Sequence III Surveillance Panel
Teleconference Meeting Minutes

February 17, 2016

Agenda

1.0) Attendance

The attendance is shown in Attachment 1.

2.0) Approval of minutes

2.1) Minutes from 02/03/2016 Conference Call
The minutes were approved without objection.

3.0) Action Item Review

3.1) Analysis of IIIF & IIIG run 7-10 data for differences.
The Stats Group will meet Feb. 18 and report at a future meeting.

4.0) Old Business

4.1) Update on work underway by George Szappanos group.
George Szappanos was not available to report; in his stead Chairman Glaenzer noted that last week's build workshop produced a number of items to be worked through which he highlighted for the panel; the list is shown in Attachment 2.

4.2) Test procedure update. **Haumann**
Karin Haumann has been working with a facilitator to update the procedure to ASTM test method format. Karin noted that phosphorus retention calculation method has been an area of discussion. It was noted that the current procedure addresses calcium, barium, and magnesium. General consensus resulted in the current method being carried forward in the IIIH.

4.3) Engine Build manual update. **Clark**
Sid Clark is working on completing the manual and expects it to be available in the next few weeks.

5.0) New Business

5.1) Request by AOAP & PCEOCP for endorsement of IIIH test for MRV and Phos Retention use.
The AOAP and PCEOCP panels have requested a statement from the Seq. III Surveillance Panel that the IIIH is an acceptable tool to evaluate MRV and Phos Retention, with acceptable precision. For easy reference, the IIIH matrix analysis is shown in Attachment 3. During discussion, concerns were expressed that there wasn't IIIGA (or ROBO) data presented on oils 434-2, 436, and 438-1 for comparison to the IIIH. After further discussion, Chairman Glaenzer took the action to work with the TMC to see if any of the requested data can be made available. (Post meeting note: the request for data is shown in Attachment 4).

5.2) Update on LTMS plans for Sequence IIIH. **Glaenzer**
Chairman Glaenzer will schedule a face-to-face meeting in the future.

6.0) Work Remaining

6.1 Set up LTMS. **Underway**
6.2) Determine whether matrix stands can be considered calibrated based on their matrix tests. **TBD**
6.3) Review and finalize the Qi Limits **TBD**
6.4) Determine calibration and referencing protocols. **Surveillance Panel**
6.5) Appendix K Update. **Martinez**
6.6) Surveillance Panel recommendation regarding test readiness for the category. **June, 2015**
6.7) Publish research report **TBD**

7.0) **Next Meeting**

7.1) Tentatively scheduled for March 2, 2016.

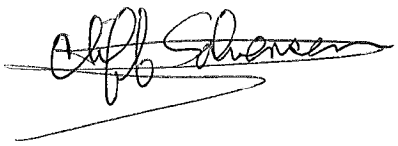
8.0) **Meeting Adjourned**

The meeting adjourned at 11:40 am.

ATTACHMENT 1

ASTM Sequence III Surveillance Panel (22 Voting members) date:

Name/Address	Phone/Fax/Email		Signature
Ed Altman	804-788-5279	Voting Member	Present ✓
Jeff Betz	jeff.betz@fcagroup.com	Voting Member	Present
Jason Bowden	440-354-7007	Voting Member	Present ✓
Timothy L. Caudill	606-329-1960 x5708	Voting Member	Present
Richard Grundza	412-365-1031	Voting Member	Present ✓
Jeff Hsu, PE	j.hsu@shell.com	Voting Member	Present
Tracey King	947-517-4107	Voting Member	Present
Teri Kowalski	734-995-4032	Voting Member	Present
Patrick Lang	210-522-2820	Voting Member	Present ✓
Addison Schweitzer	210-706-1586	Voting Member	Present ✓
Bruce Matthews	248-830-9197	Voting Member	Present
David Tsui	973-305-2337	Voting Member	Present
Cliff Salvesen		Voting Member	Present ✓
Andrew Ritchie	908-474-2097 Gordon	Voting Member	Present
Ron Romano	313-845-4068	Voting Member	Present ✓
Greg Shank	301-790-5817	Voting Member	Present
Kaustav Sinha, Ph.D.	713-432-6642	Voting Member	Present
Thomas Smith	859-357-2766	Voting Member	Present
Scott Stap	scott.stap@tgidirect.com	Voting Member	Present
Mark Sutherland	210-867-8357	Voting Member	Present
George Szappanos	440-347-2352 Jay Bryan	Voting Member	Present
Haiying Tang	248-512-0593	Voting Member	Present ✓



ASTM Sequence III Surveillance Panel (22 Voting members) date:

Name/Address	Phone/Fax/Email		Signature
Ricardo Affinito	affinito@chevron.com	Non-Voting Member	Present
Art Andrews	856-224-3013	Non-Voting Member	Present
Dan Lanctot	TEI	Non-Voting Member	Present
Doyle Boese	908-474-3176	Non-Voting Member	Present ✓
Adam Bowden	440-354-7007	Non-Voting Member	Present
Dwight H. Bowden	440-354-7007	Non-Voting Member	Present
Matt Bowden	440-354-7007	Non-Voting Member	Present
Jerome A. Brys	440 347-2631	Non-Voting Member	Present ✓
Bill Buscher III	210-240-8990	Non-Voting Member	Present
Bob Campbell	804-788-5340	Non-Voting Member	Present
Chris Castanien	Chris.Castanien@gmail.com	Non-Voting Member	Present
Martin Chadwick	210-706-1543	Non-Voting Member	Present
Jeff Clark	412-365-1032	Non-Voting Member	Present ✓
Sid Clark	586-873-1255	Non-Voting Member	Present ✓
Todd Dvorak	804-788- 6367	Non-Voting Member	Present ✓
Frank Farber	412-365-1030	Non-Voting Member	Present
Joe Franklin	210-523-4671	Non-Voting Member	Present
David L. Glaenzer	804-788-5214	Non-Voting Member	Present ✓
Karin E. Haumann	281-544-6986	Non-Voting Member	Present ✓
Walter Lerche	313-667-1918	Non-Voting Member	Present
Josephine G. Martinez	510-242-5563	Non-Voting Member	Present
Mike McMillan	mmcmillan123@comcast.net	Non-Voting Member	Present ✓
Bob Olree	248-689-3078	Non-Voting Member	Present
Kevin O'Malley	kevin.omalley@lubrizol.com	Non-Voting Member	Present
Christian Porter	804-788-5837	Non-Voting Member	Present
Phil Rabbat	914-785-2217	Non-Voting Member	Present
Allison Rajakumar	440-347-4679	Non-Voting Member	Present
Scott Rajala	srajala@ilacorp.com	Non-Voting Member	Present

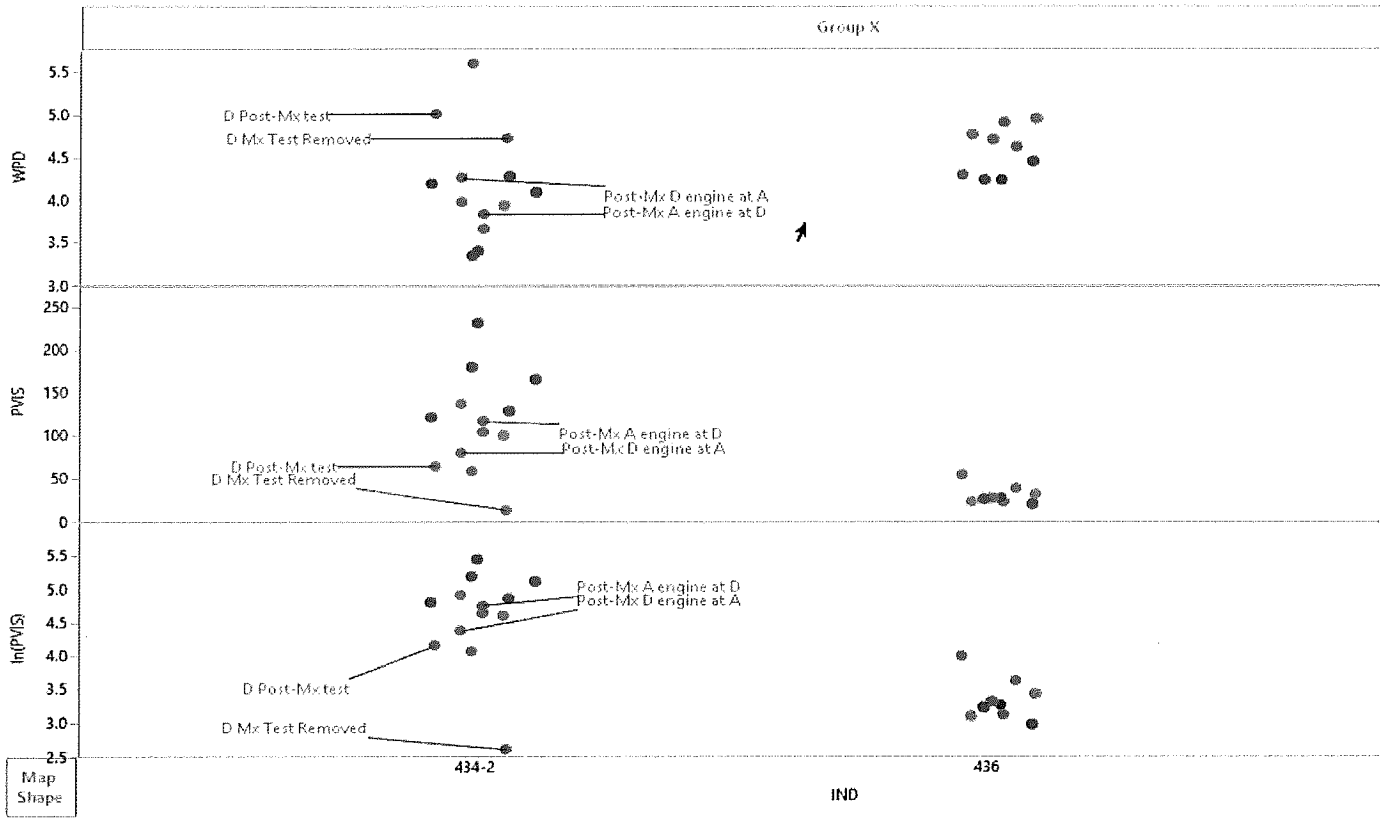
ASTM Sequence III Surveillance Panel (22 Voting members) date:

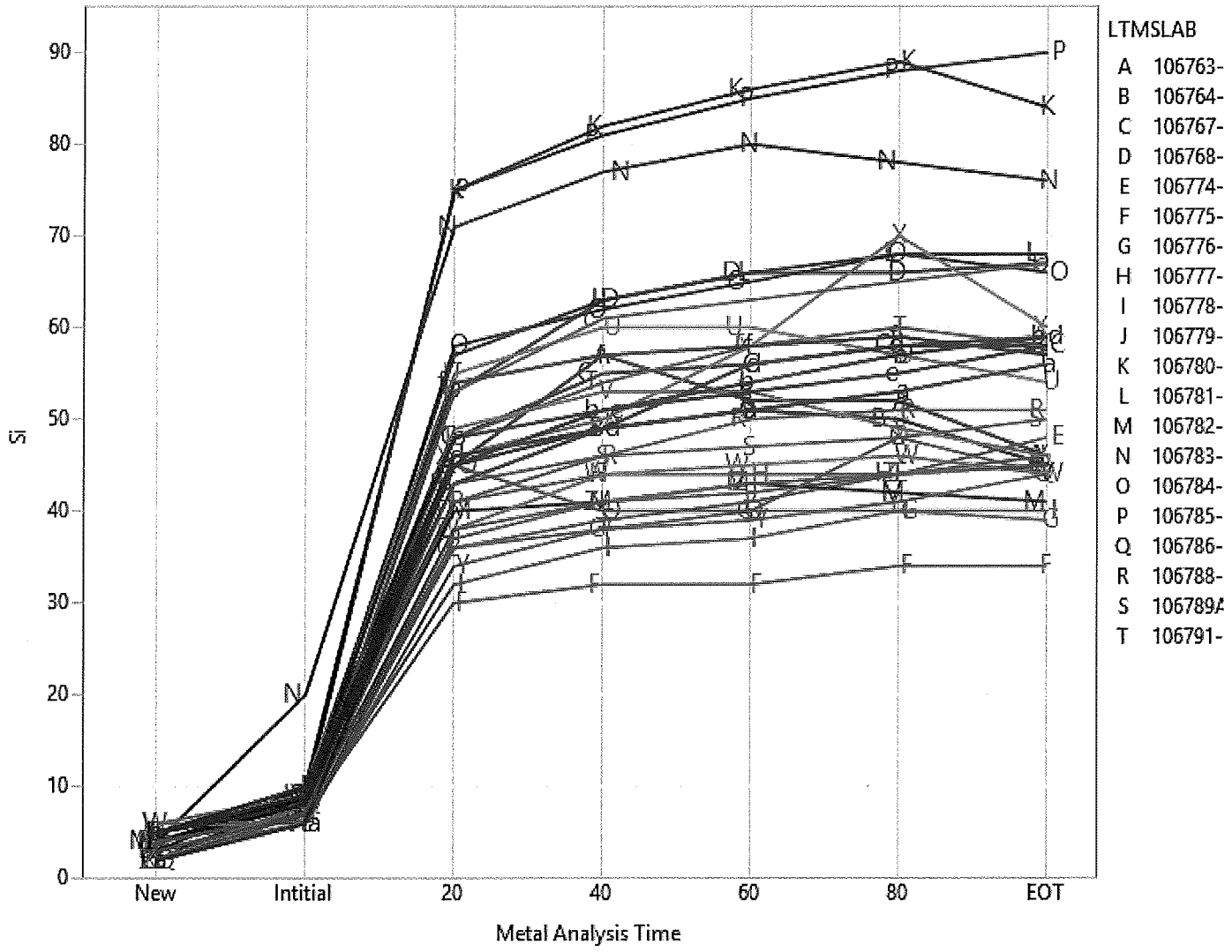
Name/Address	Phone/Fax/Email		Signature
Jim Rutherford	510-242-3410	Non-Voting Member	Present
Amol Savant	606-320-1960 x5604	Non-Voting Member	Present
Philip R. Scinto	440-347-2161	Non-Voting Member	Present
Don Smolenski	248-255-7892	Non-Voting Member	Present ✓
Jim Linden		Non-Voting Member	Present
Tom Wingfield	wingftm@cpchem.com	Non-Voting Member	Present
Charlie Leverett		Non-Voting Member	Present
Terry Bates	ASTM Facilitator	Non-Voting Member	Present
Chris Taylor	VP Fuels	Non-Voting Member	Present

Gordon Farnworth ✓

ATTACHMENT 2

- Review of SWRI/Afton test results – Kevin
  - Statistical evaluation – did it make a real difference?
- Variations observed in engine build workshop that might lead to severity precision improvement – Sid:
  - Bore gauge standardization – Sid / Addison
  - Torqueing of mains and head bolts with factory oil still on bolts/block
  - Use of EF411; minimize/limit?
    - Rings and chain
  - Torque pattern?
  - **Honing procedure changes?**
  - Cleaning changes?
- Engine build procedure modifications/update - Sid
- Block measurement by Chrysler - Jeff:
  - Identified bore measurement inconsistency; led to standardization of bore gauge
    - Sunnen gauge
  - Surface finish fairly consistent between labs
  - *Do we now have enough data, and confidence in it, to generate new limits? Limits on which parameters?*
    - Step 1 – revised honing procedures according to changes from the workshop
    - Step 2 – quantify the change if any in surface finish
    - Step 3 – base limits on that data (enough?)
- Engine number upload, "TPHE" or engine number? – Rich
  - Both types have been uploaded
  - use TPHE type, and field length needs to be 14
  - labs to re-etch the numbers onto the blocks
- Labs to send oil pressure and engine number data to Betz – Addison/Jeff
  - What is the variability in oil pressure right from factory?
- Evaluation of Silicon data – Geo:
  - At 20 hours there is a jump of ~30-70 ppm from new, then flat. Issue?
- Can we remove oil cooler TC? – Geo:
  - Record only, and potential for leaks
- Rear seal carrier / oil pan / gasket / sealant issue; how to correct? Action - OHT
- corrosion in cooling system issue; what is causing? – Ed
  - aluminum oxide
  - does system need to be flushed?
- blowby bracket design - Geo
  - Lubrizol validation test on RO434
  - Design approval by group
- Installation of JTEC blowby meter to replace sharp edge orifice - Addison
- Next steps – Afton to eventually re-run RO434 with changes. What changes? - Ed


Group X
WPD
PVIS
ln(PVIS)
D Post-Mx test
D Mx Test Removed
Post-Mx D engine at A
Post-Mx A engine at D
Post-Mx A engine at D
Post-Mx D engine at A
D Post-Mx test
D Mx Test Removed
Post-Mx A engine at D
Post-Mx D engine at A
D Post-Mx test
D Mx Test Removed
Map Shape
434-2
436
IND


Si
90
80
70
60
50
40
30
20
10
0
New
Intitial
20
40
60
80
EOT
Metal Analysis Time
LTMSLAB
A 106763-
B 106764-
C 106767-
D 106768-
E 106774-
F 106775-
G 106776-
H 106777-
I 106778-
J 106779-
K 106780-
L 106781-
M 106782-
N 106783-
O 106784-
P 106785-
Q 106786-
R 106788-
S 106789A
T 106791-

ATTACHMENT 3

Sequence IIIH Precision Matrix Statistical Analysis

Statistics Group

February 10, 2015

Statistics Group

- Arthur Andrews, ExxonMobil
- Doyle Boese, Infineum
- Jo Martinez, Chevron Oronite
- Ricardo Affinito, Chevron Oronite
- Kevin O'Malley, Lubrizol
- Martin Chadwick, Intertek
- Richard Grundza, TMC
- Lisa Dingwell, Afton
- Todd Dvorak, Afton
- Travis Kostan, SwRI

IIIH Matrix Status:
27 out of 28 tests analyzed

IIIH Matrix Test Status

	Lab-Stand	D-1	E-1	B-1	G-1	G-2	A-1	A-2
Run Order	1	434-2 106788-IIIH ✓	438-1 106784-IIIH Low MAP and Fuel Flow	438-1 106796-IIIH Oil Leak	36 106763-IIIH ✓	436 106764-IIIH Low MAP & Erratic Fuel Flow	438-1 106774-IIIH ✓	434-2 106778-IIIH ✓
			438-1 106785-IIIH ✓	438-1 106797-IIIH ✓		436 111422-IIIH ✓		
	2	434-2 106789-IIIH Loss of Oil Pressure	436 106782-IIIH Low MAP & Fuel Flow	436 106792-IIIH ✓	438-1 106767-IIIH ✓	434-2 107873-IIIH ✓	438-1 107869-IIIH ✓	438-1 107870-IIIH ✓
		434-2 106789A-IIIH ✓	436 106783-IIIH ✓					
	3	436 106786-IIIH ✓	434-2 106781-IIIH ✓	436 106793-IIIH ✓	438-1 106768-IIIH ✓	434-2 110227-IIIH ✓	434-2 106779-IIIH ✓	436 106775-IIIH ✓
	4	438-1 106791-IIIH ✓	434-2 106780-IIIH ✓	434-2 106795-IIIH ✓	434-2 110228-IIIH ✓	438-1 107872-IIIH ✓	436 106777-IIIH ✓	436 106776-IIIH ✓

Excluded →

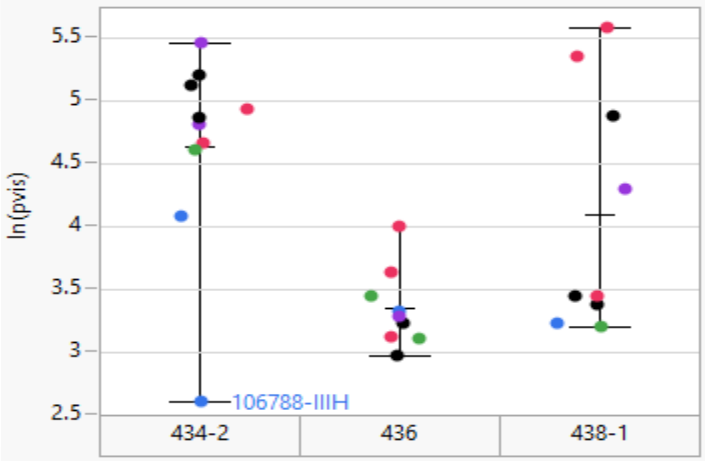
✓ Indicates operation task force has reviewed operational data and found the test to be operationally valid.

