Unapproved Minutes of the June 19, 2013
Sequence VG Surveillance Panel
Conference Call

The meeting was called to order by Chairman Andy Ritchie at 2:00 PM EST.

A list of the attendees on the call is included as Attachment 1.

Chairman Ritchie listed the agenda items he would like to cover in this call:

1) Review and approval of minutes from June 11, 2013 call
2) Discussion of Statistical Group's analysis of results from the fuel approval matrix for Batch No. AK2821NX10 fuel
3) Plans for additional data analysis or future testing, if any
4) Old Business.
5) New Business.
6) Next Meeting

Chairman Ritchie asked if there were any corrections to the minutes from the June 11, 2013 VG Panel conference call. There being none, Ed Altman made a motion to approve the minutes. Dwight Bowden seconded the motion. The motion was approved unanimously.

Chairman Ritchie then asked Doyle Boese to go through the analysis and recommendations which the Statistical Group had prepared on the fuel matrix results. (See Attachment 2) Rather than going through the complete 48 slide presentation the Statistical Group had prepared, Doyle indicated he would just cover the highlights and conclusions from the analysis. The process used was to combine the separate analyses conducted by the individual Statistical Group members into a single presentation. After discussing the analyses, there was consensus agreement among the Statistical Group members on the material shown in Attachment 2. The analyses were done with and without the results from Oil 925-3, because Oil 925-3 contains older chemistry which may not react the same as oils containing current chemistry. Also, the results for Oil 925-3 are not close to the pass/fail limits for the various parameters. As indicated in Attachment 2, Oil 925-3 discriminates with Oil 1006-2 for all parameters, but Oil 925-2 discriminates with Oil 1009 only for RCS and AEV. The two do not discriminate for AES, APV or OSCR. Oil 1009 does discriminate with Oil

1006-2 for AES, APV and OSCR. The labs were not statistically different for AES and AEV, but there were some differences found between some labs for RCS, APV and OSCR. Stands within labs were not found to be statistically different for all parameters. For variability, AES has larger variability compared to LTMS, while AES, RCS, APV and OSCR all have variability comparable to LTMS. Oil 1009 AES had the highest standard deviation. Attachment 2 contains the full analysis, including fuel batch adjustment recommendations and the calibration rate for each of the oils with no adjustments and with the recommended adjustments, the latter including Oil 925-3 and excluding Oil 925-3.

Chairman Ritchie then asked the Panel to focus on the subset of slides from the Statistical Group presentation shown in Attachment 3. Discussion of these slides centered around whether or not to include results from Oil 925-3 in the analysis. Rich Grundza commented that the Oil 925-3 results were noticeably different from the results from the other two oils and that the varnish results for Oil 925-3 were also highly variable. Doyle and Rich then calculated how the calibration results would change if the varnish parameter were excluded from the analysis. This improves the calibration rates for all three scenarios mentioned in the previous paragraph. Martin Chadwick added that, in his analysis, after three runs a precision alarm would be tripped, primarily because one oil is so far away from the other two. This assumes the new failing oil, Oil 940, behaves like Oil 925-3. Chairman Ritchie commented that Oil 940 is likely to fail, and others agreed.

Looking at the matrix results and analysis package as a whole, Ron Romano indicated he is uncomfortable accepting this fuel batch without more data. He expressed concern about making all of the recommended adjustments and then going forward with a different, failing oil that may react differently. Others commented that shortening the test length could be a possibility. Ed Altman asked if we should look at what would happen if Oil 940 does or does not react the same as Oil 925-3 did. Chairman Ritchie asked how long it would take to determine this, and Doyle answered that this could probably be done in couple of hours. Martin suggested that there are more issues if we want to look at LTMS implications, and Doyle replied that he was not including LTMS considerations in his time estimate. Other Panel members agreed that seeing how Oil 940 impacts the calculations is a good idea, and Chairman Ritchie suggested the Panel adjourn and reconvene on Friday to give the Statistical Group time to make those calculations. It was agreed

that another conference call would be held on Friday, June 21, at 10:30 am EDT.

Old Business

Ed Altman, referring to minutes from previous Sequence VG Surveillance Panel meetings and conference calls, questioned why Haltermann had released the last 24K gallons of the current VG fuel when the Panel had indicated it was to be conserved, particularly the last 6000 gallons which was indicated as being kept for emergency purposes. Ed indicated he had been told that Haltermann had divided this 6000 gal of fuel, distributed it, and now has no more of the current fuel remaining. Ed wants to know what happened to this fuel and wants Afton to have access to some of it. Ron Romano indicated he though the last 6000 gallons went to SwRI and Intertek for VH development work. Bill Buscher confirmed that 3000 gallons had indeed been sent to each lab for this purpose. Ed said he was under the understanding that it would be a Surveillance Panel decision as to what to do with the last 6000 gallons, and he still feels Afton should get some of that fuel. Bill said he thinks SwRI has enough fuel left for about two tests. Al Lopez said he thinks Intertek probably has about the same amount remaining. Ed said one possibility is that the remaining fuel be divided among the labs running VG tests. After some further discussion, Wayne Petersen said Mark Overaker will have a report at the next call on the disposition of the last 24K gallons of current VG fuel by Haltermann.

New Business: None

Next Meeting: The next VG Panel conference call was scheduled for Friday, June 21, 2013 at 10:30 AM EDT.

Attachment 1

Attendees during 6/19/2013 Sequence VG Surveillance Panel Call

BP Castrol – Timothy Miranda

Afton – Ed Altman

Ford - Ron Romano

GM – Bruce Matthews

Haltermann – Wayne Petersen, Tracey King

Infineum – Andy Ritchie, Mike McMillan, Doyle Boese

Intertek – Al Lopez, Martin Chadwick

Lubrizol – Chris Mileti, Jerome Brys, Jessica Buchanan, Chris Castanien

OHT – Dwight Bowden

Oronite– Jo Martinez

SwRI – Raham Kirkwood, Bill Buscher

TEI – Clayton Knight

TMC – Rich Grundza

Toyota – Jim Linden

Sequence VG Fuel Approval Matrix and Correction Factor Analysis

Statistics Group

June 19, 2013

Matrix Analysis Summary

- Oil Discrimination
  - 925-3 discriminates with 1009 for RCS and AEV
  - 925-3 discriminates with 1006-2 for all parameters
  - 1009 discriminates with 1006-2 for AES, APV and OSCR
- Lab Difference
  - Labs are not statistically different for AES and AEV
  - Lab D1 is lower than G for RCS, Lab D1 is lower than A and G for APV, and Lab G is lower than A and D1 for OSCR
- Stand Difference
  - Stands within labs are not statistically different for all parameters
- Variability
  - AEV has larger variability compared to LTMS
  - AES, RCS, APV and OSCR have variability comparable to LTMS
- RO 1009 AES showed the largest average y_i of -1.6.

