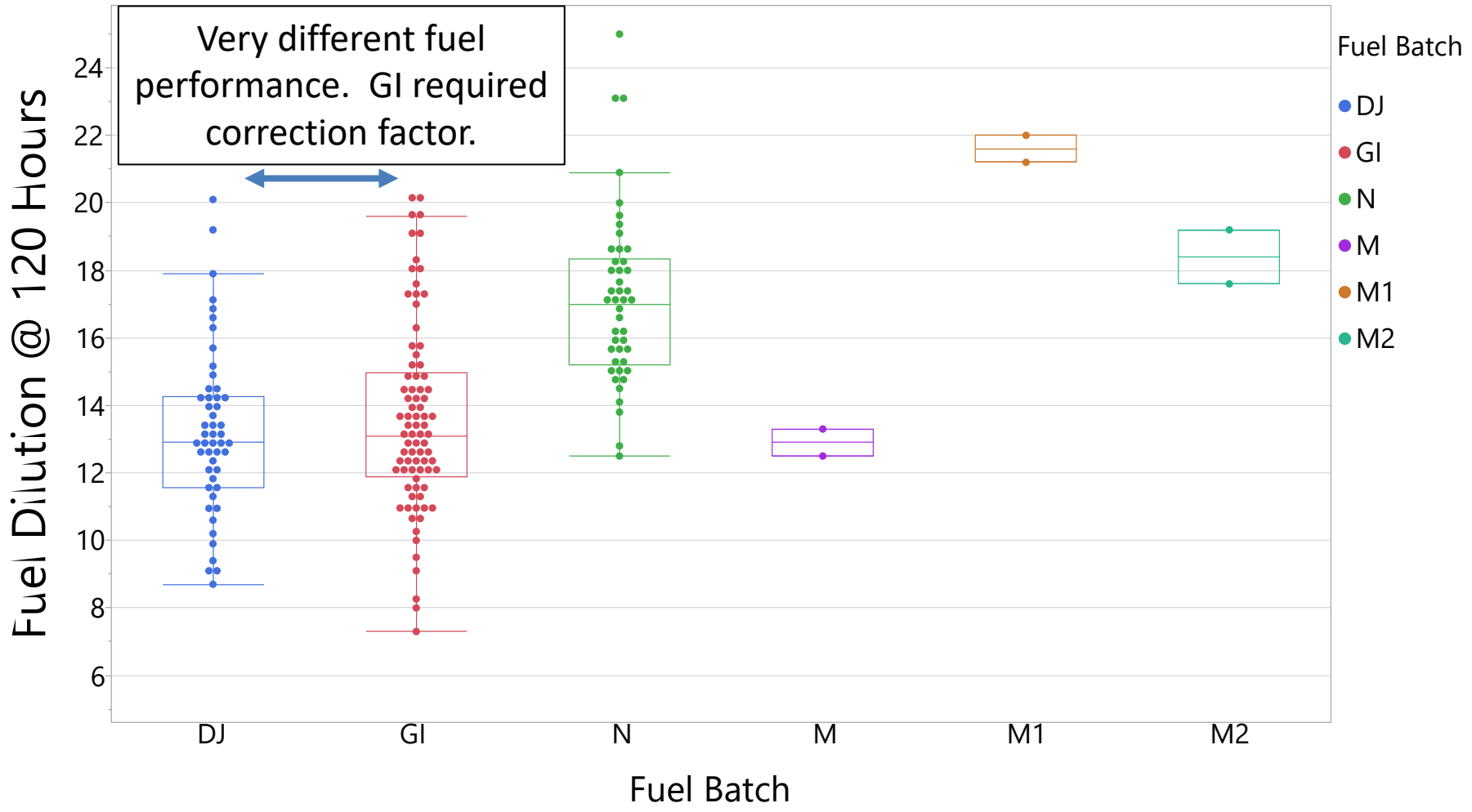
Sequence VH
Fuel Dilution and Severity Data