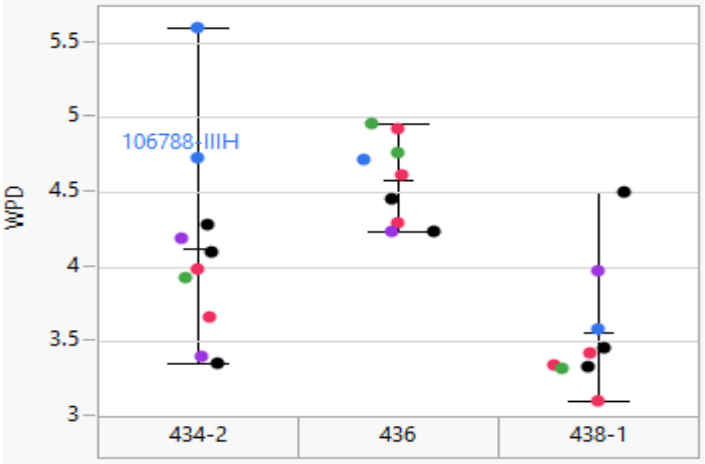
Test Reported

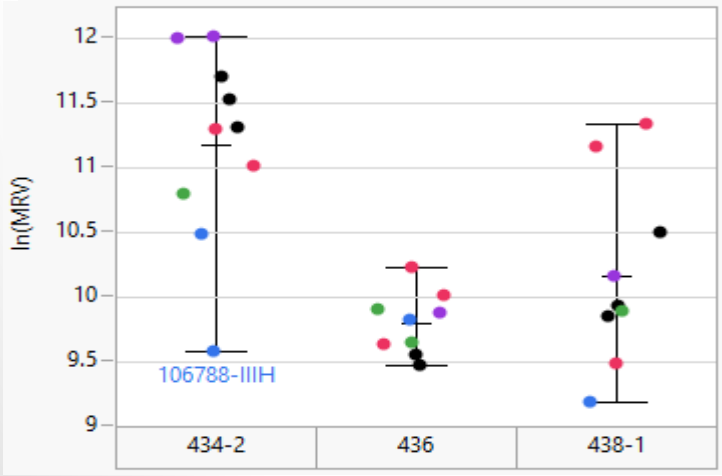
Invalid

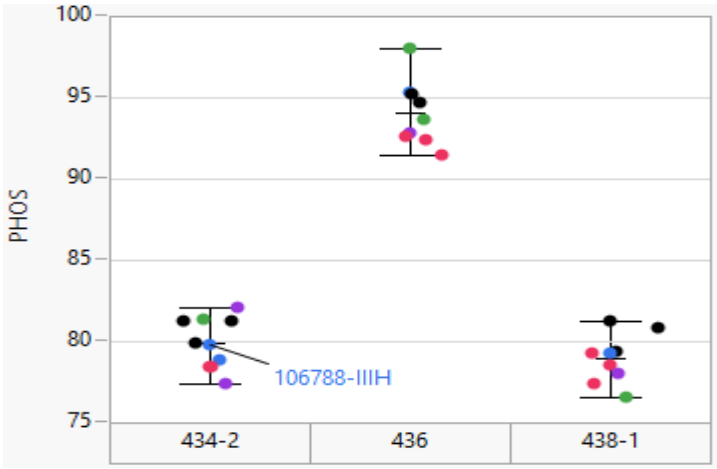
Summary

IIIH Task Force passed a motion on 11-30-15 to remove testkey 106788-IIIH from the precision matrix analysis. This testkey was deemed valid during the review of the operational data of precision matrix tests.









Summary

Removing a data point without being able to identify a procedural change that would minimize the likelihood of a similar occurrence in future tests is of concern.

- If there is an assignable cause for the results of 106788, then the risk is that the variability this induces in the test could be observed in future testing affecting stand calibration and oil discrimination at the labs.
- If the results of 106788 are indicative of inherent test variability, then test precision, oil targets, and LTMS will be misrepresented by its removal.

If the industry chooses to move forward with this test without redevelopment, then these issues need to be kept in mind when setting reference intervals and acceptance criteria, and when establishing candidate pass limits. Robust reference and candidate limits could minimize any potential problems caused by the problems observed in the matrix data while providing a larger data set that can be used to refine the test further.

As more data are gathered, LTMS should be updated to reflect the current variability of the test.

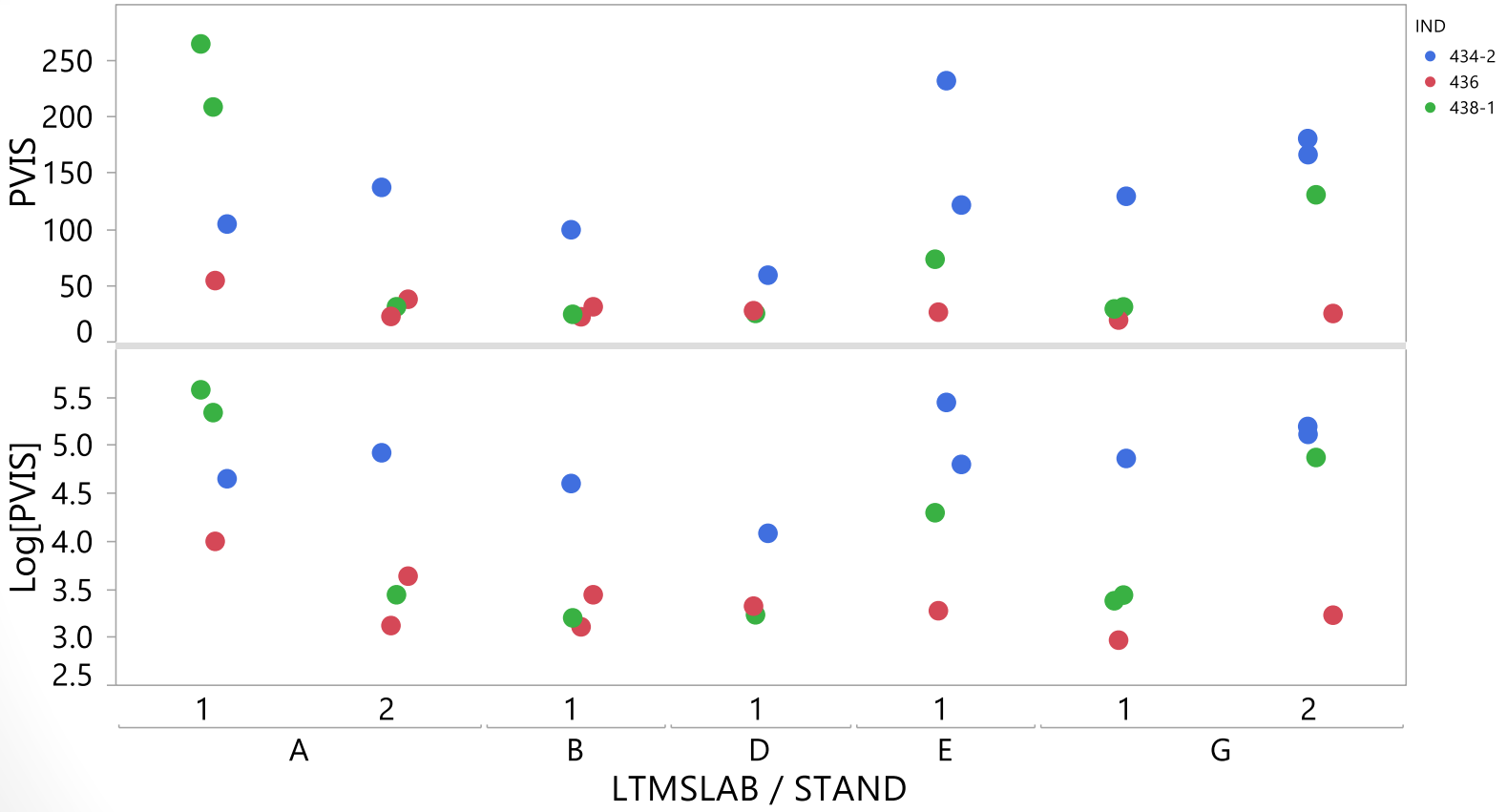
Effort in finding assignable cause(s) for the results of 106788 should continue.

- The industry should consider operational and build data not currently acquired.

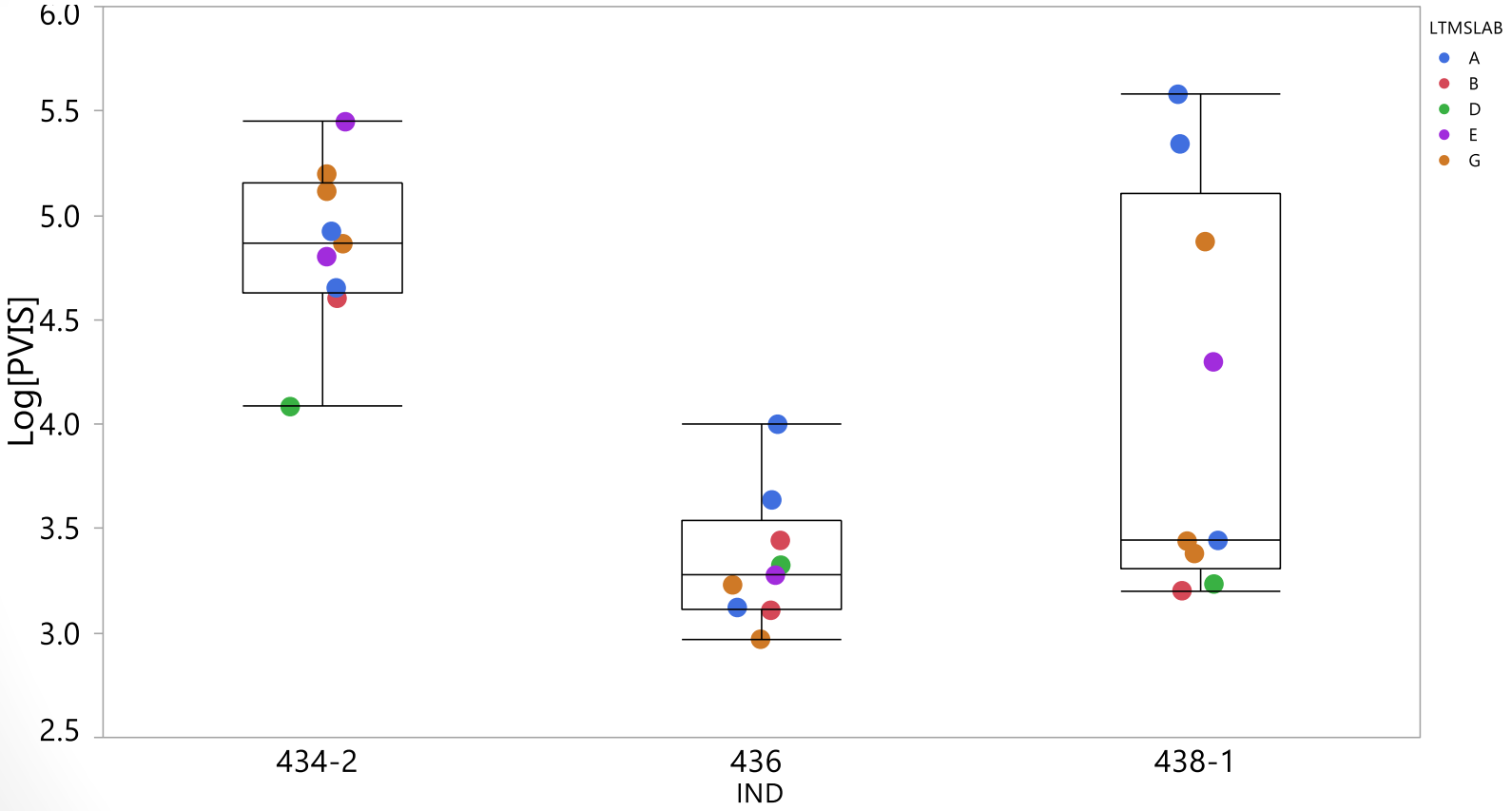
Summary

n=27	LnPVIS	WPD	LnMRV	Phos
Lab Difference	No significant difference	No significant difference	No significant difference	A<G
Stand(Lab) Difference	A2<A1, G1<G2	No significant difference	A2 < A1	No significant difference
Oil Discrimination	436 < 434-2, 438-1; 438-1 < 434-2	436 > 438-1	436, 438-1 < 434-2	436 > 434-2, 438-1
Precision, s, RMSE	0.4764	0.48	0.4270	1.57

Percent Viscosity Increase



LnPVIS



LnPVIS ANOVA

Summary of Fit

RSquare	0.791392
RSquare Adj	0.698678
Root Mean Square Error	0.47638
Mean of Response	4.096557
Observations (or Sum Wgts)	27

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	15.496788	1.93710	8.5358
Error	18	4.084886	0.22694	**Prob > F**
C. Total	26	19.581674		<.0001*

Effect Tests

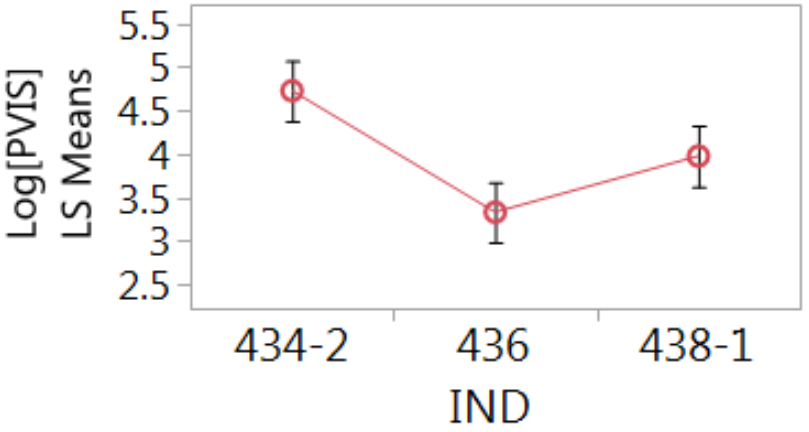
Source	DF	Sum of Squares	F Ratio	Prob > F
IND	2	8.3274921	18.3475	<.0001*
LTMSLAB	4	2.3754503	2.6168	0.0696
LTMSAPP[LTMSLAB]	2	2.8959191	6.3804	0.0080*

LnPVIS Oil Discrimination

436 is significantly lower than 434-2

436 is significantly lower than 438-1

438-1 is significantly lower than 434-2

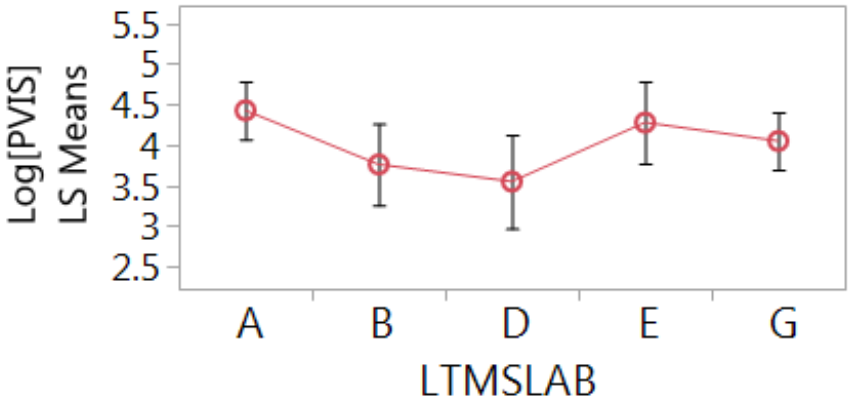


Oil1	Oil2	Difference	p-Value
434-2	436	1.3985	0.00
438-1	436	0.7519	0.01
434-2	438-1	0.6465	0.03

Oil	LnPVIS LS Mean	PVIS LS Mean
434-2	4.7292	113
436	3.3308	28
438-1	3.9773	53

LnPVIS Lab Difference

No significant lab difference



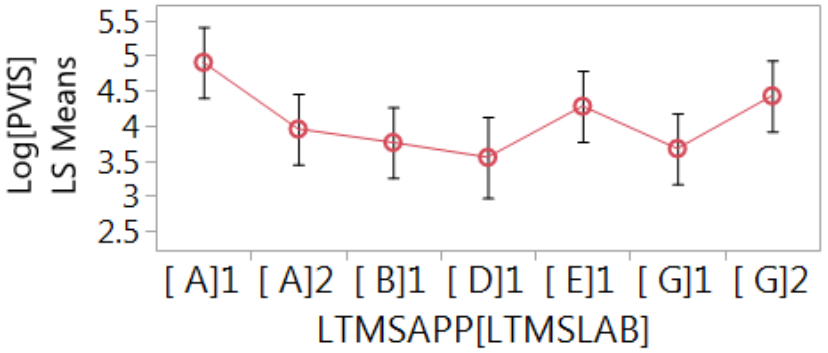
Lab1	Lab2	Difference	p-Value
A	D	0.8794	0.09
E	D	0.7294	0.31
A	B	0.6674	0.2
E	B	0.5174	0.57
G	D	0.5011	0.54
A	G	0.3783	0.53
G	B	0.2891	0.86
E	G	0.2283	0.93
B	D	0.212	0.98
A	E	0.15	0.99

Lab	LnPVIS LS Mean	PVIS LS Mean
A	4.4274	84
B	3.7601	43
D	3.548	35
E	4.2775	72
G	4.0492	57

LnPVIS Stand(Lab) Difference

Stand A2 is significantly lower than Stand A1

Stand G1 is significantly lower than Stand G2



Lab/Stand1	Lab/Stand2	Difference	p-Value
[A]1	[A]2	0.9504	0.01
[G]2	[G]1	0.7526	0.04

Lab/Stand	LnPVIS LS Mean	PVIS LS Mean
[A]1	4.9027	135
[A]2	3.9522	52
[G]1	3.6729	39
[G]2	4.4255	84

LnPVIS Precision

Model: Oil, Lab, Stand(Lab)

Model RMSE

- s = 0.4764
- IIIH Prove-out s=0.61
- IIIG Precision Matrix s=0.2919
- IIIG recent data s=0.54-0.63