Fuel Batch Adjustment Recommendations

- AES
  - If SP suggests including 925-3, recommend Linear Adjustment: Adjusted AES = (AES – 3.56)/0.50
  - If SP suggests excluding 925-3, recommend Linear Adjustment: Adjusted AES = (AES + 8.43)/1.96
- RAC
  - If SP suggests including 925-3, recommend Linear Adjustment: Adjusted RAC = (RAC – 4.98)/0.46
  - If SP suggests excluding 925-3, recommend no adjustment.
- AEV and APV
  - Recommend no adjustments
- Ln(OSCR + 1)
  - If SP suggests including 925-3, recommend Fixed Adjustment: – 0.482
    If SP suggests excluding 925-3, recommend Fixed Adjustment: -1.049

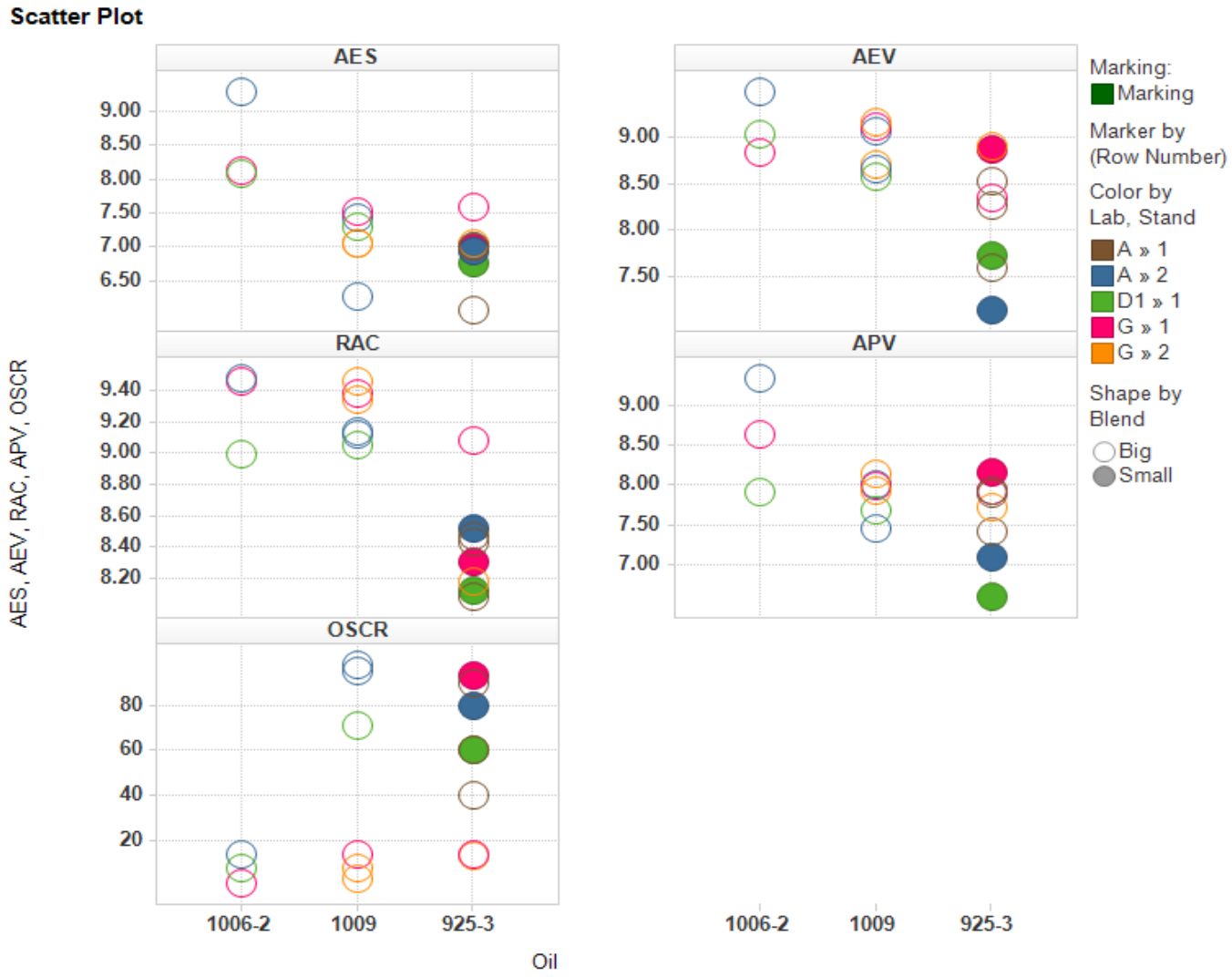
Calibration Rate with Adjustments

Number of matrix oils (17) meeting stand calibration severity requirements ($y_i \leq 1.8$):

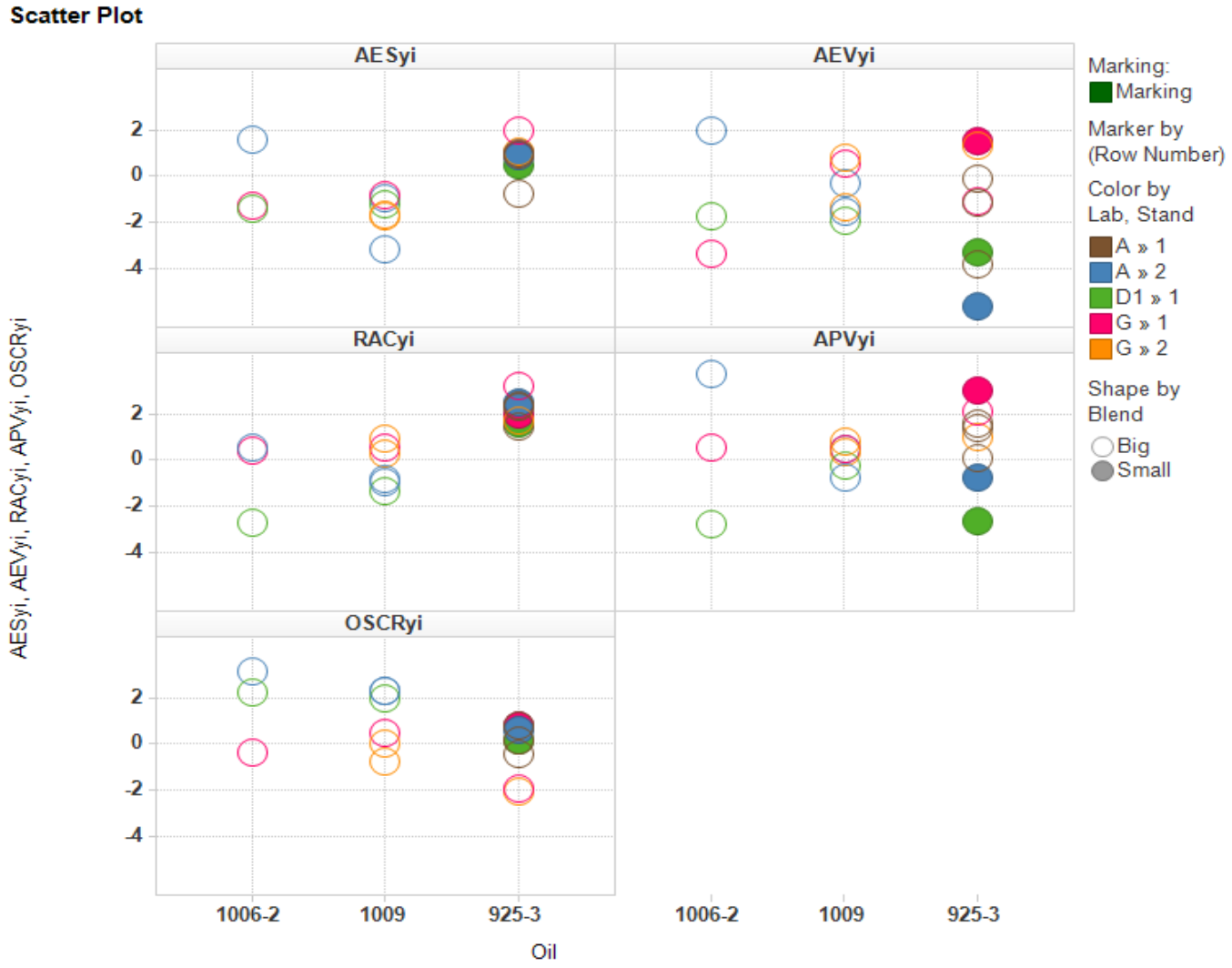
- No adjustment – 4
  - 925-3: 1
  - 1006-2: 0
  - 1009: 3
- Recommended adjustment (including 925-3) – 2
  - 925-3: 1
  - 1006-2: 0
  - 1009: 1
- Recommended adjustment (excluding 925-3) – 6
  - 925-3: 1
  - 1006-2: 0
  - 1009: 5