SOUTHWEST RESEARCH INSTITUTE®

May 8, 2025

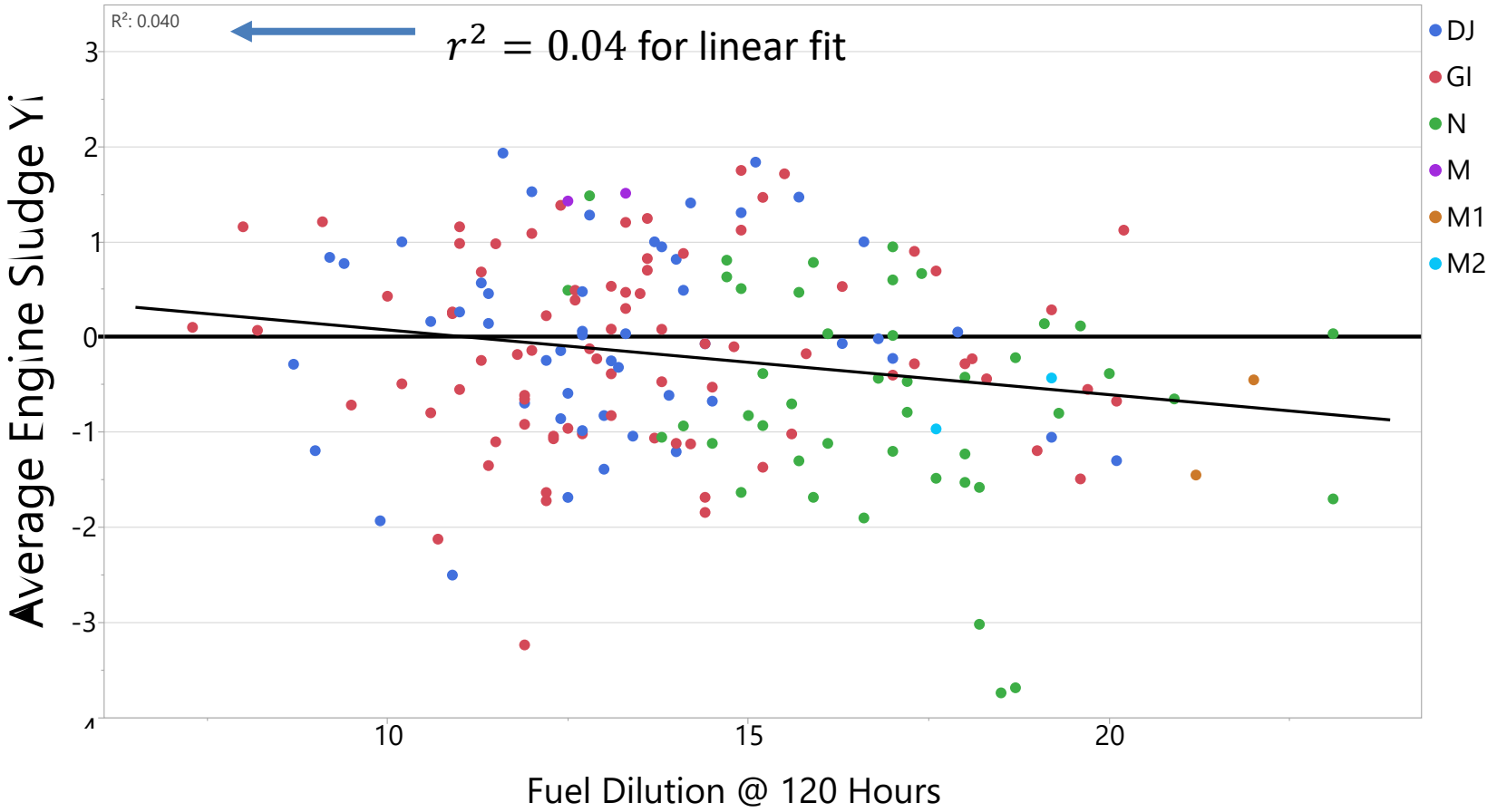
Fuel Dilution by Fuel Batch

M2 batch is higher but in the range of some N batch tests.



Average Engine Sludge vs. Fuel Dilution

There has been only a very weak correlation of fuel dilution with average engine sludge severity.



Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.76	0.367255	2.06	0.0412*
FUELH120	-0.07	0.024905	-2.73	0.0069*

Based on model coefficients, reducing fuel dilution by 5% is expected to change sludge by 0.35 standard deviations, which equates to only 0.18 merits. This difference is well within severity adjustments capabilities.

HF295 Adjustment.

Panel meeting

May 8th 2025

Indresh Mathur

Haltermann Solutions

Monument Renewables & Fuels

Houston, TX

Monument Chemical

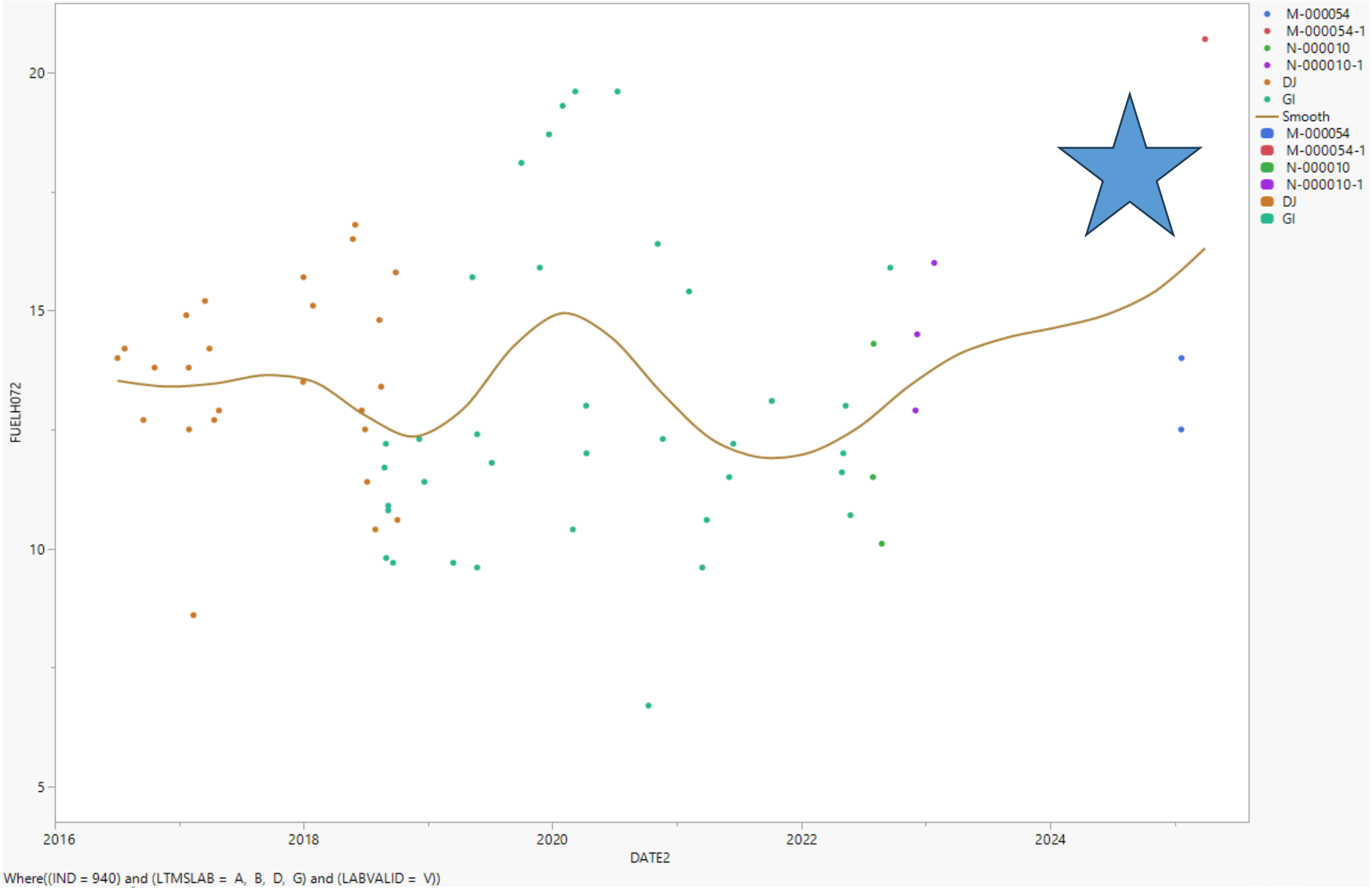
haltermannsolutions

PRODUCT:	SVGM2				Batch No	M-000054-2	M-000054-1	M-000054
PRODUCT CODE:	HF0295				Tank No.	70-1	MGNX10100	70-1
					Date:	4/17/2025	3/13/2025	1/2/2025