Repeatability

- s = 0.4764
- r = 1.3205

Reproducibility

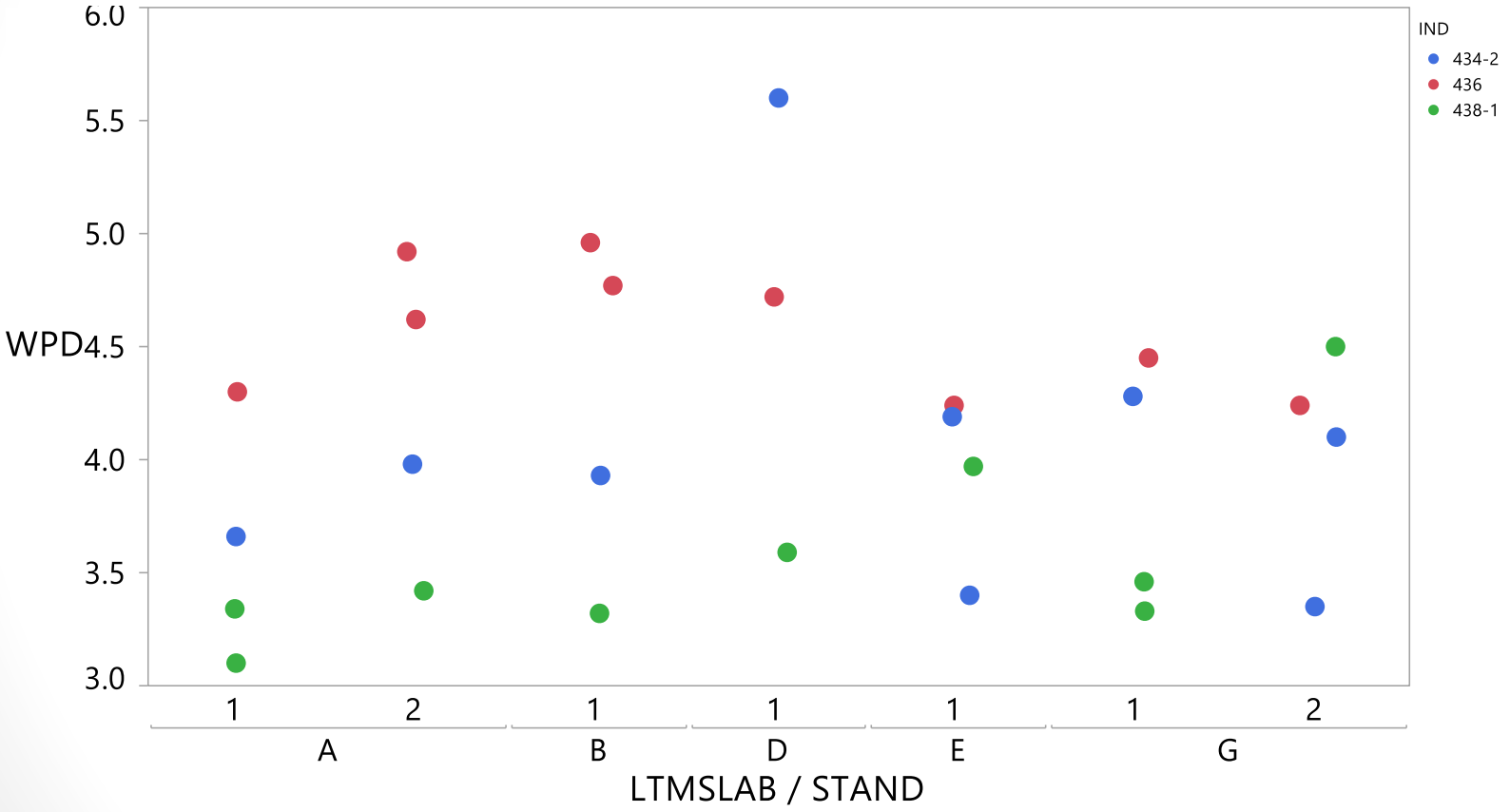
- s = 0.6238
- R = 1.7291

PVIS Precision

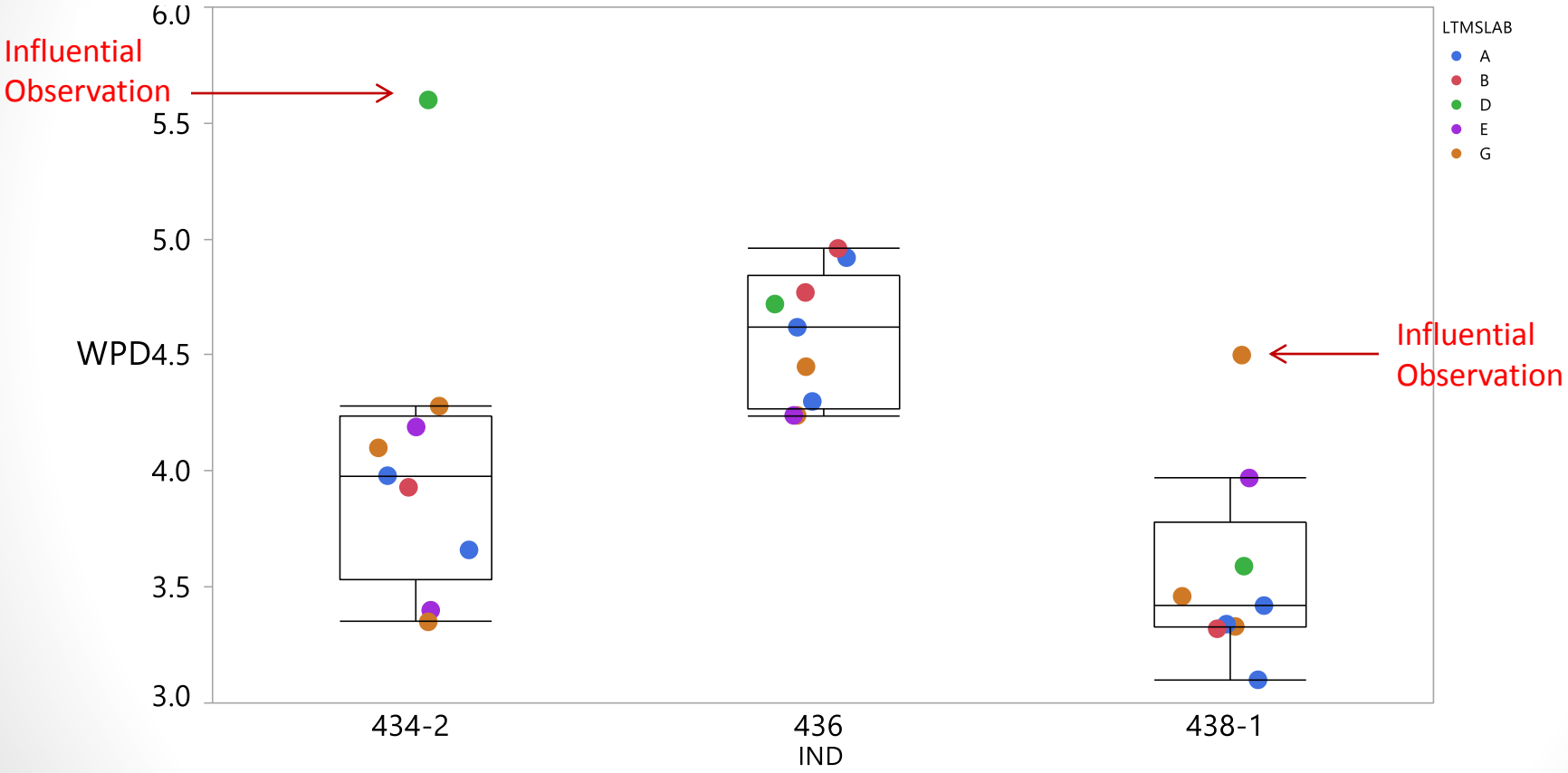
Based upon the Seq. III pooled standard deviations (s_r) and ASTM's repeatability (r) definition for the *maximum allowable difference between successive test results*, there is no significant difference between a PVIS result[1] of *150% - 562%* for the IIIH and *150% - 337%* for the IIIG.

Note 1: A PVIS of 150% was arbitrarily selected in the calculations as the lower pass/fail limit.

Weighted Piston Deposit



WPD


Influential Observation
6.0
5.5
5.0
WPD4.5
4.0
3.5
3.0
LTMSLAB
A
B
D
E
G
Influential Observation
434-2
436
438-1
IND

WPD ANOVA

Summary of Fit

RSquare	0.601774
RSquare Adj	0.424785
Root Mean Square Error	0.478543
Mean of Response	4.064444
Observations (or Sum Wgts)	27

Analysis of Variance

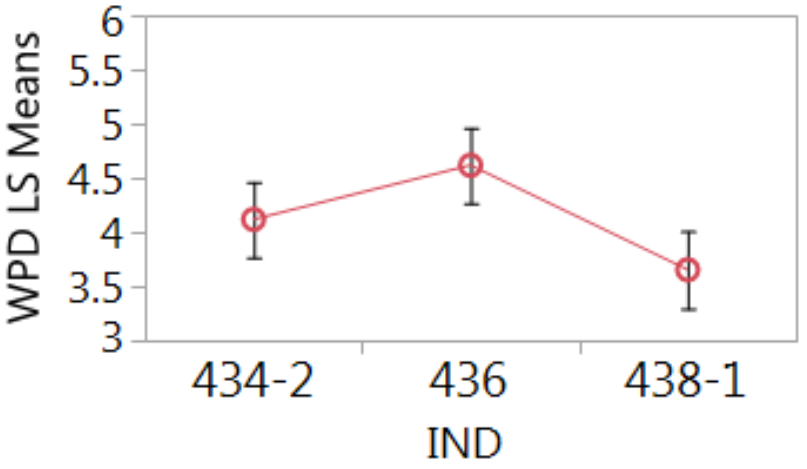
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	6.229002	0.778625	3.4001
Error	18	4.122065	0.229004	**Prob > F**
C. Total	26	10.351067		0.0148*

Effect Tests

Source	DF	Sum of Squares	F Ratio	Prob > F
IND	2	3.9474770	8.6188	0.0024*
LTMSLAB	4	1.2340817	1.3472	0.2911
LTMSAPP[LTMSLAB]	2	0.3058781	0.6678	0.5251

WPD Oil Discrimination

436 is significantly higher than 438-1

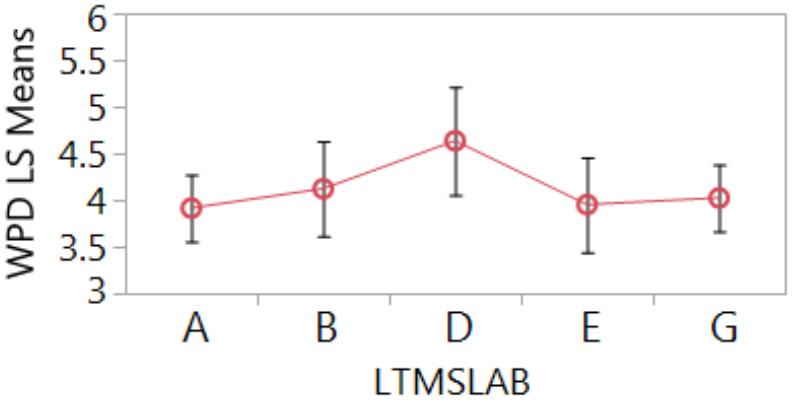


Oil1	Oil2	Difference	p-Value
436	438-1	0.96	0.00
436	434-2	0.5	0.11
434-2	438-1	0.46	0.14

Oil	WPD LS Mean
434-2	4.12
436	4.62
438-1	3.65

WPD Lab Difference

No significant lab difference

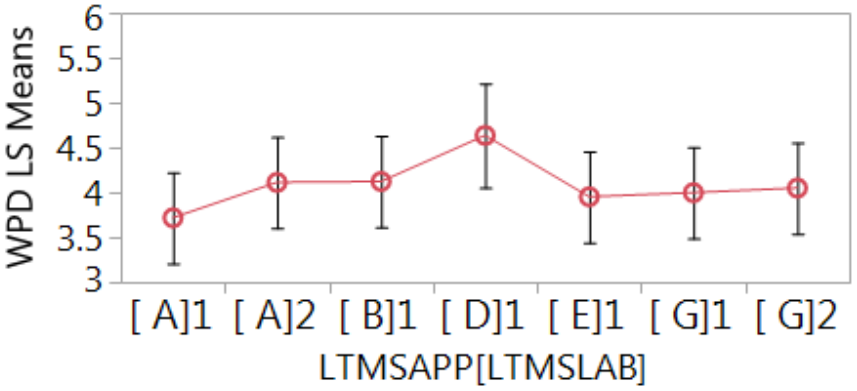


Lab1	Lab2	Difference	p-Value
D	A	0.72	0.22
D	E	0.68	0.37
D	G	0.61	0.36
D	B	0.51	0.64
B	A	0.21	0.95
B	E	0.17	0.99
G	A	0.11	0.99
B	G	0.10	1.00
G	E	0.07	1.00
E	A	0.04	1.00

Lab	WPD LS Mean
A	3.92
B	4.12
D	4.64
E	3.95
G	4.02

WPD Stand(lab) Difference

No significant stand(lab) difference



Lab/Stand1	Lab/Stand2	Difference	p-Value
[A]2	[A]1	0.39	0.27
[G]2	[G]1	0.05	0.88

Lab/Stand	WPD LS Mean
[A]1	3.72
[A]2	4.11
[G]1	4.00
[G]2	4.05

WPD Precision

Model: Oil, Lab, Stand(Lab)

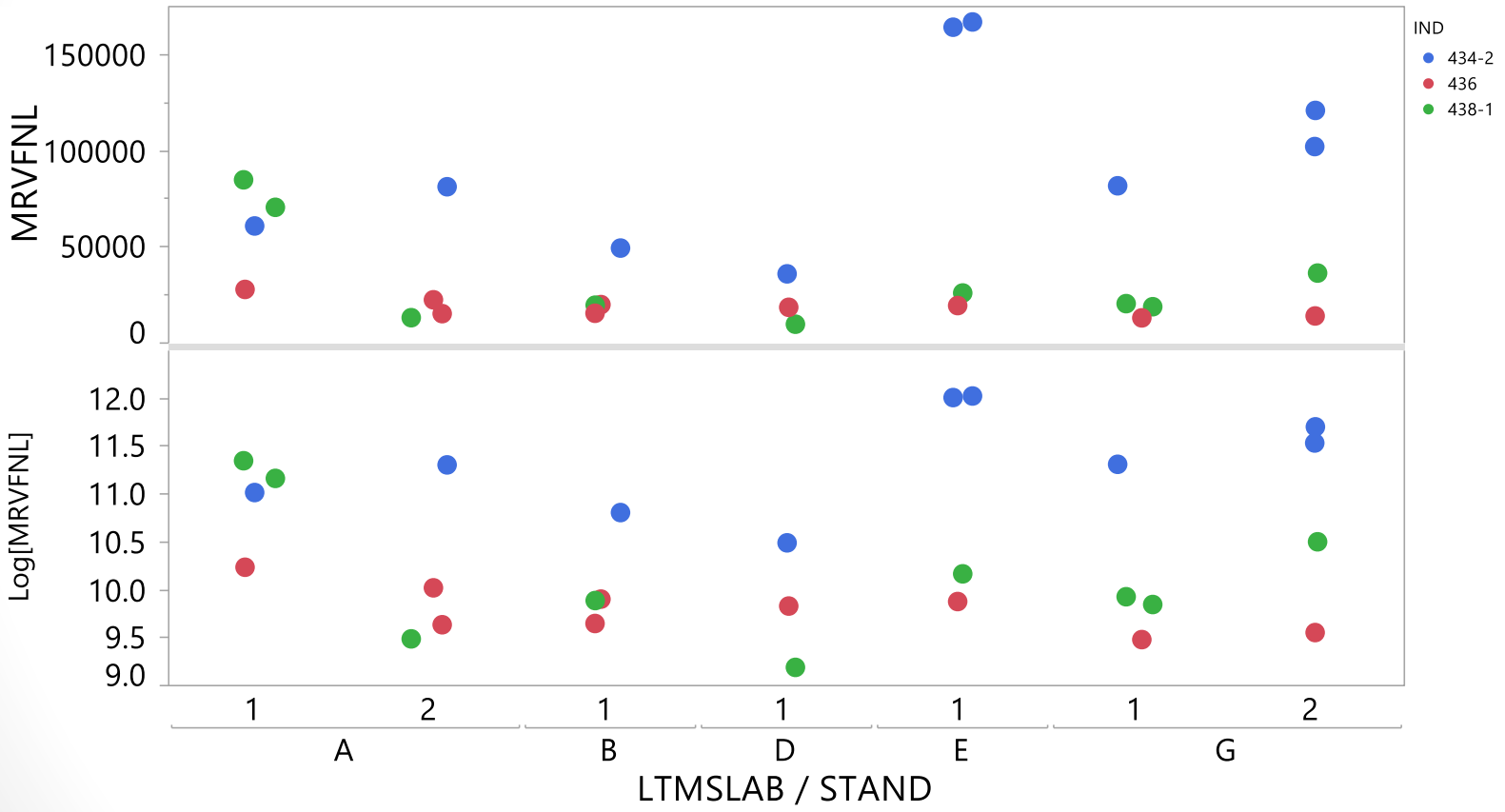
Model RMSE	Repeatability	Reproducibility
• s = 0.48 • IIIH Prove-out s=0.40 • IIIG Precision Matrix s=0.60 • IIIG recent data s=0.39-0.43	• s = 0.48 • r = 1.33	• s = 0.49 • R = 1.36

WPD Precision

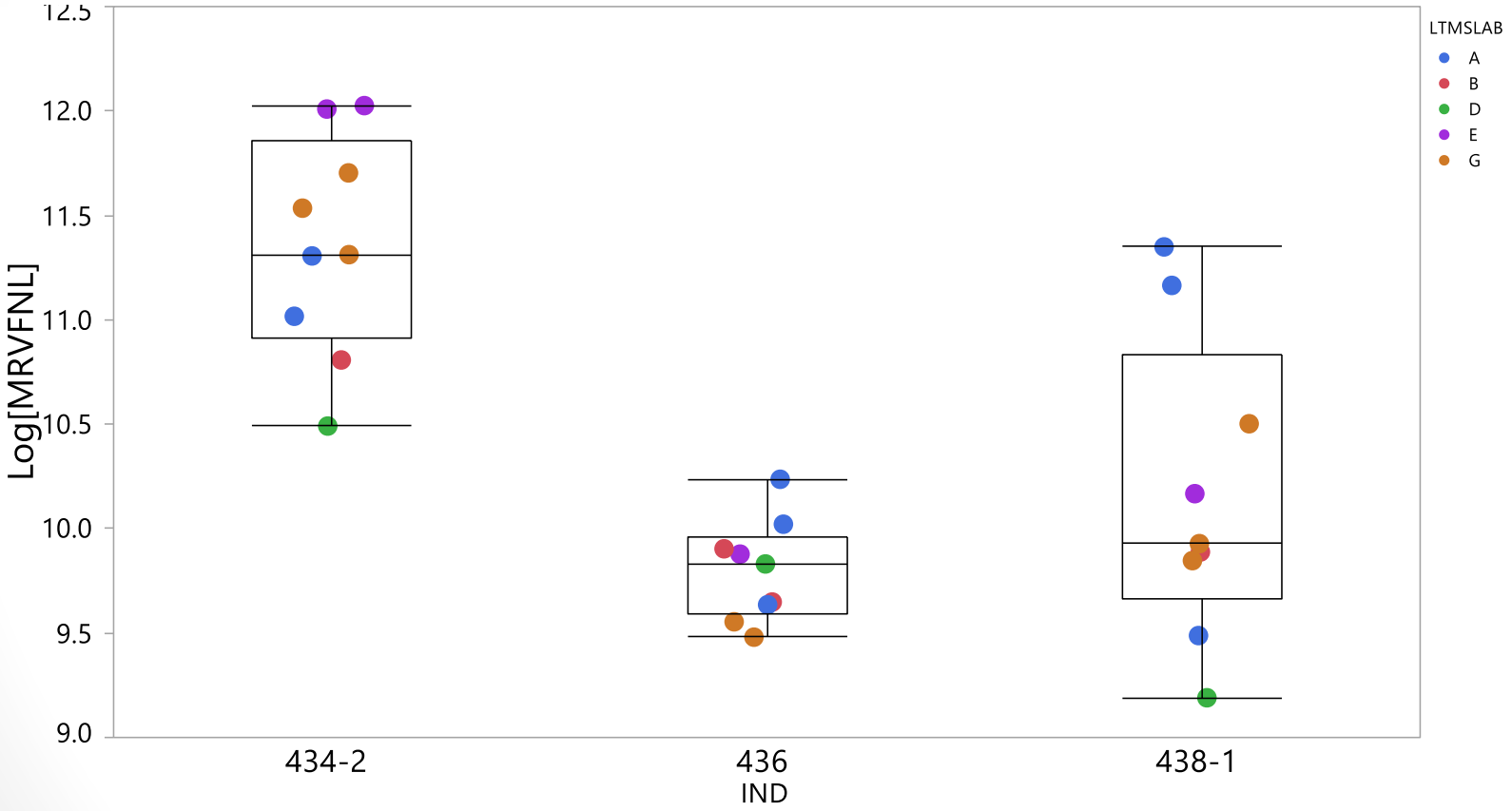
Based upon the Seq. III pooled standard deviations (s_r) and ASTM's repeatability (r) definition for the *maximum allowable difference between successive test results*, there is no significant difference between a WPD result[1] of 2.7 – *4.0* for the IIIH and 2.*3* – *4.0* for the IIIG.