Matrix Analysis

Fuel Approval Matrix: Actual



Fuel Approval Matrix: Yi



Summary of Effects

AES:

- Big blend is not statistically different than small blend
- 1006-2 is significantly higher than 1009 and 925-3, 1009 and 925-3 have mean difference of 0.16 merits with p-value=0.83
- Labs are not statistically different from one another
- Stands within labs are not statistically different from one another
- RMSE=0.50 comparable with LTMS s=0.45

RCS:

- Big blend is not statistically different than small blend
- 925-3 significantly lower than 1009 and 1006-2, 1009 is not significantly different than 1006-2
- Lab D1 is marginally lower than G (p-value=0.065)
- Stands within labs are not statistically different from one another
- RMSE=0.23 comparable with LTMS s=0.25

Full Model: f(Blend, Lab, Oil, Lab*Oil)
Final Model: f(Lab, Oil)

Summary of Effects

AEV:

- Big blend is not statistically different than small blend
- 925-3 is significantly lower than 1009 and 1006-2, 1009 is not significantly different than 1006-2
- Labs are not statistically different from one another
- Stands within labs are not statistically different from one another
- RMSE=0.46 quite large compared to LTMS s=0.16

APV:

- Big blend is not statistically different than small blend
- 1006-2 is significantly higher than 1009 and 925-3, 1009 and 925-3 have mean difference of 0.28 merits with p-value=0.38
- Lab D1 is significantly lower than A and G
- Stands within labs are not statistically different from one another
- RMSE=0.37 comparable to LTMS s=0.31

Full Model: f(Blend, Lab, Oil, Lab*Oil)
Final Model: f(Lab, Oil)

Summary of Effects

OSCR:

- Big blend is not statistically different than small blend
- 1006-2 is significantly lower than 1009 and 925-3, 1009 and 925-3 have mean difference of 0.34 merits with p-value=0.64
- Lab G is significantly lower than labs A and D1
- Stands within labs are not statistically different from one another
- RMSE=0.69 comparable to LTMS s=0.793

Full Model: f(Blend, Lab, Oil, Lab*Oil)
Final Model: f(Lab, Oil)

Use Current Target Means and Standard Deviations

Parameter	RO	Targets		New Fuel Batch	
		Mean	SD	Mean	SD
AES*	1006-2	8.65	0.41	8.64	0.35
	1009	7.94	0.52	7.93	0.23
RAC	1006-2	9.40	0.15	9.31	0.28
	1009	9.29	0.18	9.25	0.17
AEV	1006-2	9.24	0.12	9.12	0.33
	1009	8.99	0.22	8.88	0.26
APV	1006-2	8.52	0.22	8.63	0.72
	1009	7.79	0.43	7.87	0.25
Ln(OSCR + 1)*	1006-2	0.896	0.579	0.817	1.047
	1009	2.200	1.038	2.239	1.375

* Corrected for New Fuel Batch using corrections calculated omitting RO 925-3

Statistically Different at 0.05 level

Use Current Severity Adjustment Standard Deviation

Parameters	LTMS SD	RMSE^
AES*	0.45	0.31
RAC	0.25	0.11
AEV	0.16	0.30
APV	0.31	0.40
Ln(OSCR+1)	0.793	0.457

*Corrected for New Fuel Batch

Significantly Different at 0.05 level

^Model with Lab + Oil(1006-2,1009)

Recommendations

- Continue using current oil target means and standard deviations. Review when we get 10 tests on each oil.

- Continue using LTMS standard deviation for severity adjustment.

Fuel Batch Correction Factor Analysis

Analysis Details

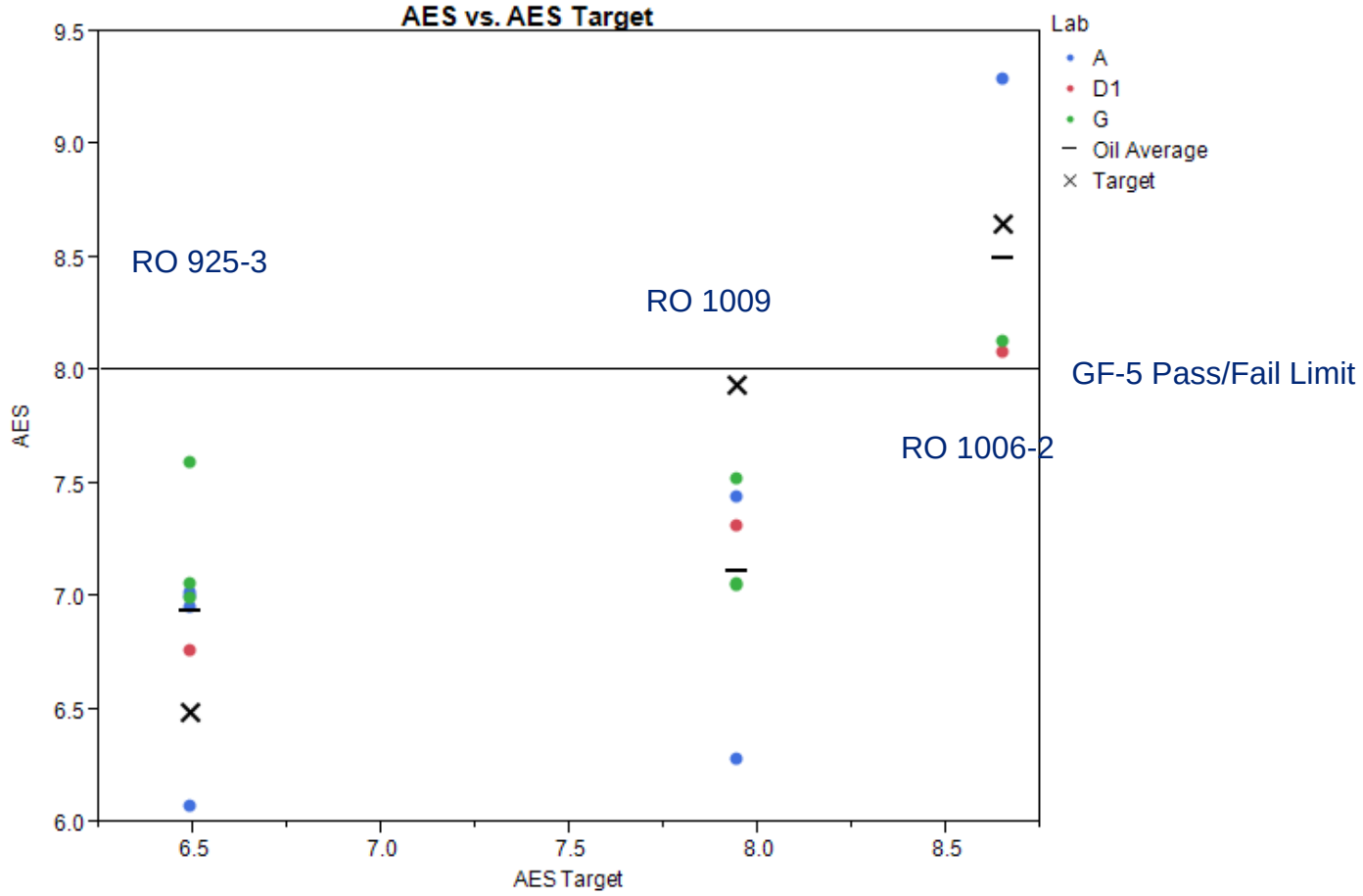
- Data set includes 17 test results from fuel batch matrix compiled by TMC – results were Lab Severity adjusted as appropriate.
- When discussing AES, SP agreed during June 11 teleconference that:
  - Quadratic adjustment factor is not proper.
  - RO 925-3 technology is not current and may react differently than current technologies.
- The impropriety of a quadratic adjustment factor was applied to the other parameters as well so only constant and linear factors were considered.
- Analyses were completed with and without 925-3 data – when analyses differs between the two, selection is for SP as propriety of 925-3 data is not a statistical decision.