TEST	METHOD	UNITS	SPECIFICATIONS			RESULTS	RESULTS	RESULTS
			MIN	TARGET	MAX			
Distillation - IBP	ASTM D86[2]	°C	22.2		35.0	27.0	31.4	29.1
5%		°C				42.9	44.1	42.5
10%		°C	48.9		57.2	51.0	52.5	50.8
20%		°C				65.1	66.4	64.1
30%		°C				83.5	83.0	80.6
40%		°C				101.2	99.8	97.6
50%		°C	98.9		115.2	110.9	110.2	108.6
60%		°C				119.0	118.0	115.3
70%		°C				128.4	128.5	124.3
80%		°C				154.0	154.6	145.8
90%		°C	162.8		176.7	175.9	176.4	172.9
95%		°C				183.2	184.6	180.6
Distillation - EP		°C	196.1		212.8	201.8	207.0	199.5
Recovery		vol %		Report		98.0	97.1	97.4
Residue		vol %			2.0	1.1	1.1	0.9
Loss		vol %		Report		0.9	1.8	1.7
Gravity	ASTM D4052[1]	°API	56.5		61.2	57.0	56.7	58.0
Specific Gravity	ASTM D4052[1]	---		Report		0.7505	0.7518	0.7467
Reid Vapor Pressure	ASTM D5191[1]	kPa	60.7		63.4	62.0	61.7	63.4
Carbon	ASTM D5291[2]	wt fraction	0.8580		0.8690	0.8659	0.8677	0.8642
Hydrogen	ASTM D5291[2]	wt fraction				0.1341	0.1323	0.1358
Carbon	ASTM D3343[1]	wt fraction		Report		0.8688	0.8689	0.8665
Oxygen	ASTM D4815[2]	wt %			0.05	None Detected	None Detected	None Detected
Sulfur	ASTM D5453[1]	mg/kg	40		65	49	51	58
Lead	ASTM D3237[2]	mg/l			2.6	None Detected	None Detected	None Detected
Phosphorous	ASTM D3231[2]	mg/l			1.3	None Detected	None Detected	None Detected
Composition, aromatics	ASTM D1319[2]	vol %	29.0		35.0	34.3	34.3	30.8
Composition, aromatics	ASTM D5769[2]	vol %		Report		35.2	35.7	33.8
Composition, olefins	ASTM D1319[2]	vol %	5.0		8.0	6.4	6.4	5.8
Composition, olefins	ASTM D6550[2]	vol %	5.5	Report	7.5	6.0	6.1	6.6
Composition, saturates	ASTM D1319[2]	vol %		Report		59.3	59.3	63.4
Oxidation Stability	ASTM D525[2]	minutes	1440			1440+	1440+	1440+
Copper Corrosion	ASTM D130[2]	Class			1	1a	1a	1a
Existent gum, unwashed	ASTM D381[2]	mg/100mL			5.0	1.5	3.0	2.0
Existent gum, washed	ASTM D381[2]	mg/100mL			3.0	<0.5	0.5	<0.5
Research Octane Number	ASTM D2699[2]		97.0		99.0	98.2	97.4	98.3
Motor Octane Number	ASTM D2700[2]			Report		89.0	85.6	88.5
(R+M)/2	D2699/2700[2]			Report		93.6	91.5	93.4
Sensitivity	D2699/2700[2]		7.5			9.2	11.8	9.8
Appearance	Visual			Report		C&B	C&B	C&B
Net Heat of Combustion	ASTM D240[2]	Btu/lb		Report		18540	18883	18627
Additive, Ethyl antioxidant	calculated	ptb		Report		3.5	3.5	3.5