Note 1: A WPD of 4.0 was arbitrarily selected in the calculations as the upper pass/fail limit.

MRV Viscosity



LnMRV


12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
Log[MRVFNL]
434-2
436
438-1
IND
LTMSLAB
A
B
D
E
G

LnMRV ANOVA

Summary of Fit

RSquare	0.824911
RSquare Adj	0.747094
Root Mean Square Error	0.426958
Mean of Response	10.44152
Observations (or Sum Wgts)	27

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	15.459373	1.93242	10.6006
Error	18	3.281277	0.18229	**Prob > F**
C. Total	26	18.740650		<.0001*

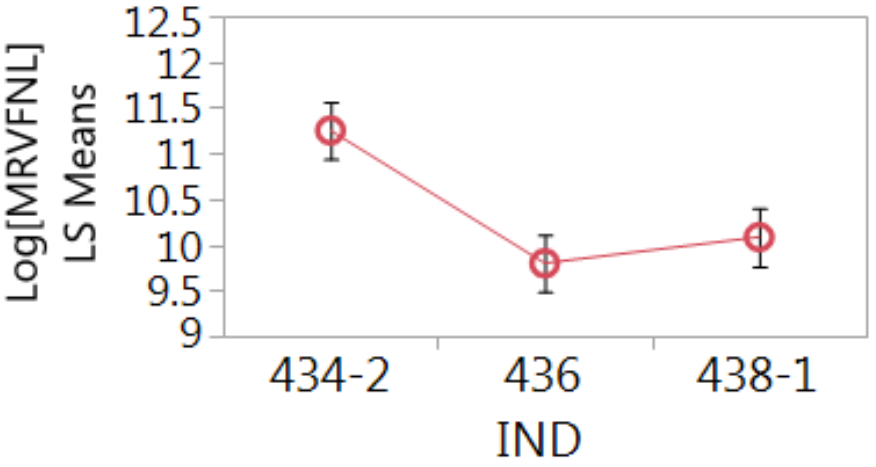
Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	2	2	10.072512	27.6272	<.0001*
LTMSLAB	4	4	2.138079	2.9322	0.0498*
LTMSAPP[LTMSLAB]	2	2	1.427663	3.9158	0.0387*

LnMRV Oil Discrimination

436 is significantly lower than 434-2

438-1 is significantly lower than 434-2

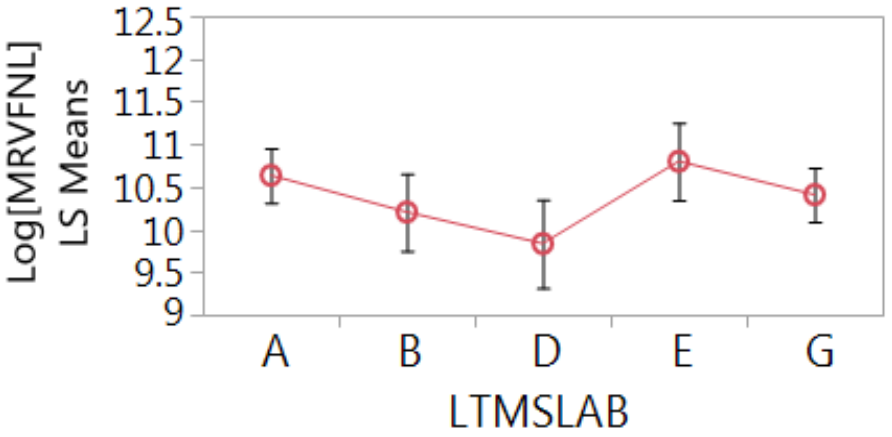


Oil1	Oil2	Difference	p-Value
434-2	436	1.4529	0.00
434-2	438-1	1.1673	0.00
438-1	436	0.2856	0.37

Oil	LnMRV LS Mean	MRV LS Mean
434-2	11.2520	77034
436	9.7991	18018
438-1	10.0847	23973

LnMRV Lab Difference

No significant lab difference

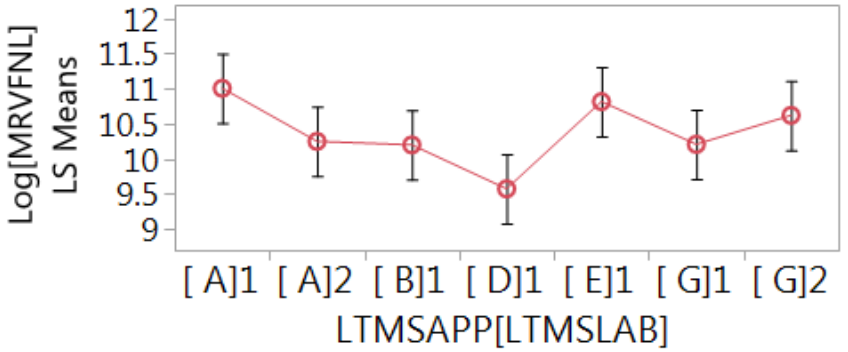


Lab1	Lab2	Difference	p-Value
E	D	0.9643	0.06
A	D	0.7990	0.08
E	B	0.5949	0.33
G	D	0.5729	0.31
A	B	0.4295	0.5
E	G	0.3915	0.58
B	D	0.3695	0.79
A	G	0.2261	0.83
G	B	0.2034	0.94
E	A	0.1653	0.97

Lab	LnMRV LS Mean	MRV LS Mean
A	10.6364	41623
B	10.2069	27089
D	9.8374	18721
E	10.8018	49109
G	10.4103	33200

LnMRV Stand(Lab) Difference

Stand A2 is significantly lower than Stand A1



Lab/Stand1	Lab/Stand2	Difference	p-Value
[A]1	[A]2	0.7578	0.02
[G]2	[G]1	0.3899	0.22

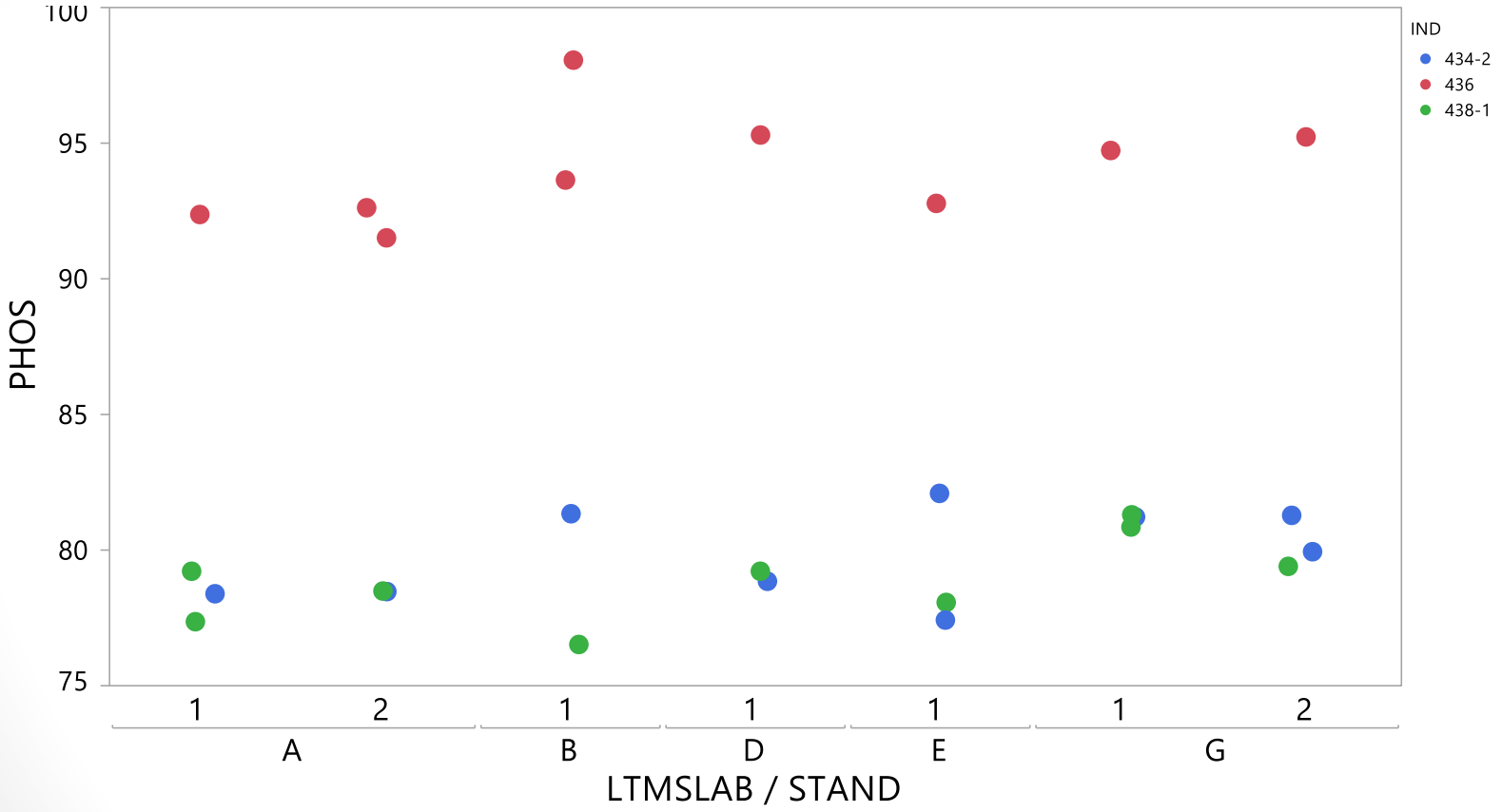
Lab/Stand	LnMRV LS Mean	MRV LS Mean
[A]1	11.0153	60797
[A]2	10.2576	28498
[G]1	10.2153	27318
[G]2	10.6053	40348

LnMRV Precision

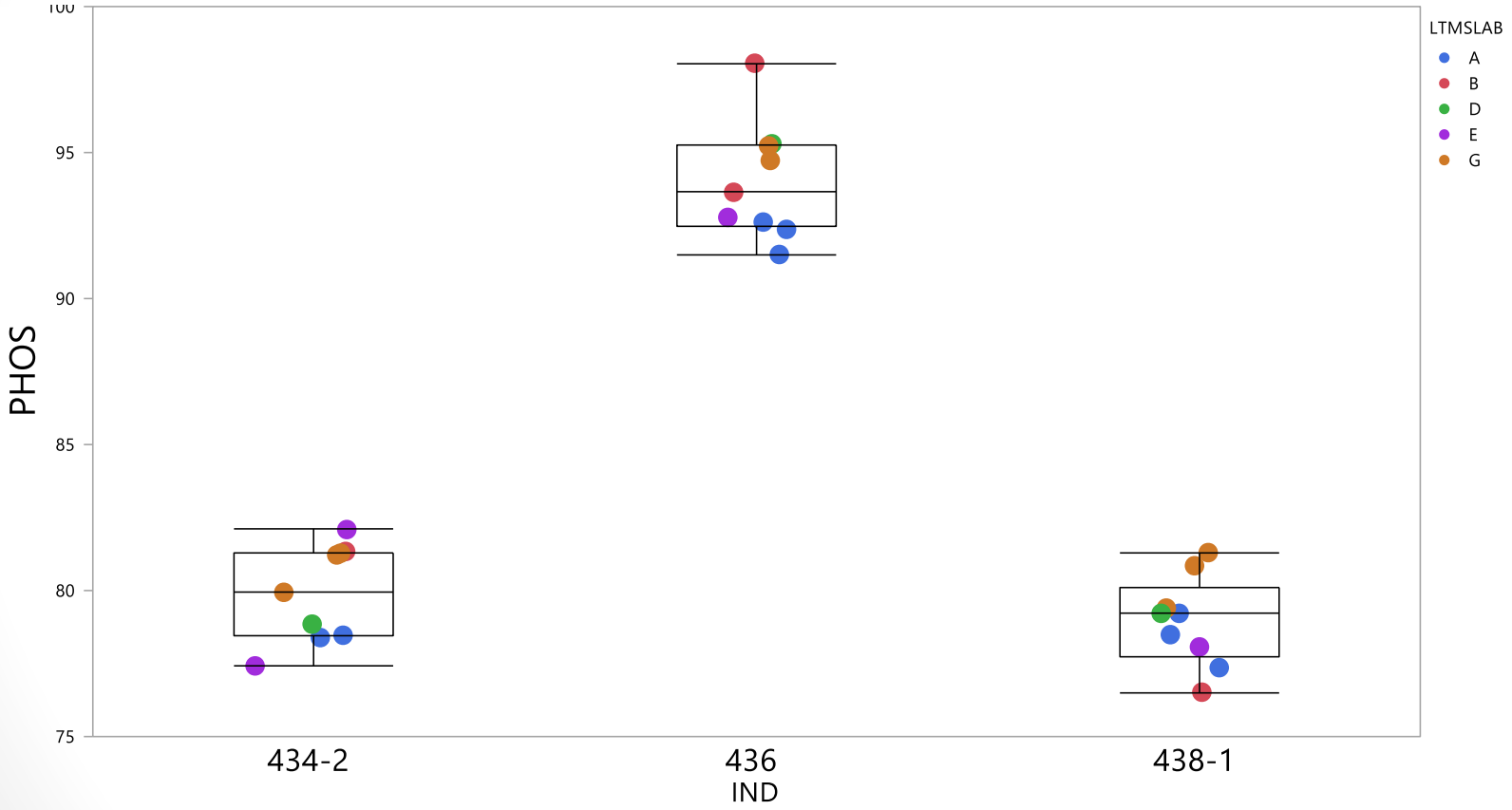
Model: Oil, Lab, Stand(Lab)

Model RMSE	Repeatability	Reproducibility
• s = 0.4270 • No IIIGA s	• s = 0.4270 • r = 1.1836	• s = 0.5332 • R = 1.4780

Phosphorus Retention



PHOS



PHOS ANOVA

Summary of Fit

RSquare	0.96727
RSquare Adj	0.952723
Root Mean Square Error	1.572013
Mean of Response	84.28407
Observations (or Sum Wgts)	27

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	1314.5782	164.322	66.4942
Error	18	44.4821	2.471	**Prob > F**
C. Total	26	1359.0603		<.0001*

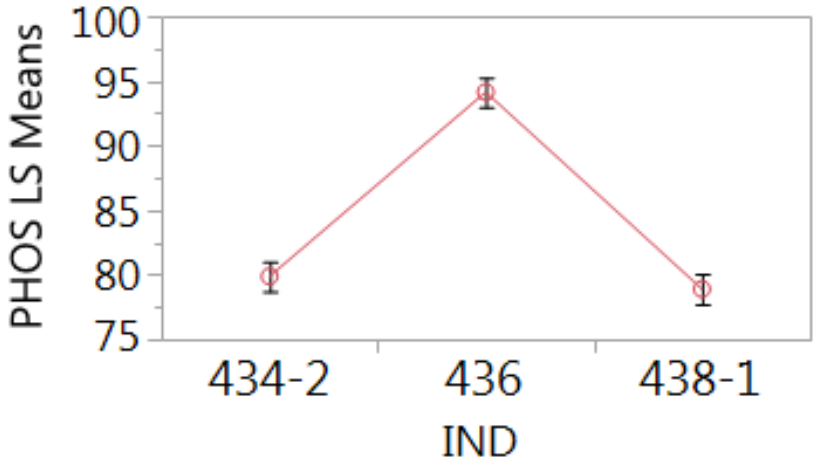
Effect Tests

Source	DF	Sum of Squares	F Ratio	Prob > F
IND	2	1235.8765	250.0533	<.0001*
LTMSLAB	4	27.5381	2.7859	0.0581
LTMSAPP[LTMSLAB]	2	1.5231	0.3082	0.7386

PHOS Oil Discrimination

436 is significantly higher than 438-1

436 is significantly higher than 434-2

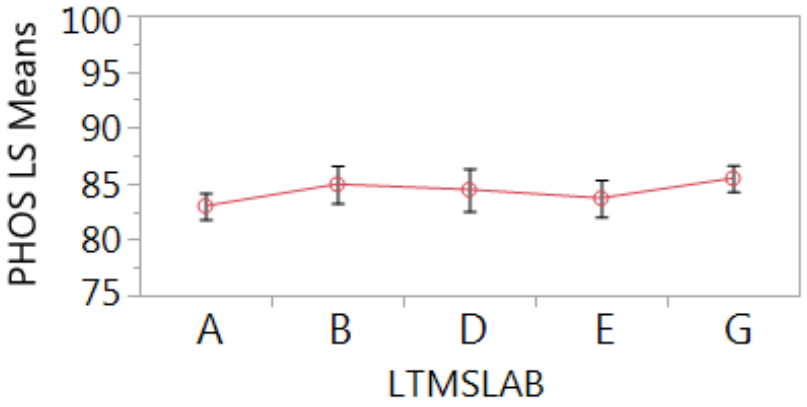


Oil1	Oil2	Difference	p-Value
436	438-1	15.24	0.00
436	434-2	14.25	0.00
434-2	438-1	0.99	0.42

Oil	PHOS LS Mean
434-2	79.89
436	94.14
438-1	78.90

PHOS Lab Difference

Lab A is significantly lower than Lab G

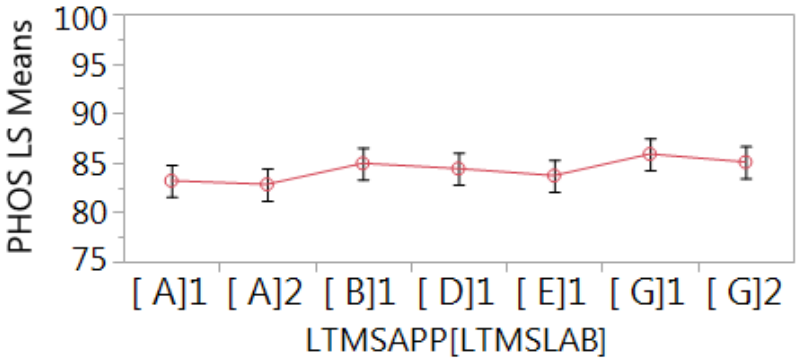


Lab1	Lab2	Difference	p-Value
G	A	2.47	0.04
B	A	1.93	0.31
G	E	1.78	0.38
D	A	1.46	0.66
B	E	1.24	0.81
G	D	1.02	0.87
D	E	0.76	0.97
E	A	0.69	0.95
G	B	0.54	0.98
B	D	0.48	0.99