Analysis Details (Continued)

- For the linear adjustment factor:
  - The lab severity adjusted result was regressed on its target – e.g. AES = $\beta_0 + \beta_1$AES Target and Adjusted AES = (AES - β_0)/β_1
  - Statistical significance of slope is relative to 1 not 0
- Statistical significance is judged versus α = 0.05.

Average Engine Sludge (AES)

AES Matrix Results



On average, AES is:

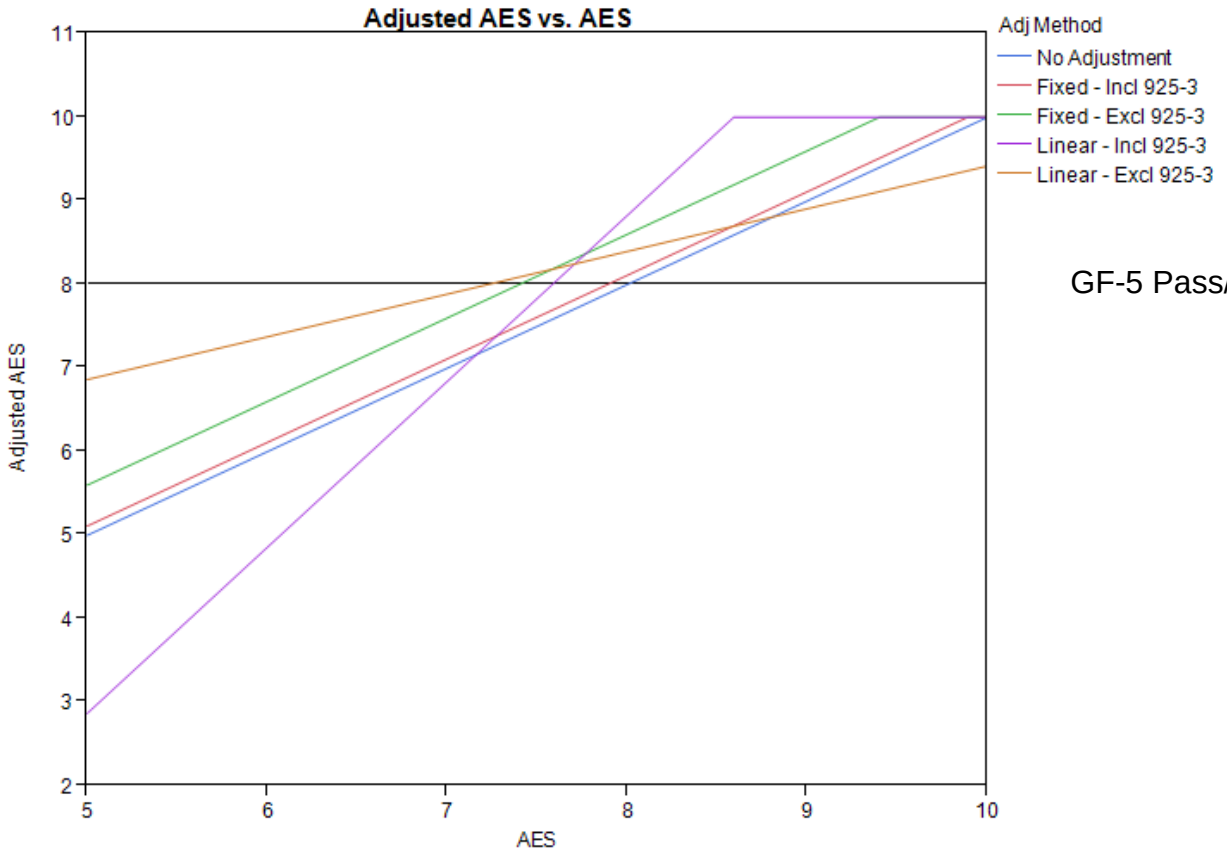
- Mild of target for RO 925-3
- Severe for RO 1006-2
- Slightly severe for RO 1009.

AES Adjustment Options

Adjustment options:

1. No adjustment
2. Fixed adjustment including 925-3: 0.11 (not statistically significant)
3. Fixed adjustment excluding 925-3: 0.60 merits (statistically significant)
4. Linear adjustment including 925-3: Adjusted AES = (AES – 3.56)/0.50 (statistically significant)
5. Linear adjustment excluding 925-3: Adjusted AES = (AES + 8.43)/1.96 (not statistically significant)