SVGM2	**Batch No.:**	NA30-1040	NA29-1300	M-000054	N-000010-2	GI3021NX10	DJ0121NX10
	Test Info:						
HF0295	**Tank No.:**	Lab Blend	Lab Blend	70-1	Tk79	79	T62
	Analysis Date:	1/30/2025	1/29/2025	1/2/2025	2/3/2023	11/25/2019	10/24/2015
	Sample date:			1/2/2025		Quarterly	

METHOD	UNITS	SPECIFICATIONS			RESULTS	RESULTS	RESULTS	RESULTS	RESULTS	RESULTS
		MIN	TARGET	MAX	Lab Blend	Lab Blend	COA			
ASTM D86[2]	°C	22.2		35.0	29.5	27.3	29.1	30.1	29.9	27.9
	°C				45.1	44.4	42.5	47.6	44.1	41.6
	°C	48.9		57.2	53.3	52.9	50.8	56.3	52.7	49.7
	°C				67.4	67.4	64.1	71.8	67.0	62.4
	°C				84.6	85.3	80.6	88.1	83.5	77.6
	°C				101.7	102.2	97.6	102.2	100.0	95.9
	°C	98.9		115.2	111.3	112.3	108.6	111.0	109.9	107.4
	°C				118.9	119.7	115.3	118.0	116.6	114.1
	°C				128.7	130.9	124.3	127.7	125.2	122.7
	°C				154.5	158.2	145.8	150.3	145.8	142.4
	°C	162.8		176.7	176.3	177.6	172.9	173.4	172.6	172.9
	°C				184.9	186.5	180.6	182.3	182.1	182.7
	°C	196.1		212.8	201.4	202.6	199.5	201.0	203.5	203.9
	vol %		Report		98.0	98.2	97.4	97.8	97.3	97.4
	vol %			2.0	1.1	1.1	0.9	1.1	1.1	1.1
	vol %		Report		0.9	0.7	1.7	1.1	1.6	1.5
ASTM D4052[1]	°API	56.5		61.2	56.06	55.23	58.00	56.78	57.3	58.4
ASTM D4052[1]	---		Report		0.7544	0.7578	0.7467	0.7516	0.7493	0.7451
ASTM D5191[1]	kPa	60.7		63.4	60.4	59.3	63.4	62.7	61.2	60.7
ASTM D5291[2]	wt fraction	0.8580		0.8690			0.8642	0.8630	0.8670	0.8667
ASTM D5291[2]	wt fraction						0.1358	0.1370	0.1330	0.1296
ASTM D3343[1]	wt fraction		Report				0.0000	0.8670	0.8687	0.8669



Where((IND = 940) and (LTMSLAB = A, B, D, G) and (LABVALID = V))

Monument Chemical

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The only targets communicated to fuel supplier…..make fuel within 1 standard deviation of targets given below:

Attachment C

Current Sequence VH Reference Targets

AVERAGE ENGINE SLUDGE (AES)

Unit of Measure: Merits

Reference Oil	Mean	Standard Deviation
931	8.00	0.60
940	6.47	0.49
1011-1	8.43	0.57

ROCKER COVER SLUDGE (RAC)

Unit of Measure: ln(10-RAC)

Reference Oil	Mean	Standard Deviation
931	0.2283	0.5715
940	0.9155	0.2260
1011-1	-0.5294	0.1924

AVERAGE ENGINE VARNISH (AEV50)

Unit of Measure: Merits

Reference Oil	Mean	Standard Deviation
931	8.97	0.30
940	8.77	0.28
1011-1	9.43	0.21

Attachment C (continued) Current Sequence VH Reference Targets

AVERAGE PISTON VARNISH (APV50)

Unit of Measure: Merits

Reference Oil	Mean	Standard Deviation
931	8.35	0.60
940	7.35	0.64
1011-1	8.96	0.48

NUMBER OF HOT STUCK RINGS

Unit of Measure: Count

Reference Oil	Maximum Allowable
931	0
940	0
1011-1	0

No mention of fuel dilution or oil screen sludge targets.

Monument Chemical

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