Lab	PHOS LS Mean
A	83.00
B	84.93
D	84.46
E	83.70
G	85.47

PHOS Stand(Lab) Difference

No significant stand(lab) difference



Lab/Stand1	Lab/Stand2	Difference	p-Value
[G]1	[G]2	0.81	0.48
[A]1	[A]2	0.37	0.75

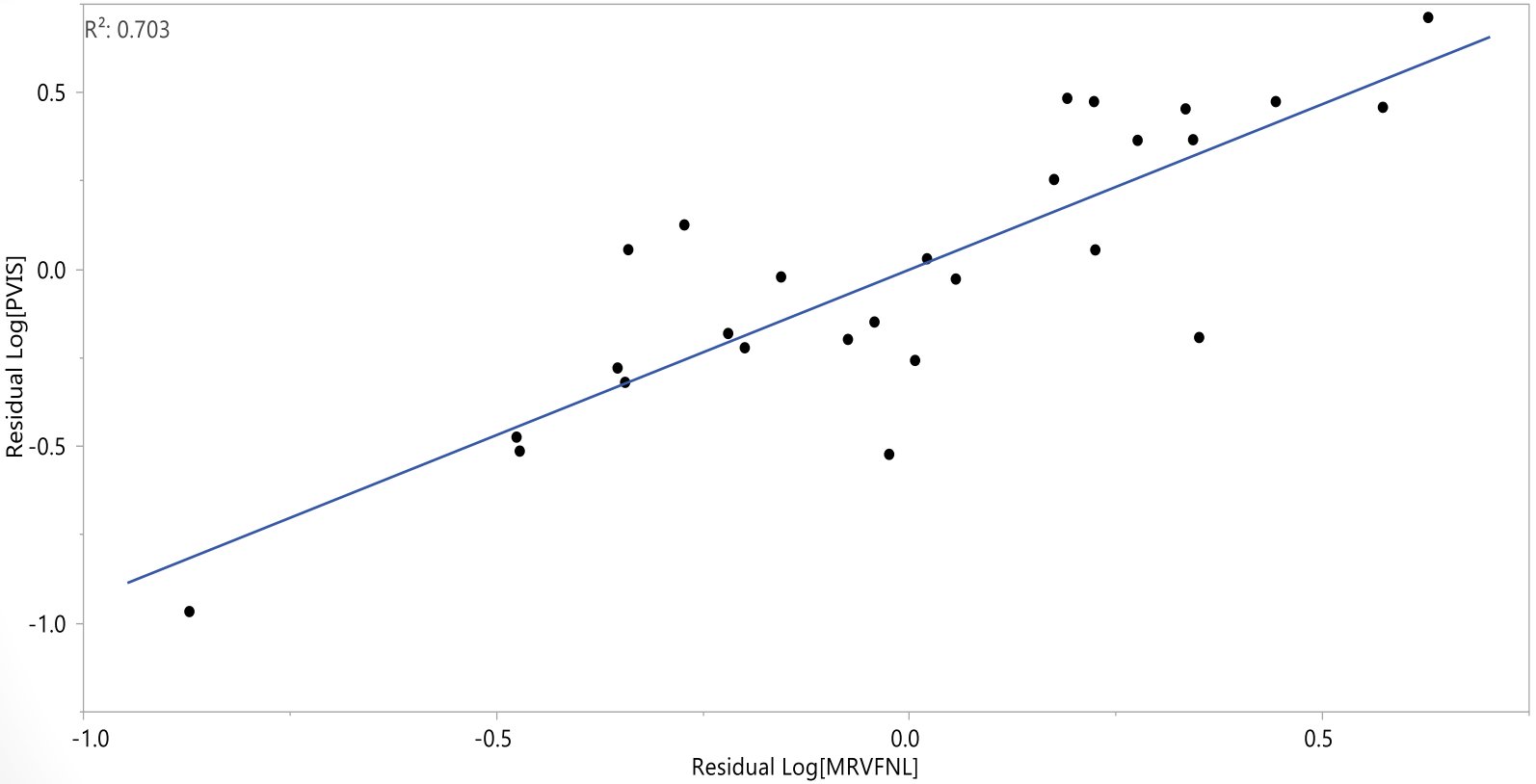
Lab/Stand	PHOS LS Mean
[A]1	83.19
[A]2	82.82
[G]1	85.88
[G]2	85.07

PHOS Precision

Model: Oil, Lab, Stand (Lab)

Model RMSE	Repeatability	Reproducibility
• s = 1.57 • IIIGB s=2.33	• s = 1.57 • r = 4.35	• s = 1.75 • R = 4.85

Correlation



PVIS and MRV are correlated

LTMS

ANOVA Factor	P-value			
	LnPVIS	WPD	LnMRV	PHOS
IND	0.00	0.00	0.00	0.00
LTMSLAB	0.07	0.29	0.05	0.05
LTMSAPP[LTMSLAB]	0.01	0.53	0.04	0.74

Looks like a Stand-based LTMS is appropriate for Sequence IIIH based on the Stand(Lab) factor being significant but a more detailed analysis of LTMS is needed to confirm this.

Reference Oil Targets

PERCENT VISCOSITY INCREASE

Unit of Measure: LN(PVIS)

IIIH			IIIG		
Reference Oil	LSMean	Standard Deviation	Reference Oil	Mean	Standard Deviation
434-2	4.7292	0.3943	434	4.7269	0.3859
436	3.3308	0.3138			
438-1	3.9773	0.9558	438	4.5706	0.1768

WEIGHTED PISTON DEPOSITS

Unit of Measure: Merits

IIIH			IIIG		
Reference Oil	LSMean	Standard Deviation	Reference Oil	Mean	Standard Deviation
434-2	4.12	0.67	434	4.80	0.96
436	4.62	0.28			
438-1	3.65	0.43	438	3.20	0.33

Reference Oil Targets

MRV VISCOSITY

Unit of Measure: LN(MRV)

IIIH			IIIGA		
Reference Oil	LSMean	Standard Deviation	Reference Oil	Mean	Standard Deviation
434-2	11.2520	0.52391	434	10.7881	0.45550
436	9.7991	0.24233			
438-1	10.0847	0.72094	438	9.8277	0.16646

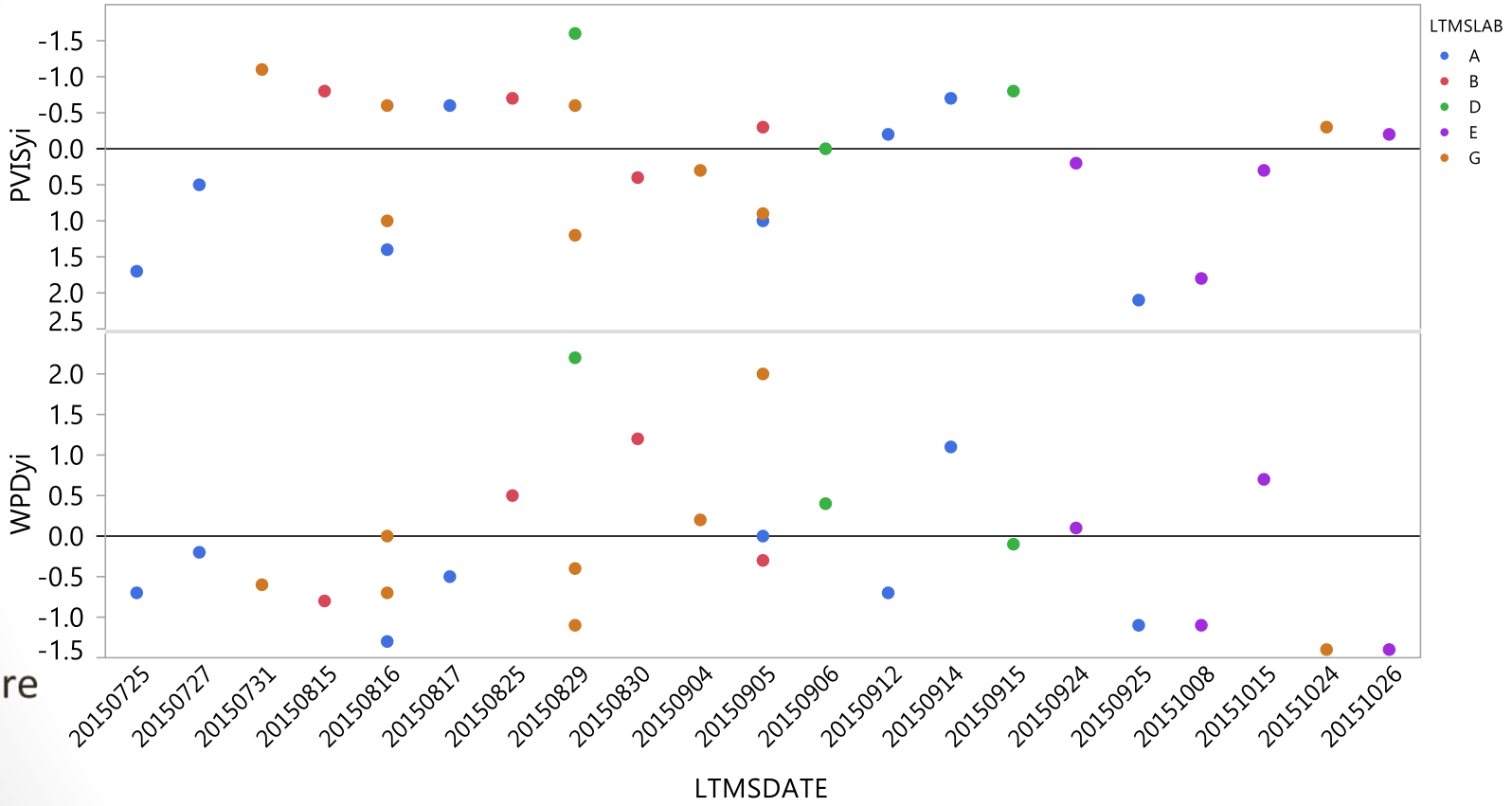
PHOSPHORUS RETENTION

Unit of Measure: Percent

IIIH			IIIGB		
Reference Oil	LSMean	Standard Deviation	Reference Oil	Mean	Standard Deviation
434-2	79.89	1.66	434	76.00	2.02
436	94.14	2.02			
438-1	78.90	1.54	438	78.20	2.56