Adjusted AES

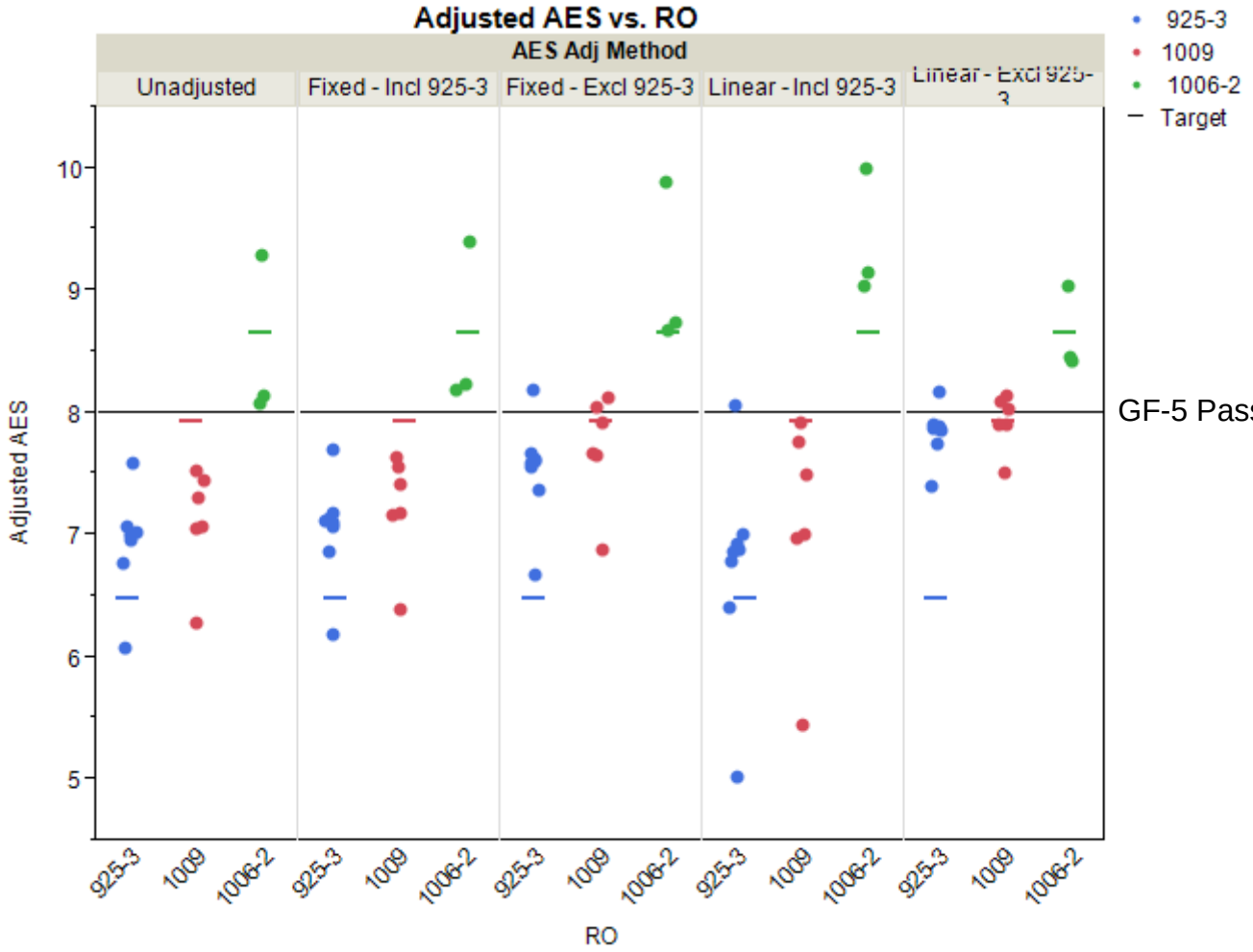


GF-5 Pass/Fail Limit

Passing raw AES values for each adjustment method:

2. Fixed – Including 925-3: 7.89
3. Fixed – Excluding 925-3: 7.40
4. Linear – Including 925-3: 7.58
5. Linear – Excluding 925-3: 7.23

Adjusted AES for Matrix Data



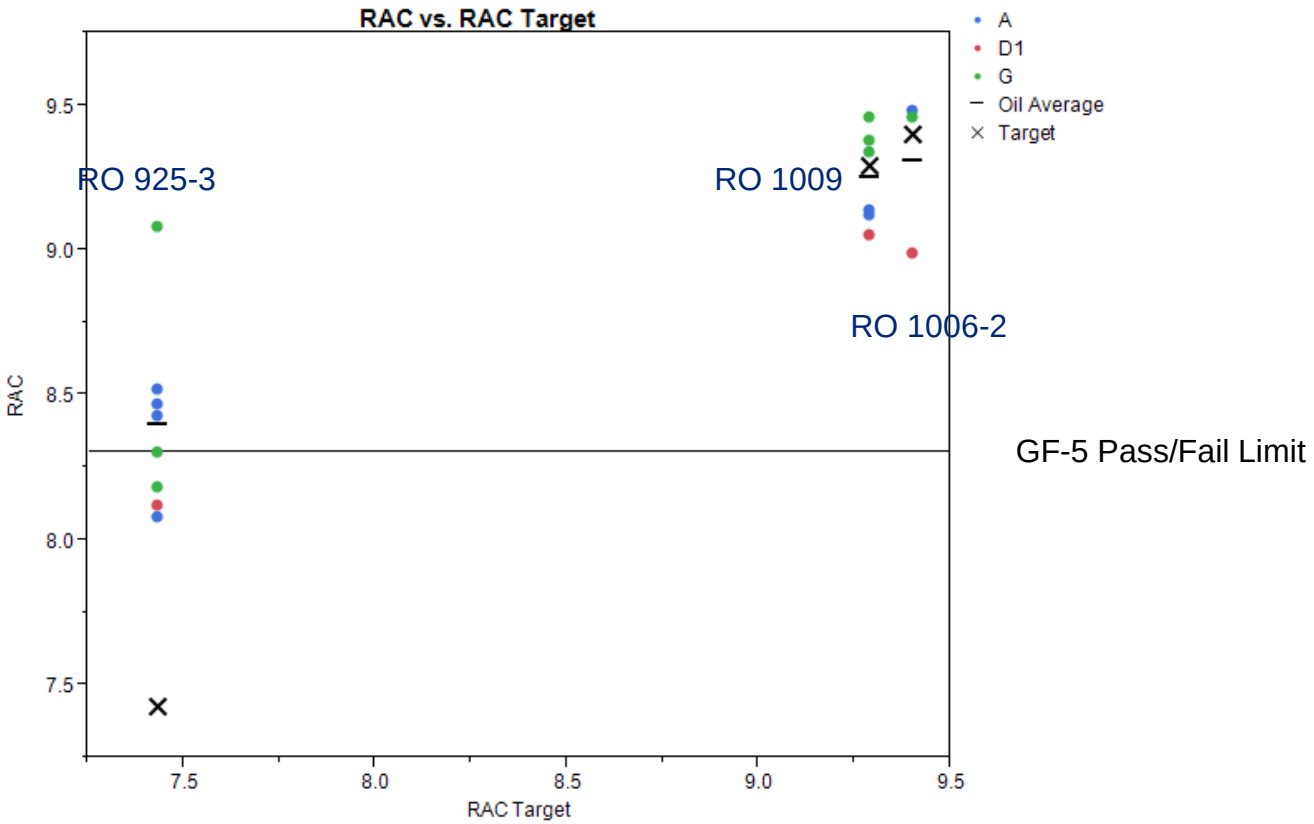
Only adjustment methods excluding RO 925-3 yields approximately 50% pass for RO 1009.

AES Adjustment Method Recommendation

- Option 4 - If SP suggests including 925-3, recommend Linear Adjustment: Adjusted AES = (AES – 3.56)/0.50
  - Slope is statistically significant
  - Matrix RO 1009 Adjusted AES are closer to target but still fail
  - Concern is that the correction slope is extremely steep
- Option 5 - If SP suggests excluding 925-3, recommend Linear Adjustment: Adjusted AES = (AES + 8.43)/1.96
  - Though the slope is not statistically significant, this method better adjusts remaining RO results about the targets.