Industry Yi

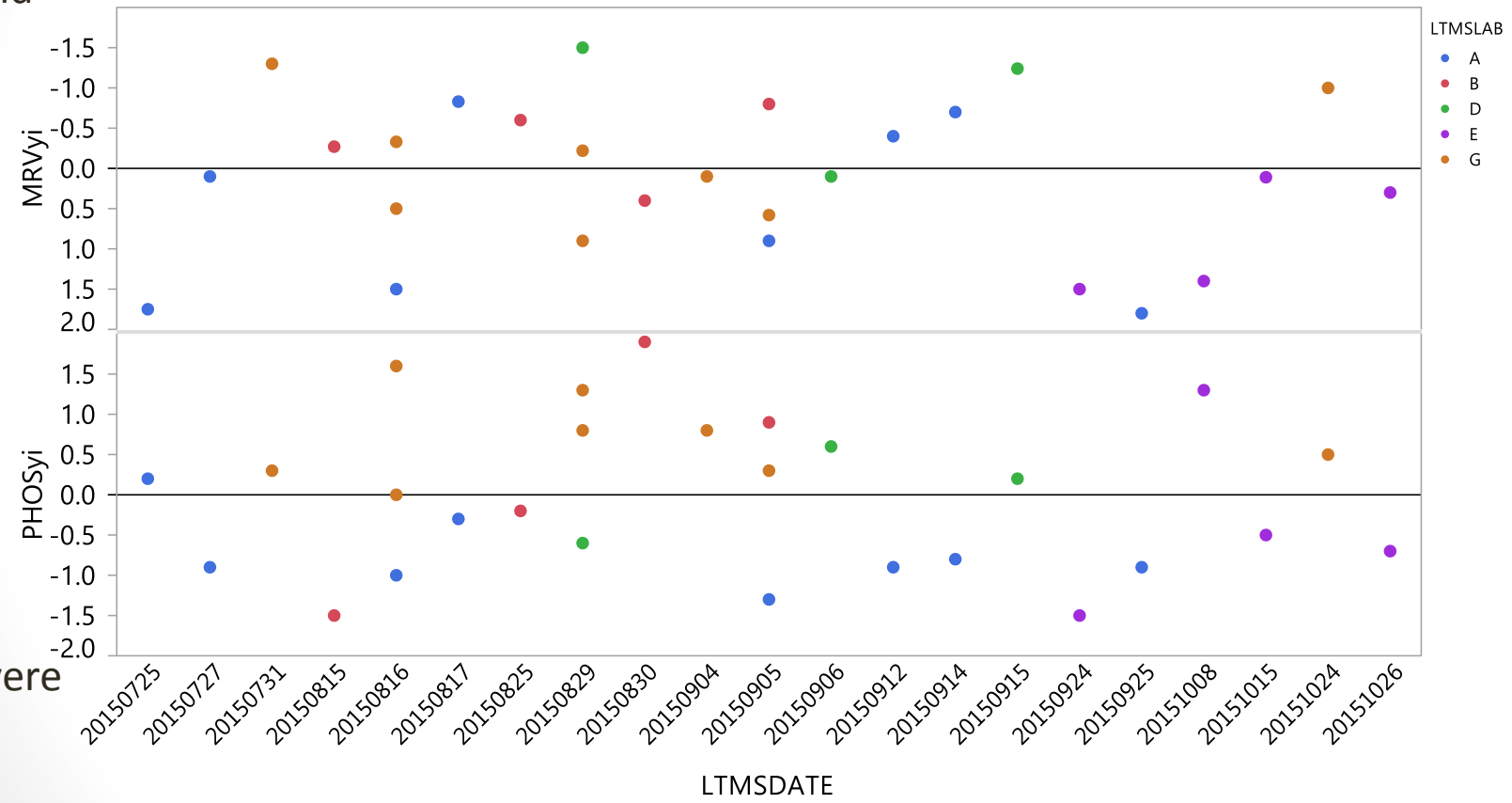
Mild



Severe

Industry Yi

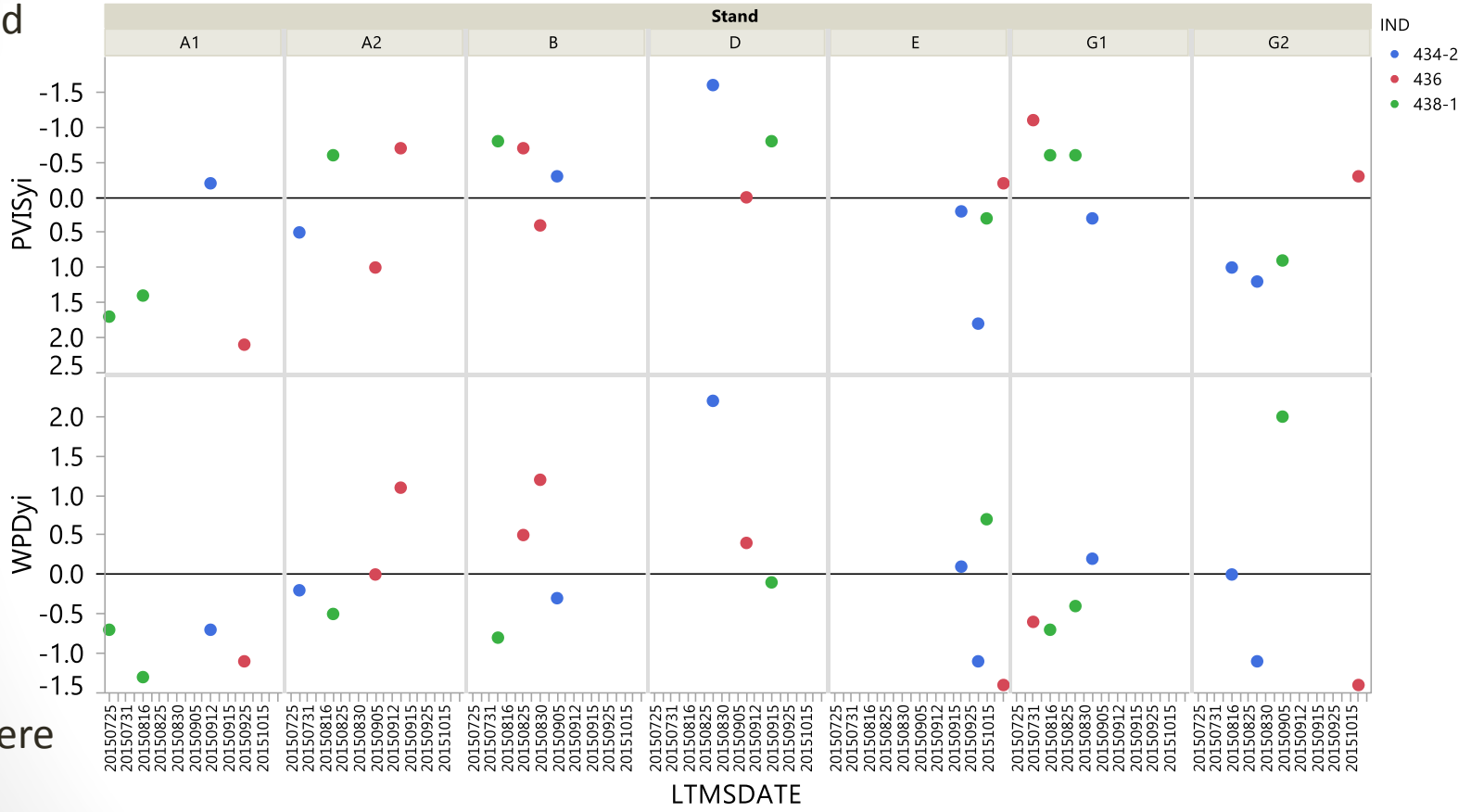
Mild



Severe

Stand Yi

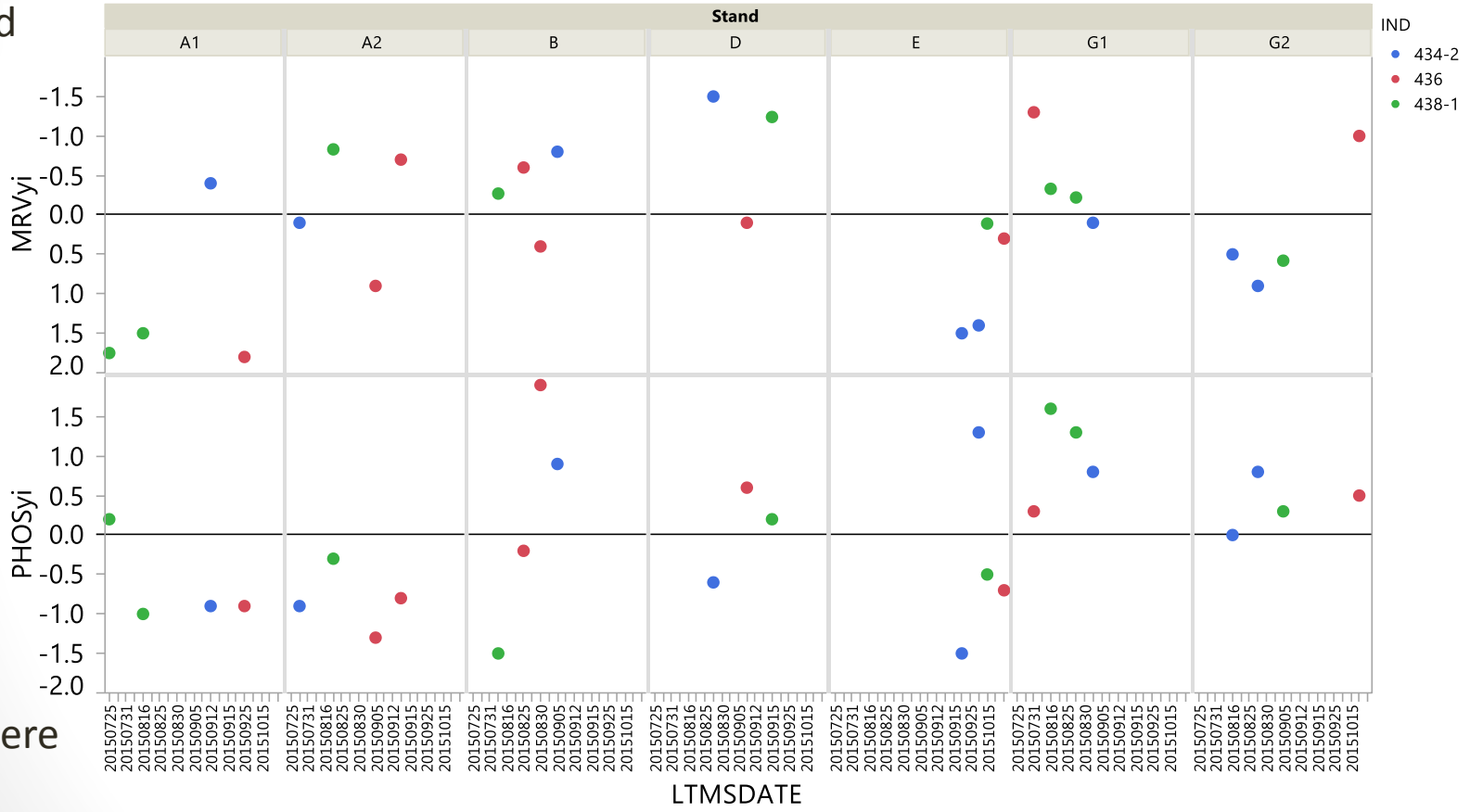
Mild



Severe

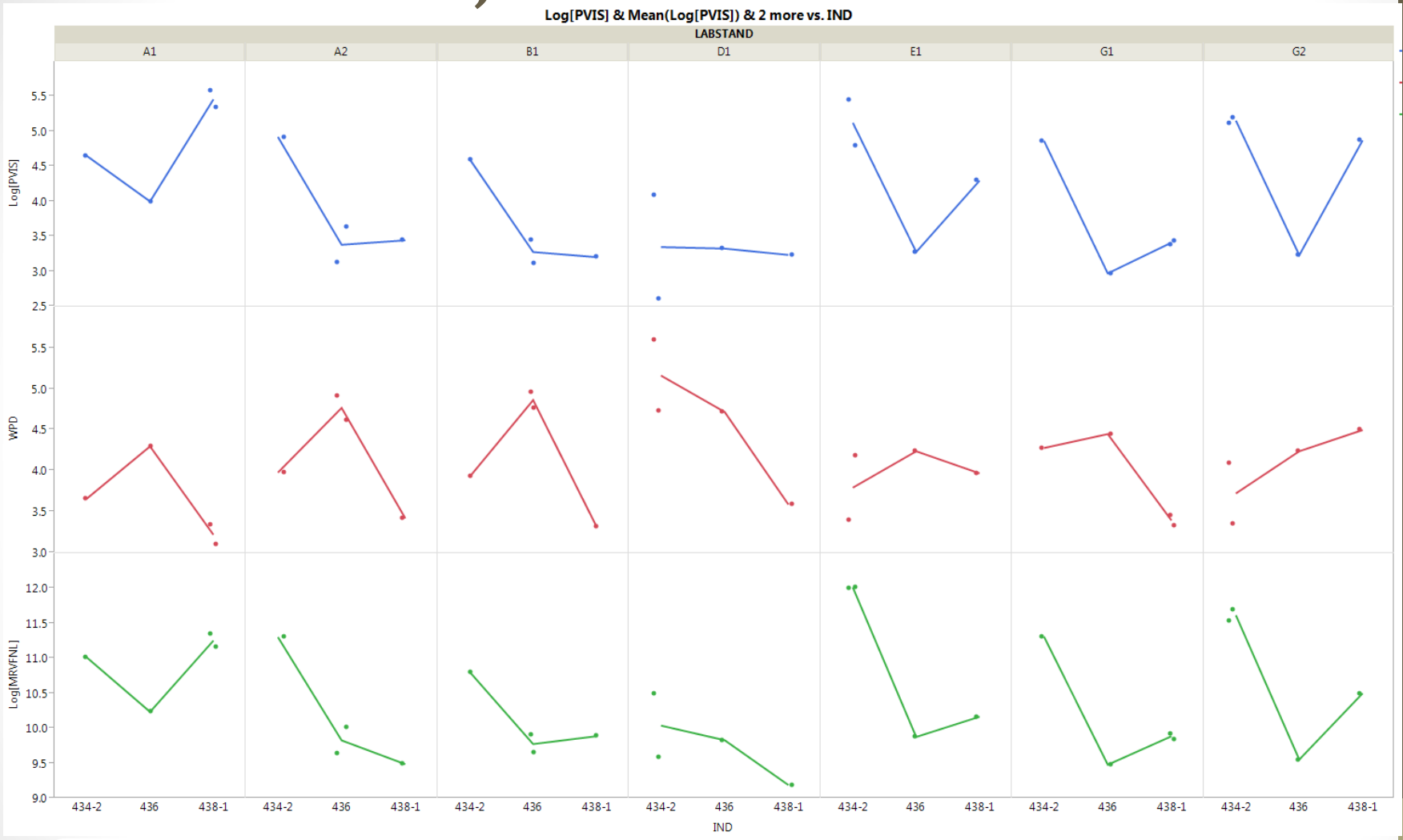
Stand Yi

Mild



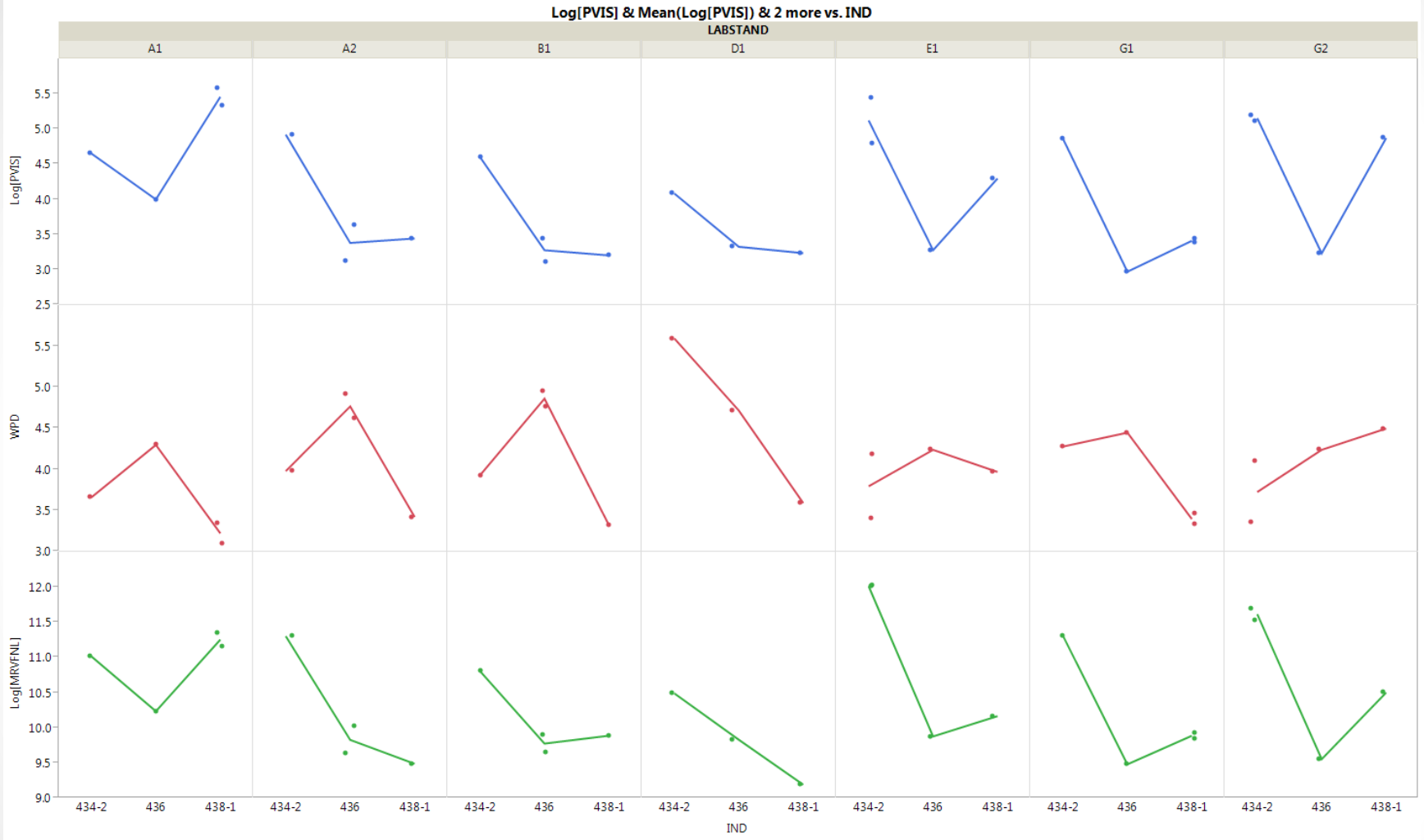
Severe

Concern 1, n=28



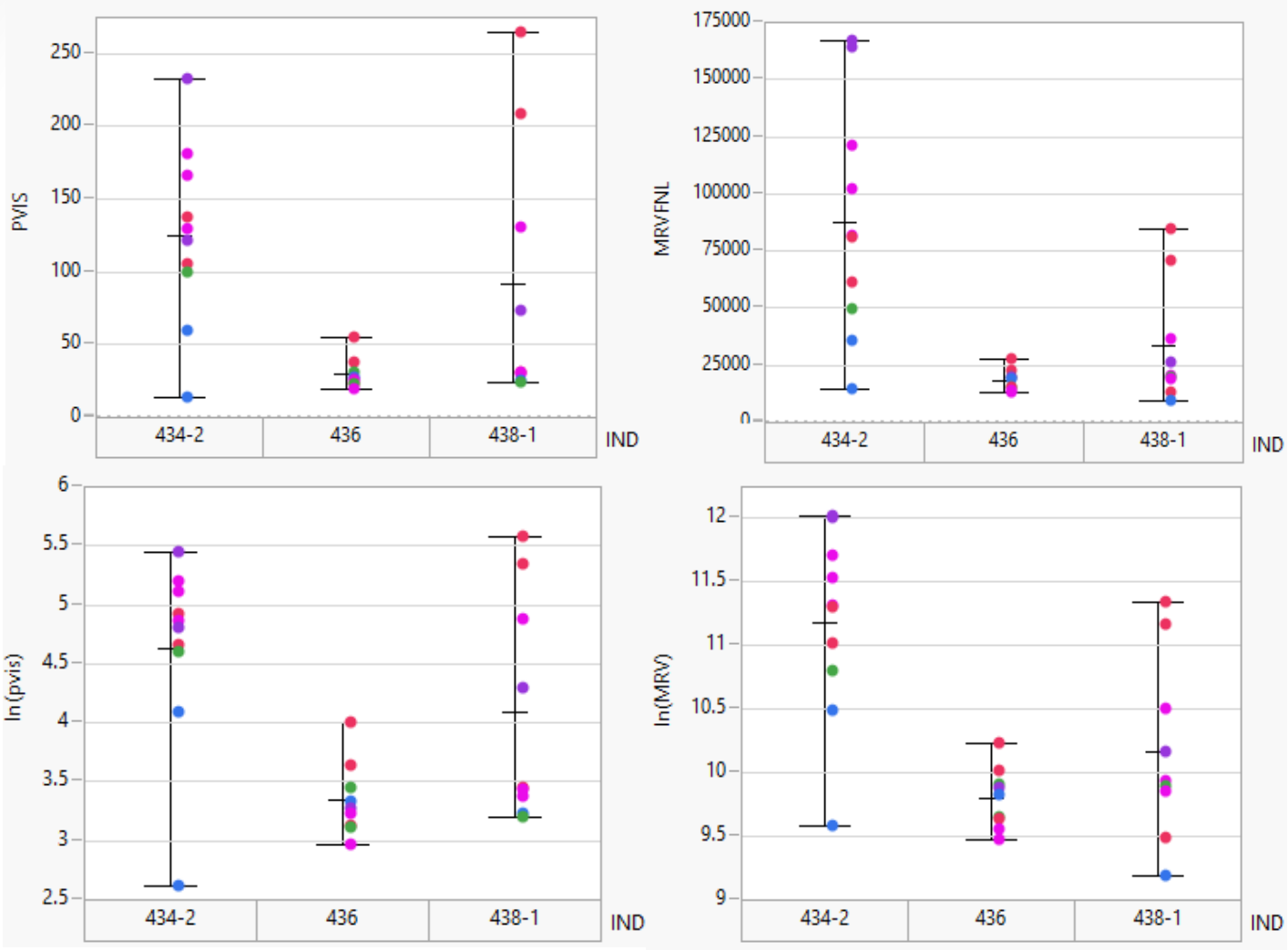
Stands do not discriminate the same way

Concern 1, n=27



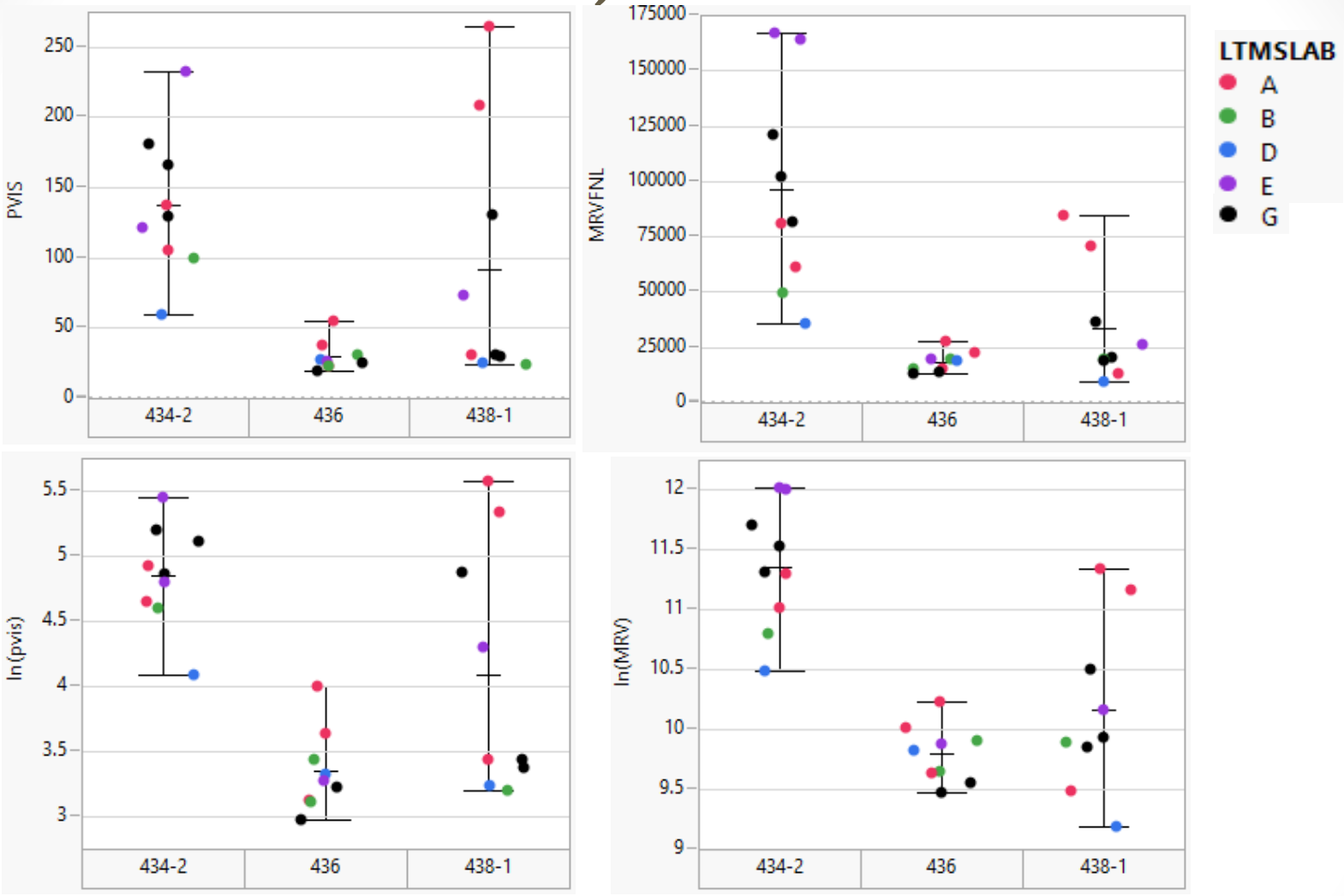
Stands do not discriminate the same way

PVIS Concern 2, n=28



If 434-2 is meant to be a failing oil, then will PVIS and/or MRV be adequate parameters to ensure failing oils won't pass and passing oils won't fail?
Is the test severe enough for PVIS to consistently reflect that 434-2 "breaks"?

PVIS Concern 2, n=27



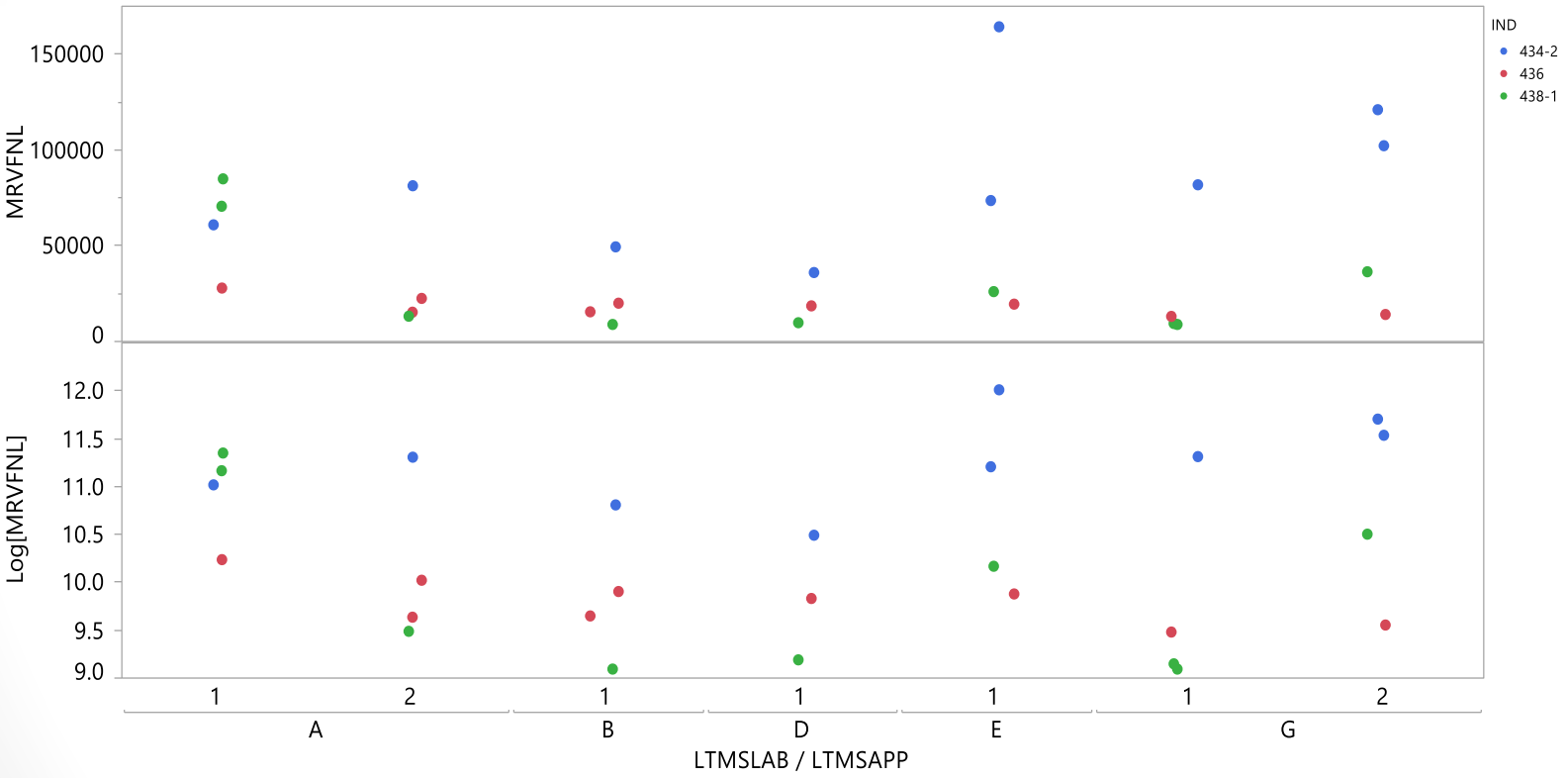
If 434-2 is meant to be a failing oil, then will PVIS and/or MRV be adequate parameters to ensure failing oils won't pass and passing oils won't fail?
Is the test severe enough for PVIS to consistently reflect that 434-2 "breaks"?

Appendix
MRV @-30C

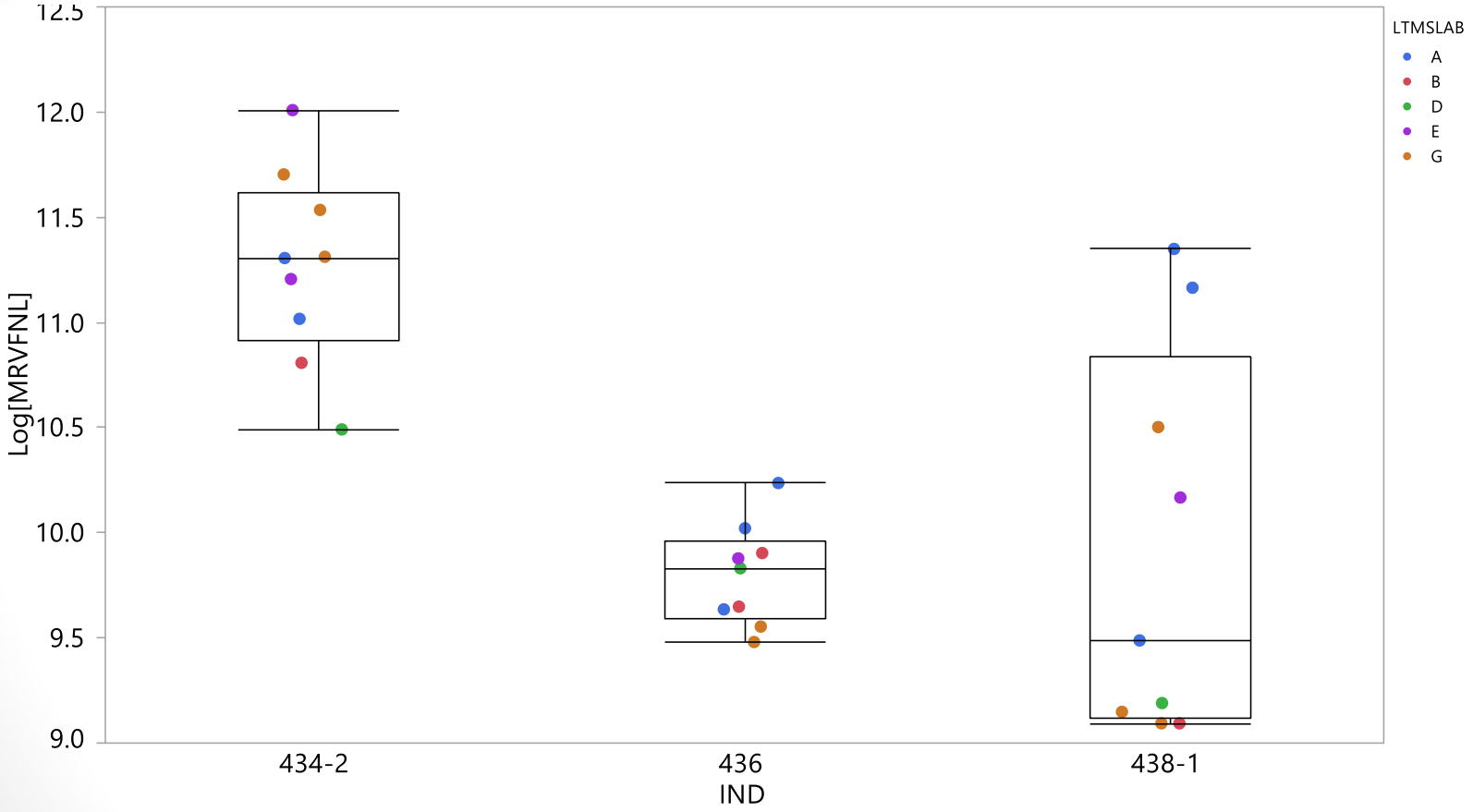
Summary

	LnPVIS	WPD	LnMRV @-30C	Phos
Lab Difference	No significant difference	No significant difference	No significant difference	A<G
Stand(Lab) Difference	A2 < A1, G1 < G2	No significant difference	A2 < A1, G1 < G2	No significant difference
Oil Discrimination	436 < 434-2, 438-1; 438-1 < 434-2	436 > 438-1	436, 438-1 < 434-2	436 > 434-2, 438-1
Precision, s, RMSE	0.4764	0.48	0.4794	1.57

MRV Viscosity (@ -30C)



LnMRV (@ -30C)


12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
Log[MRVFNL]
434-2
436
438-1
IND
LTMSLAB
A
B
D
E
G

LnMRV ANOVA

Summary of Fit

RSquare	0.801376
RSquare Adj	0.713099
Root Mean Square Error	0.479431
Mean of Response	10.32496
Observations (or Sum Wgts)	27

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	8	16.692831	2.08660	9.0780
Error	18	4.137369	0.22985	Prob > F
C. Total	26	20.830200		<.0001*

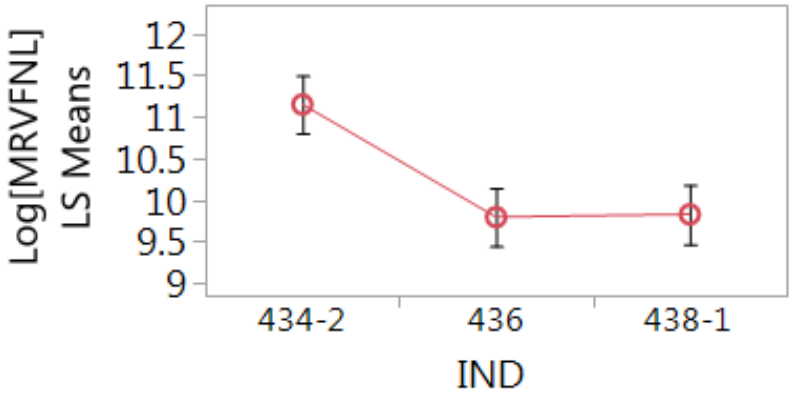
Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	2	2	10.186476	22.1586	<.0001*
LTMSLAB	4	4	2.327790	2.5318	0.0763
LTMSAPP[LTMSLAB]	2	2	2.389613	5.1981	0.0165*

LnMRV Oil Discrimination

436 is significantly lower than 434-2

438-1 is significantly lower than 434-2

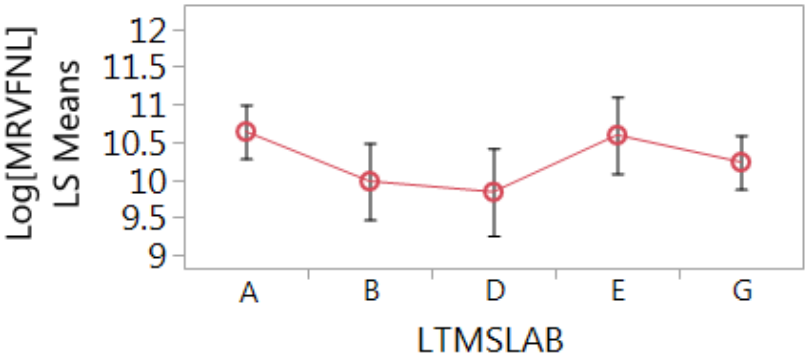


Oil1	Oil2	Difference	p-Value
434-2	436	1.3572	0.00
434-2	438-1	1.3237	0.00
438-1	436	0.0335	0.99

Oil	LnMRV LS Mean	MRV LS Mean
434-2	11.1498	69550
436	9.7926	17901
438-1	9.8261	18511

LnMRV Lab Difference

No significant lab difference



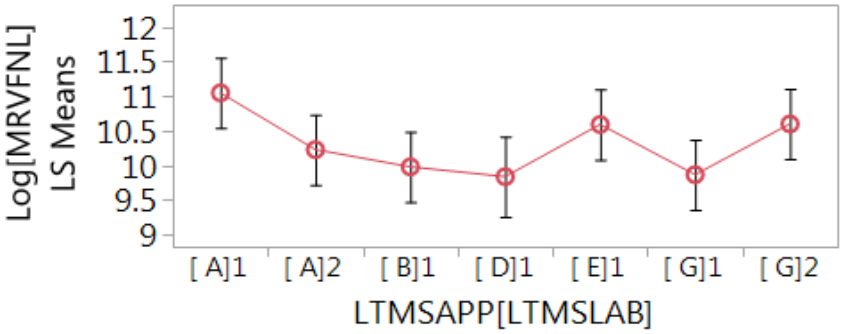
Lab1	Lab2	Difference	p-Value
A	D	0.8015	0.14
E	D	0.7544	0.28
A	B	0.6597	0.21
E	B	0.6125	0.41
A	G	0.4058	0.47
G	D	0.3958	0.74
E	G	0.3586	0.74
G	B	0.2539	0.91
B	D	0.1418	0.99
A	E	0.0472	1.00

Lab	LnMRV LS Mean	MRV LS Mean
A	10.639	41731
B	9.9793	21575
D	9.8374	18721
E	10.5918	39807
G	10.2332	27811

LnMRV Stand(Lab) Difference

Stand A2 is significantly lower than Stand A1

Stand G1 is significantly lower than Stand G2



Lab/Stand1	Lab/Stand2	Difference	p-Value
[A]1	[A]2	0.8208	0.03
[G]2	[G]1	0.7340	0.05

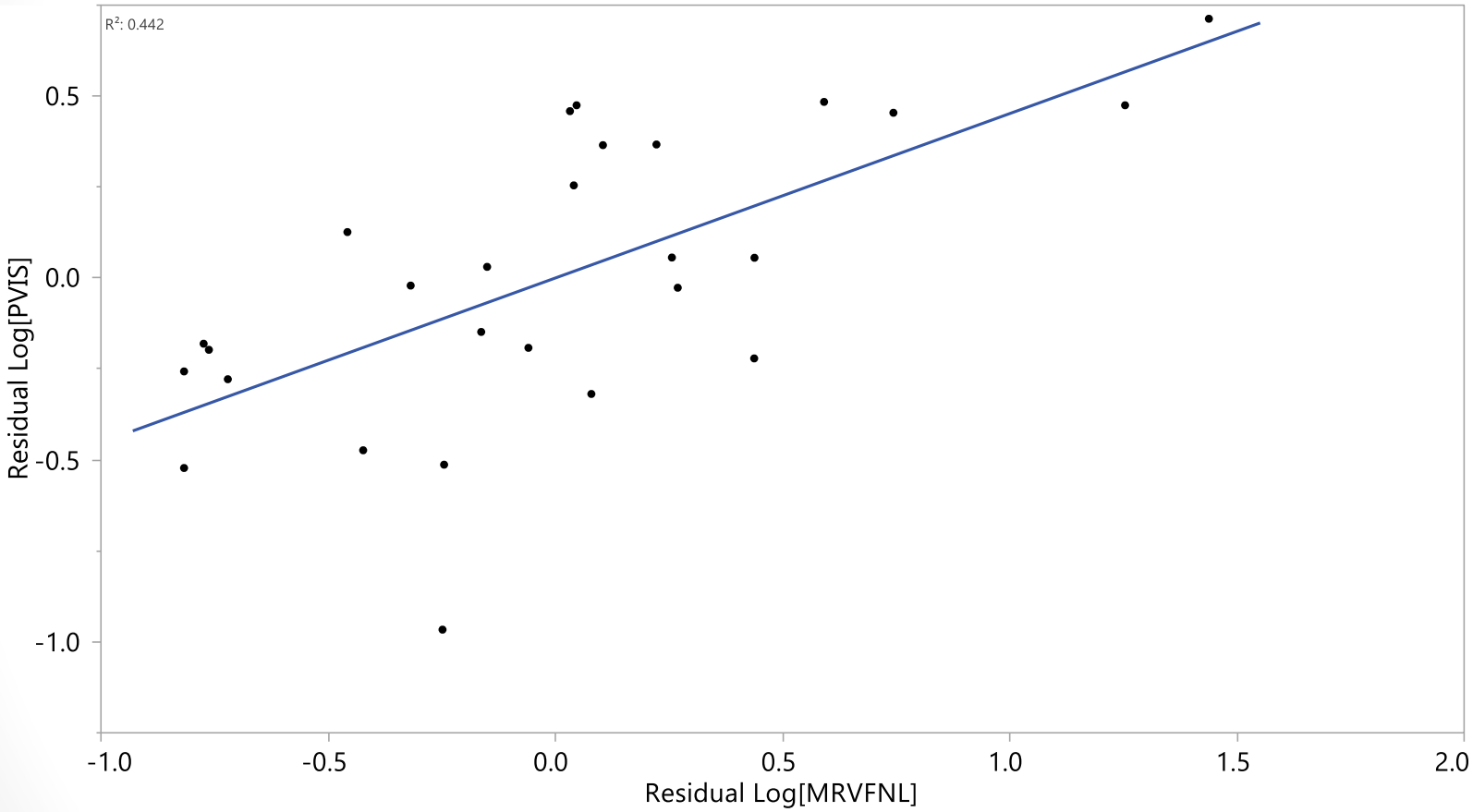
Lab/Stand	LnMRV LS Mean	MRV LS Mean
[A]1	11.0494	62906
[A]2	10.2286	27684
[G]1	9.8662	19268
[G]2	10.6002	40143

LnMRV Precision

Model: Oil, Lab, Stand(Lab)

Model RMSE	Repeatability	Reproducibility
• s = 0.4794 • No IIIGA s	• s = 0.4794 • r = 1.3288	• s = 0.6068 • R = 1.6820

Correlation



PVIS and MRV are slightly correlated

LTMS

ANOVA Factor	P-value			
	LnPVIS	WPD	LnMRV	PHOS
IND	0.00	0.00	0.00	0.00
LTMSLAB	0.07	0.29	0.08	0.05
LTMSAPP[LTMSLAB]	0.01	0.53	0.02	0.74

Looks like a Stand-based LTMS is appropriate for Sequence IIIH based on the Stand(Lab) factor being significant but a more detailed analysis of LTMS is needed to confirm this.

Reference Oil Targets

MRV VISCOSITY

Unit of Measure: LN(MRV)

IIIH			IIIGA		
Reference Oil	LSMean	Standard Deviation	Reference Oil	Mean	Standard Deviation
434-2	11.1498	0.46039	434	10.7881	0.45550
436	9.7926	0.24233			
438-1	9.8261	0.91321	438	9.8277	0.16646

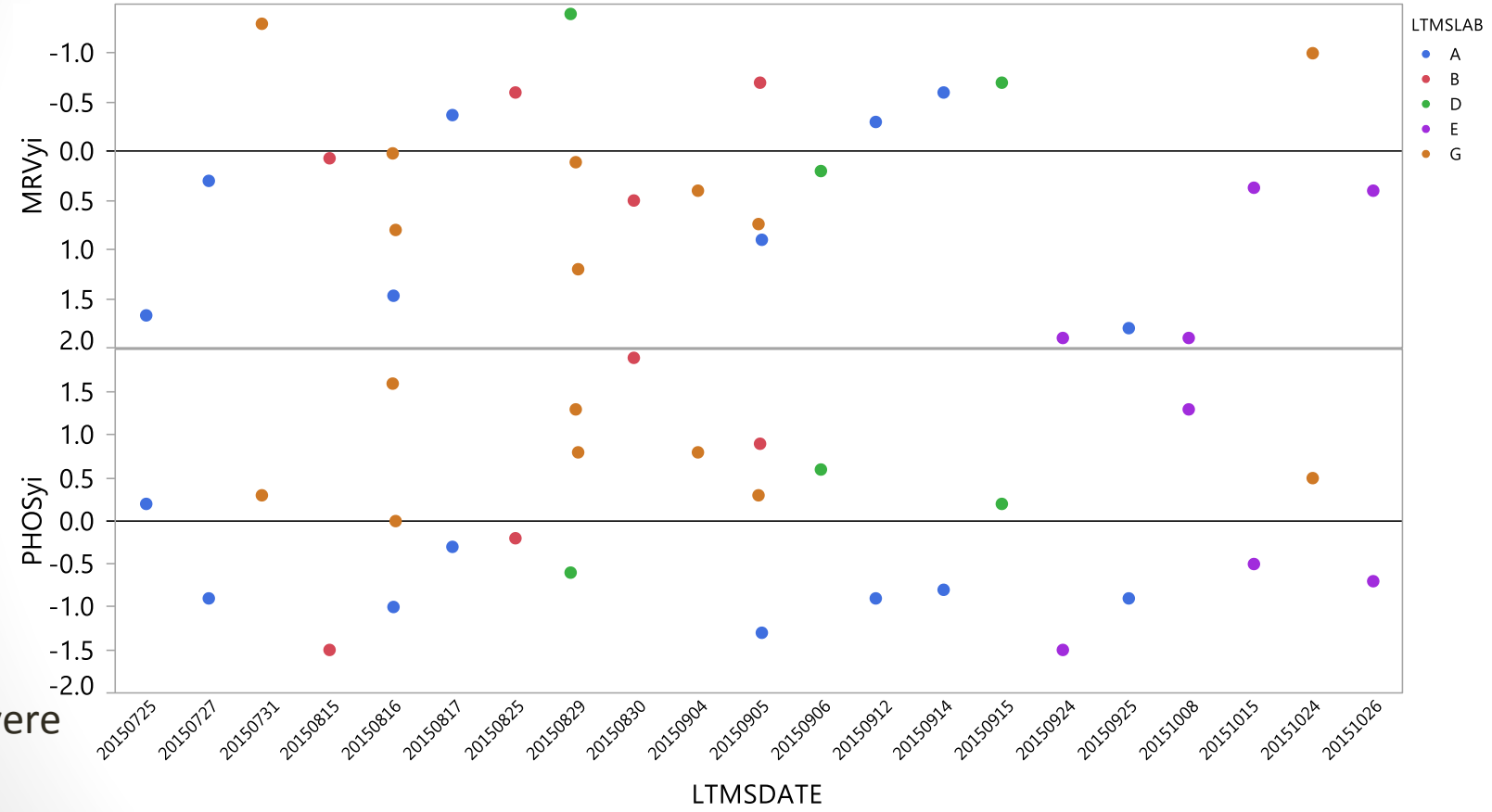
PHOSPHORUS RETENTION

Unit of Measure: Percent

IIIH			IIIGB		
Reference Oil	LSMean	Standard Deviation	Reference Oil	Mean	Standard Deviation
434-2	79.89	1.66	434	76.00	2.02
436	94.14	2.02			
438-1	78.90	1.54	438	78.20	2.56