Rocker Arm Cover Sludge (RAC)

RAC Matrix Results



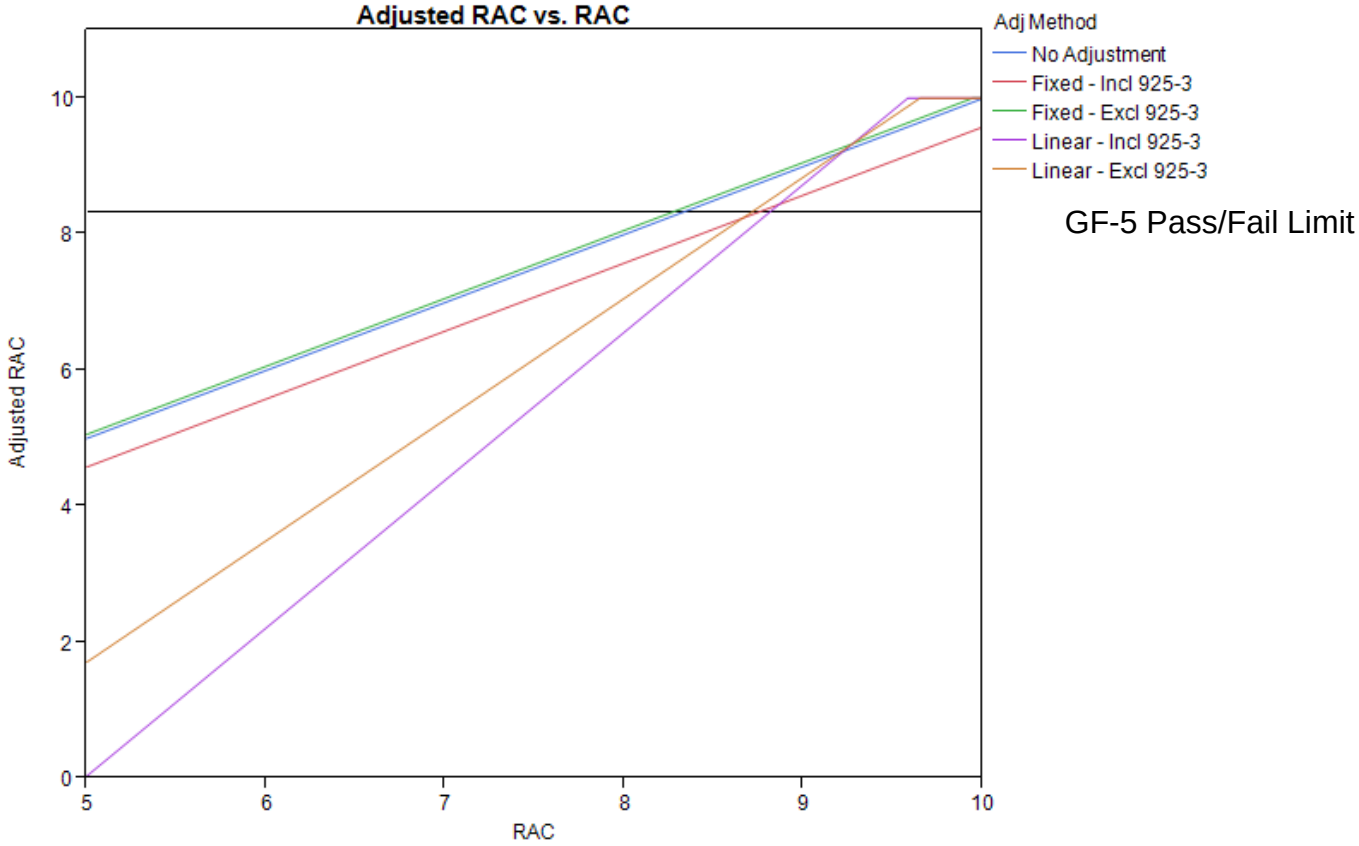
- On average, RAC is:
  - Extremely mild to target for RO 925-3
  - Just slightly severe for ROs 1006-2 and 1009.
- Approximately 50% of “failing oil” RO 925-3 is above GF-5 RAC pass/fail limit.

RAC Adjustment Options

Adjustment options:

1. No adjustment
2. Fixed adjustment including 925-3: -0.42 (statistically significant)
3. Fixed adjustment excluding RO 925-3: 0.06 (not statistically significant)
4. Linear adjustment including 925-3:
   RAC Adjusted = (RAC – 4.98)/0.46 (statistically significant)
5. Linear adjustment excluding 925-3: :
   RAC Adjusted = (RAC – 4.04)/0.56 (not statistically significant)