Industry Yi

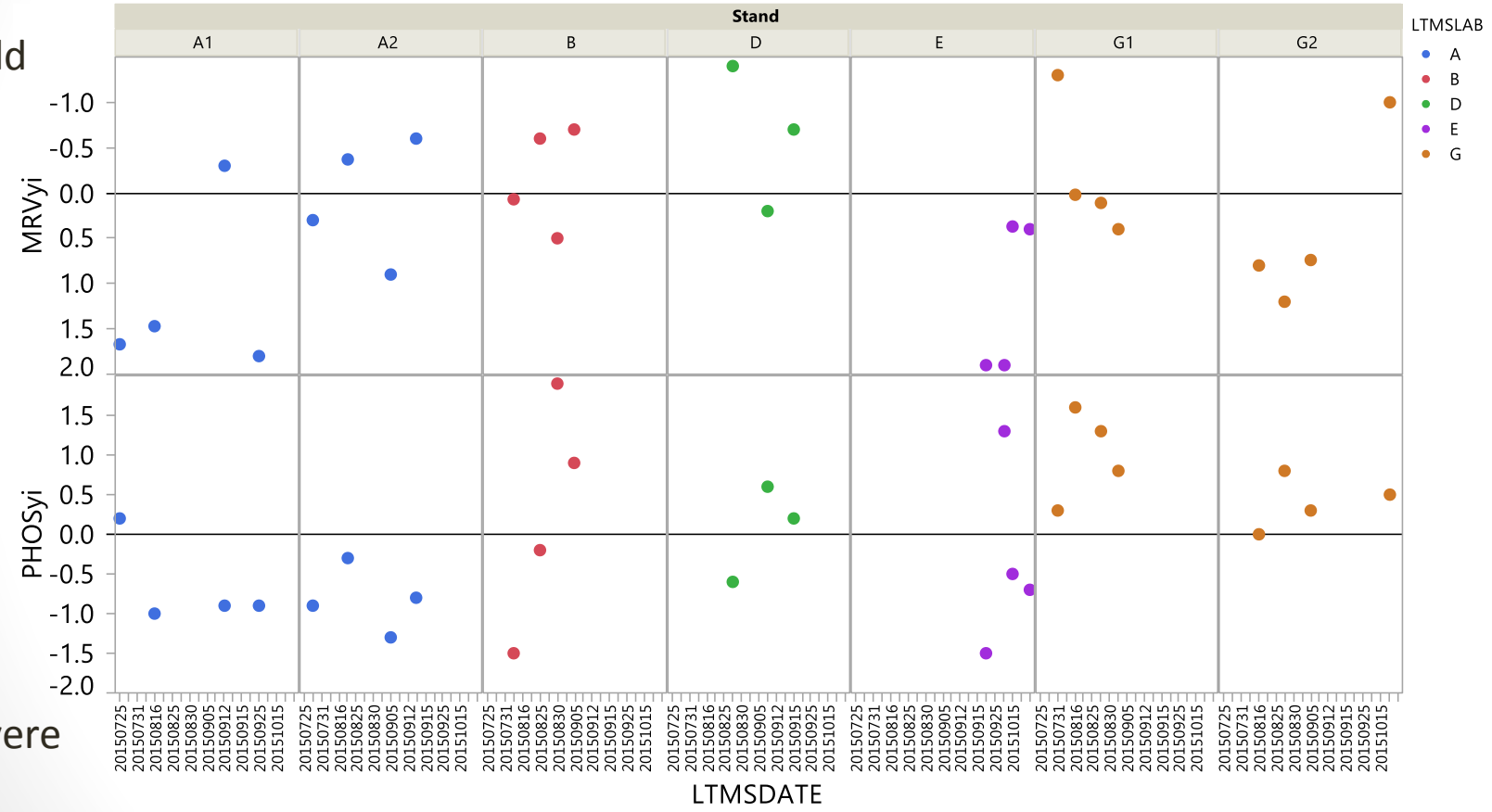
Mild



Severe

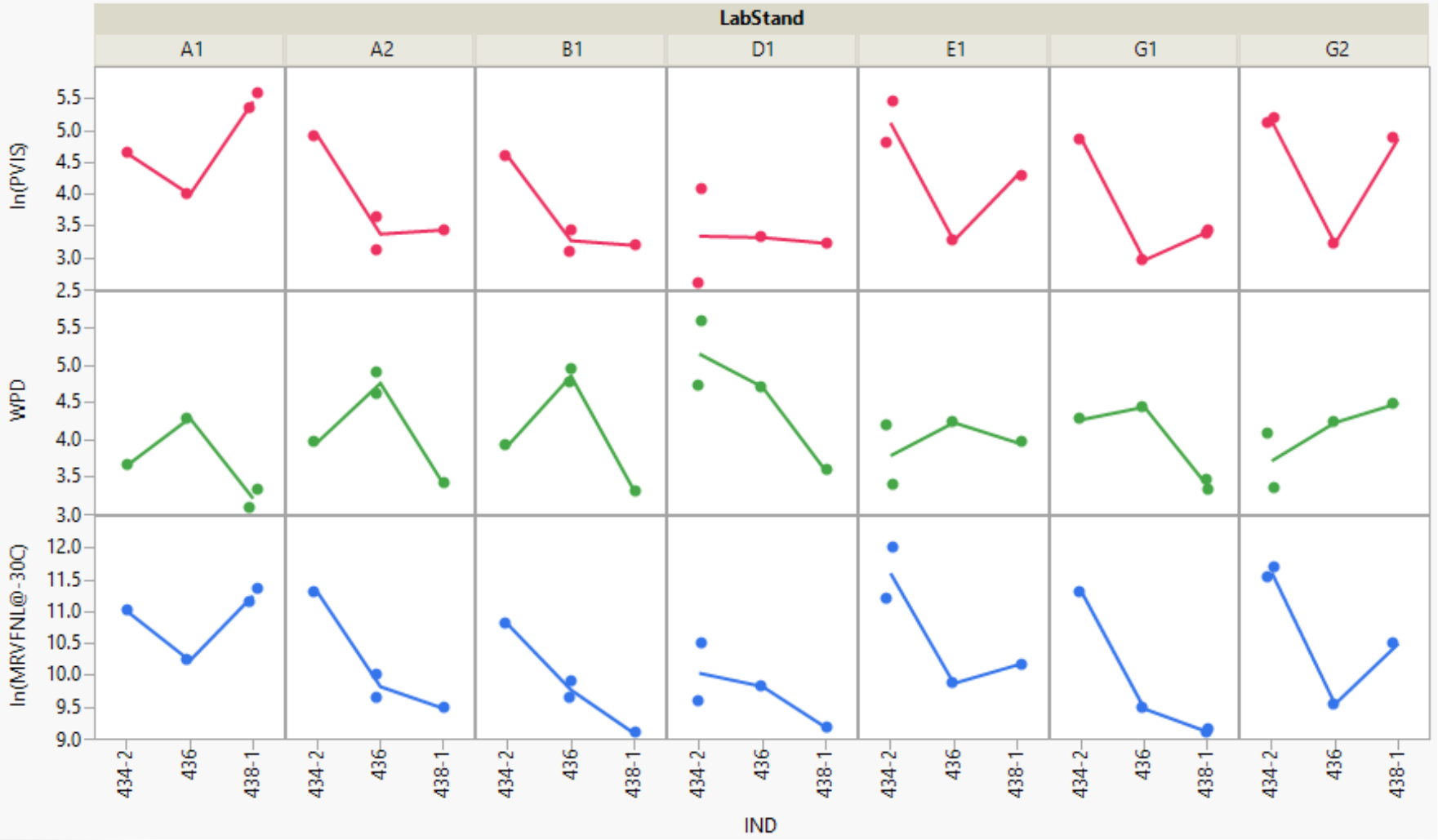
Stand Yi

Mild



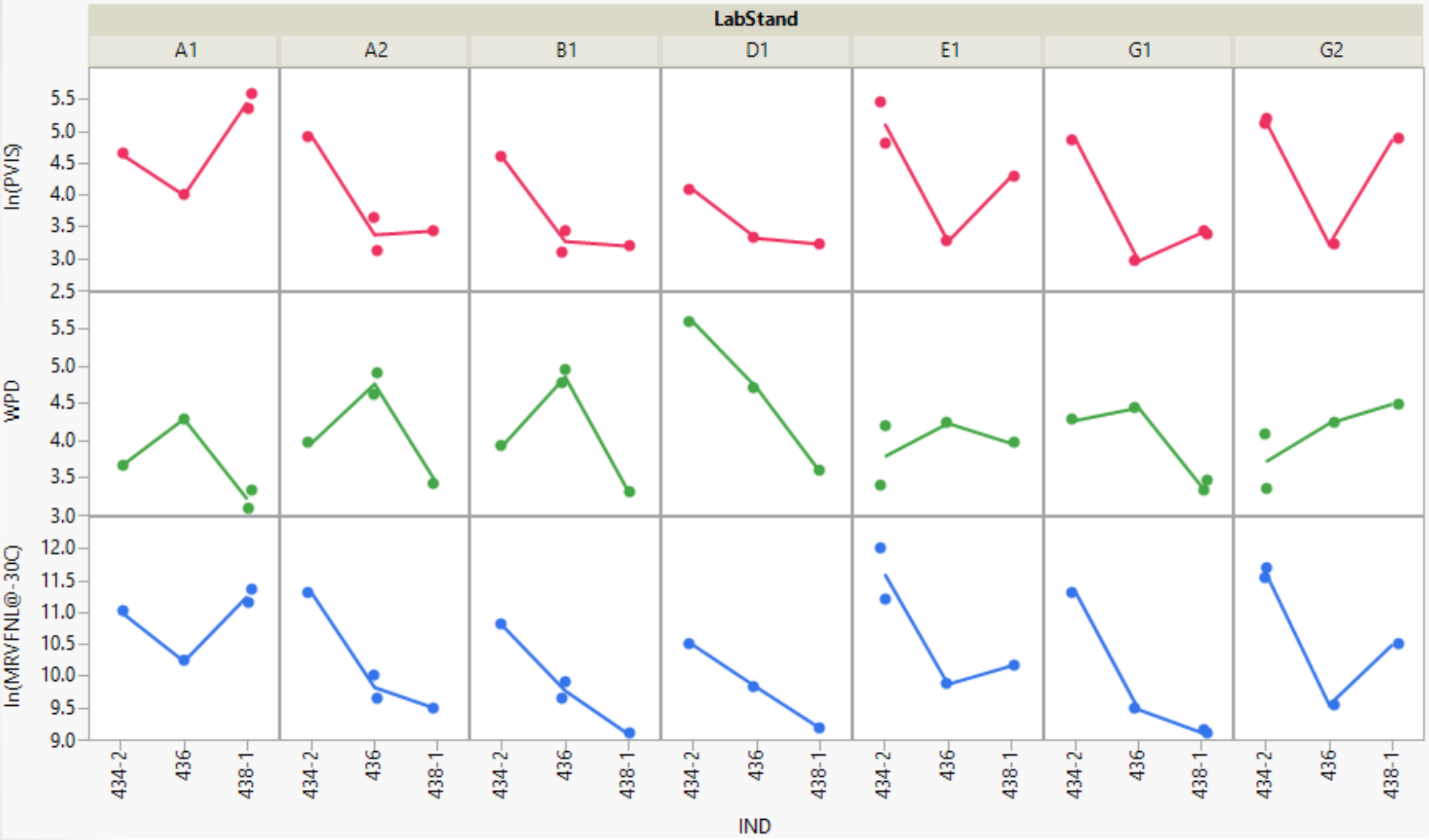
Severe

Concern 1, n=28



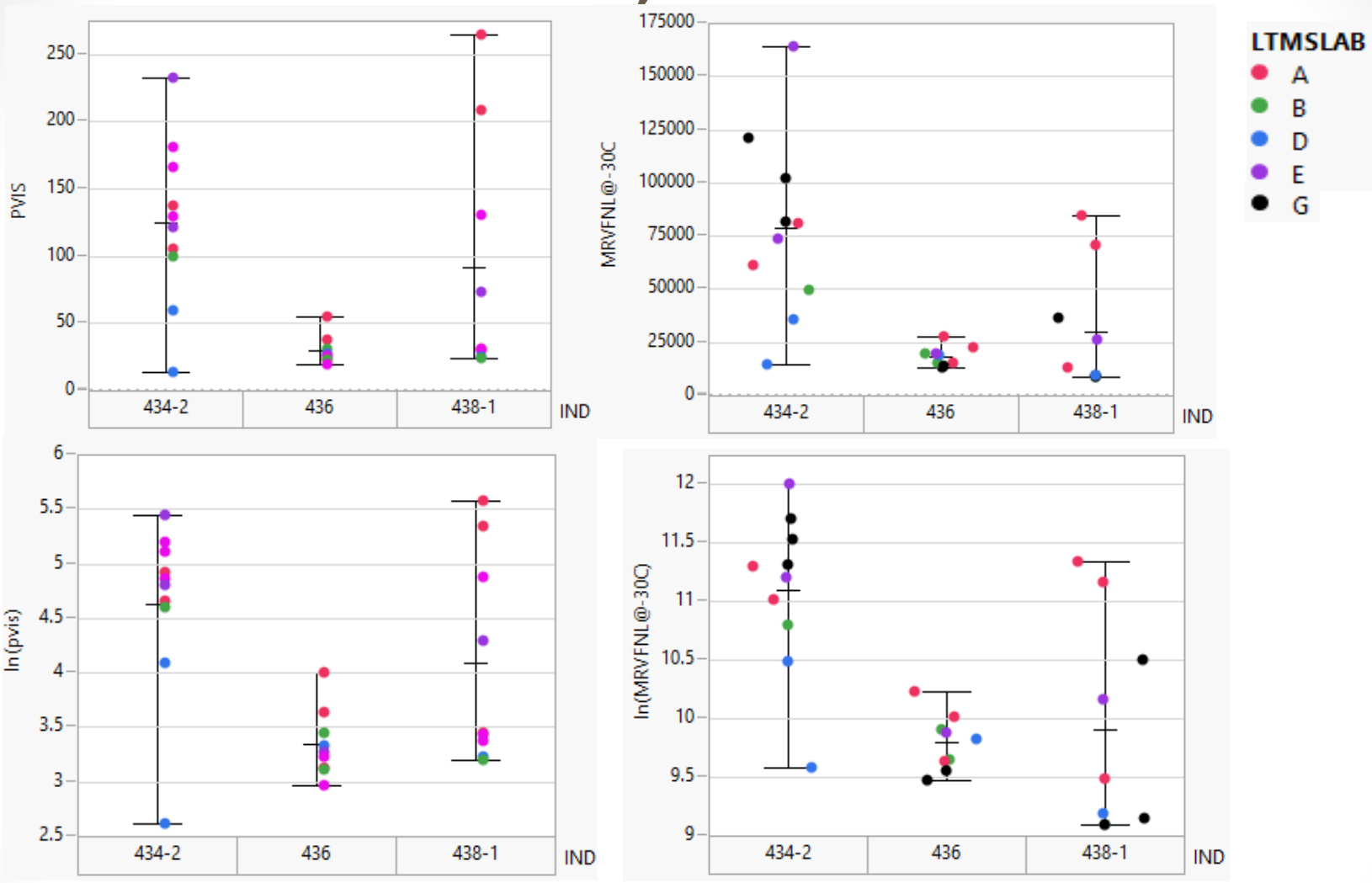
Stands do not discriminate the same way

Concern 1, n=27



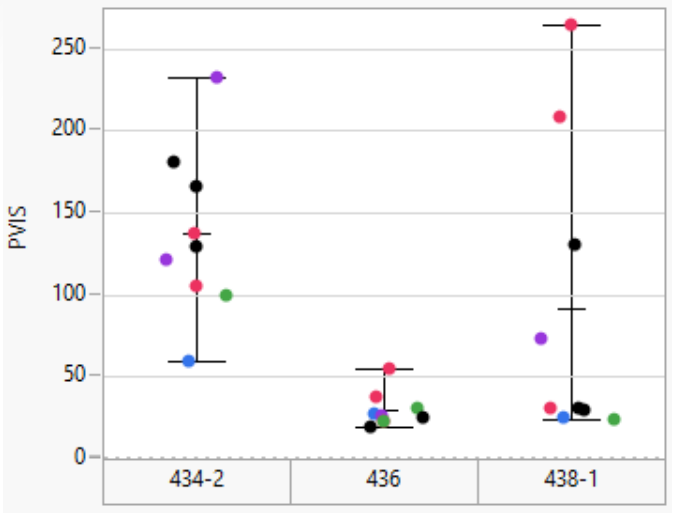
Stands do not discriminate the same way

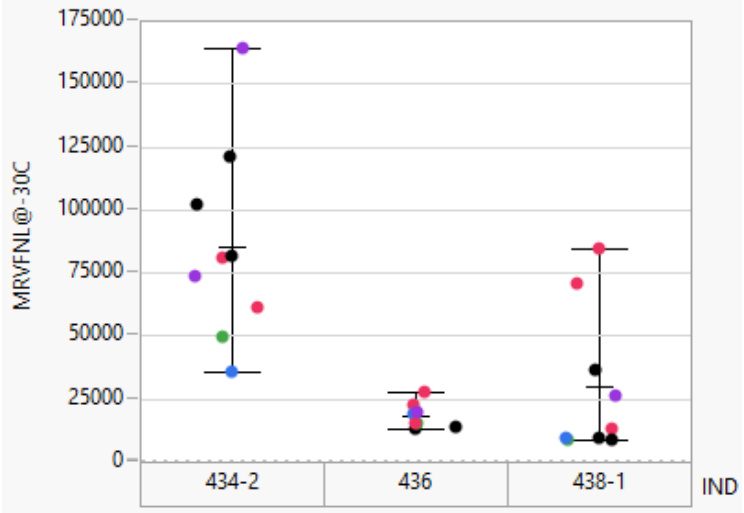
PVIS Concern 2, n=28

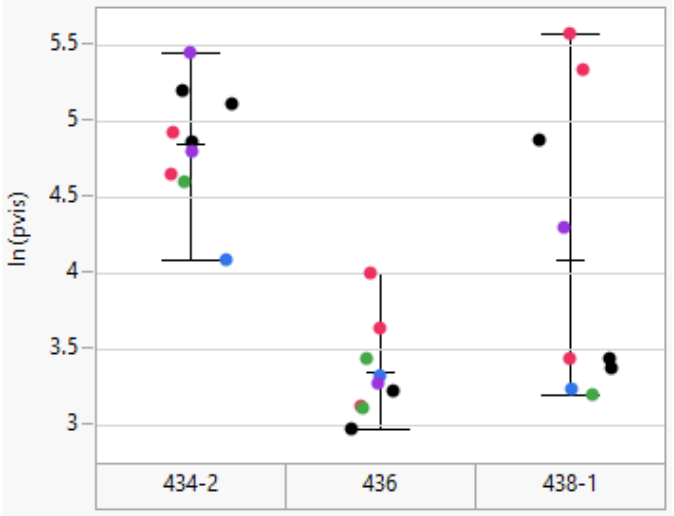


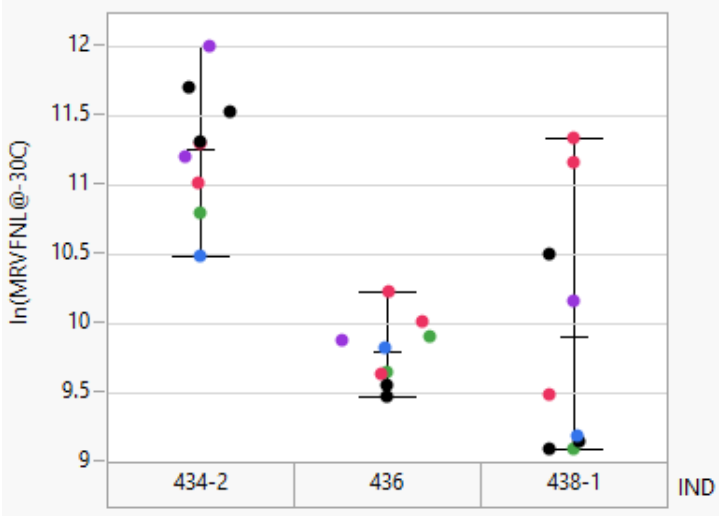
If 434-2 is meant to be a failing oil, then will PVIS and/or MRV be adequate parameters to ensure failing oils won't pass and passing oils won't fail?
Is the test severe enough for PVIS to consistently reflect that 434-2 "breaks"?

PVIS Concern 2, n=27









If 434-2 is meant to be a failing oil, then will PVIS and/or MRV be adequate parameters to ensure failing oils won't pass and passing oils won't fail?
Is the test severe enough for PVIS to consistently reflect that 434-2 "breaks"?

ATTACHMENT 4

At the AOAP and PCEOCP meetings is San Antonio, Texas last week, the Sequence III Surveillance Panel was requested to endorse the Sequence IIIH test for measuring MRV and Phosphorus Retention by the AOAP and PCEOCP groups. The Sequence III Surveillance Panel met via teleconference on Wednesday, February 17 with this item on the agenda.

The SP did not entertain any motions relative to MRV or P Retention. There was significant discussion relative to the lack of Sequence IIIG MRV or ROBO data for Sequence IIIH reference oils 434-2, 438-1 and 436. Additionally, Phosphorus Retention data for Sequence IIIH reference oils is lacking.

As chairman of the Sequence III SP, I was tasked with asking the ASTM Test Monitoring Center to contact the suppliers of the IIIH reference oils to secure any data that may be available.

Thank you for your time,

David L. Glaenzer
Sequence III Surveillance Panel Chairman
Afton Chemical Corporation
Phone: (804) 788-5214
Email: dave.glaenzer@aftonchemical.com