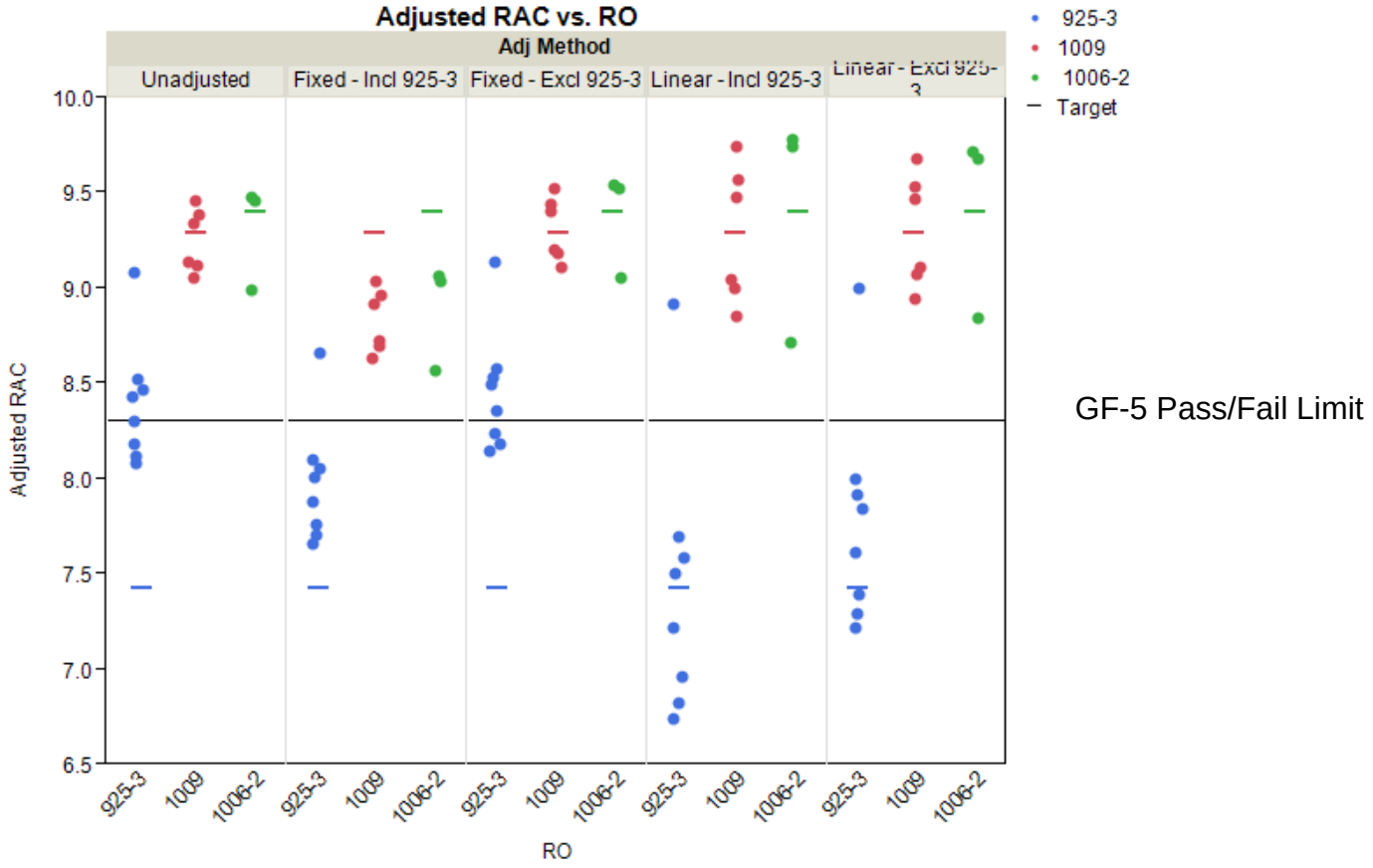
Adiusted RAC



Passing raw RAC values for each adjustment method:

2. Fixed – Including 925-3: 8.72
3. Fixed – Excluding 925-3: 8.24
4. Linear – Including 925-3: 8.80
5. Linear – Excluding 925-3: 8.69

Adjusted RAC for Matrix Data



GF-5 Pass/Fail Limit

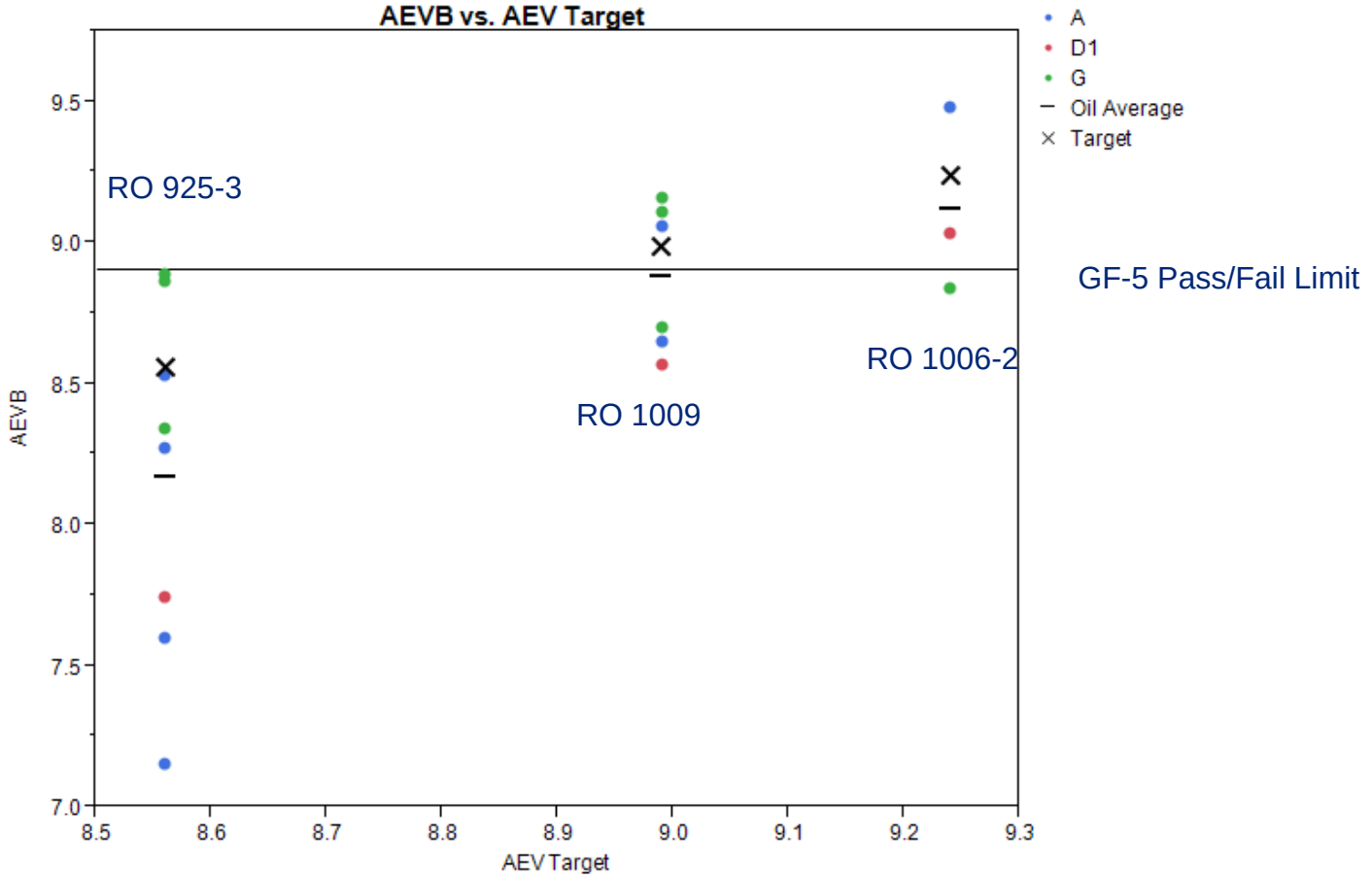
- The Fixed adjustment including 925-3 results in adjusted data for ROs 1006-2 and 1009 being severe of target and RO 925-3 being less mild than the raw data.
- Both linear methods result in RO 925-3 adjusted data being centered about the target

RAC Adjustment Method Recommendation

- Option 4 - If SP suggests including 925-3, recommend Linear Adjustment: Adjusted RAC = (RAC – 4.98)/0.46
  - Slope is statistically significant
  - Adjusted matrix results are approximately centered about targets
- If SP suggests excluding 925-3, recommend no adjustment as none are statistically significant.

Average Engine Varnish (AEV)

AEV Matrix Results



On average, AEV is:

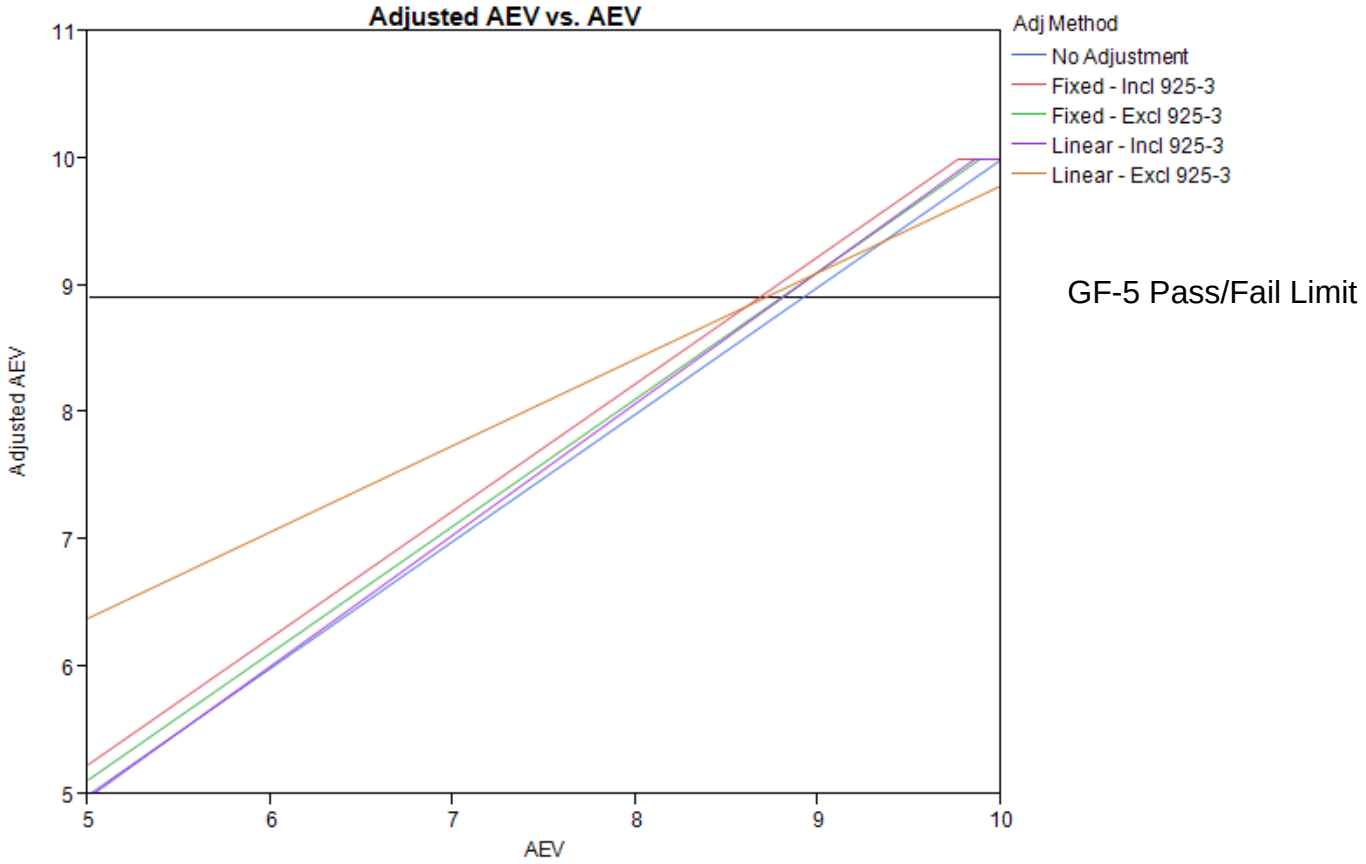
- Slightly severe for ROs 925-3 and 1006-2.
- More severe for RO 925-3.

AEV Adjustment Options

Adjustment options:

1. No adjustment
2. Fixed adjustment including RO 925-3 results : 0.24 (borderline statistically significant – p-Value = 0.055)
3. Fixed adjustment excluding RO 925-3 results: 0.12 (not statistically significant)
4. Linear model adjustment including RO 925-3 results: AEV Adjusted = (AEV + 4.39)/1.47 (not statistically significant)
5. Linear model adjustment excluding RO 925-3 results: AEV Adjusted = (AEV – 0.18)/0.97 (not statistically significant)

Adjusted AEV

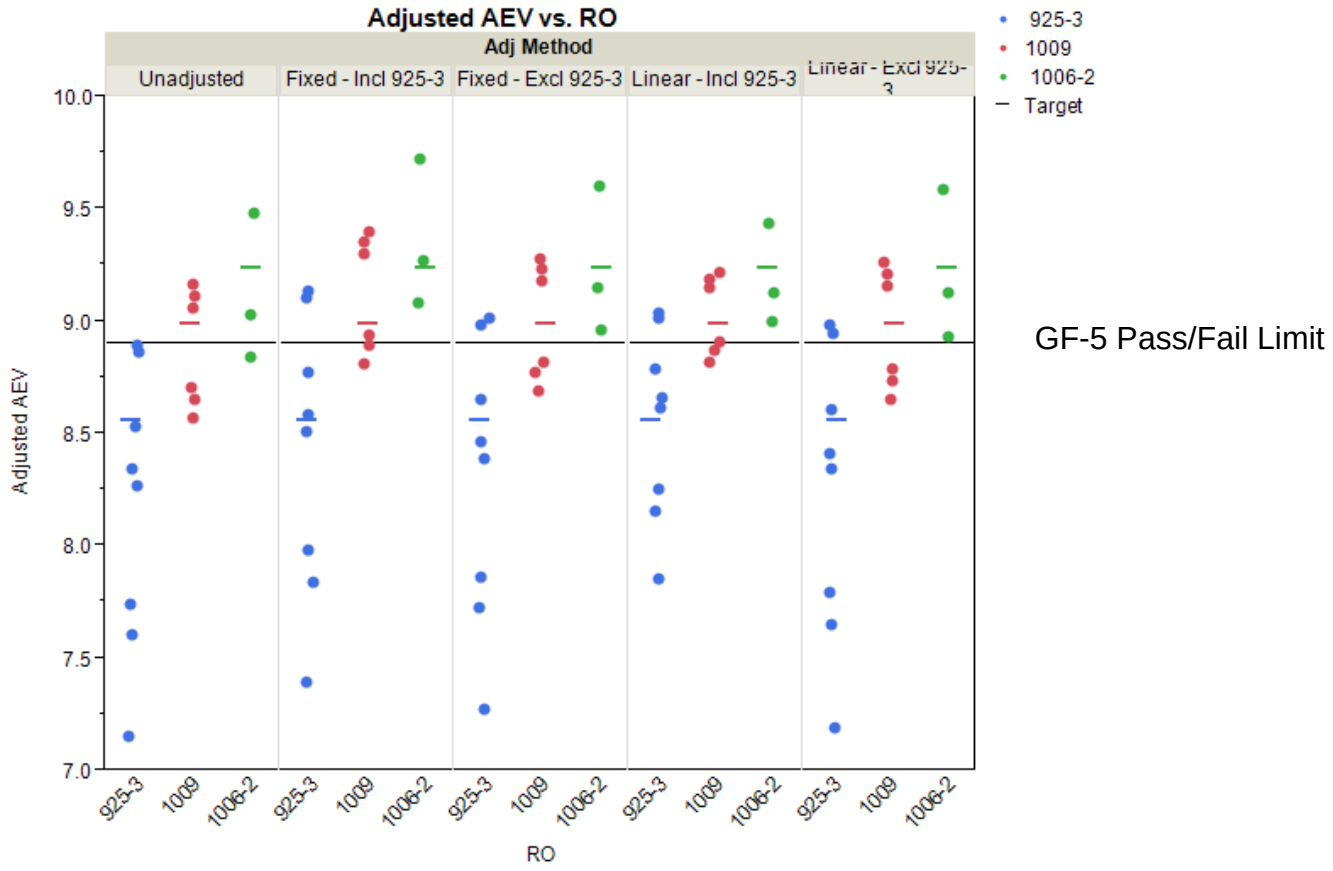


GF-5 Pass/Fail Limit

Passing raw AEV values for each adjustment method:

2. Fixed – Including 925-3: 8.66
3. Fixed – Excluding 925-3: 8.78
4. Linear – Including 925-3: 8.69
5. Linear – Excluding 925-3: 8.79

Adjusted Matrix Results



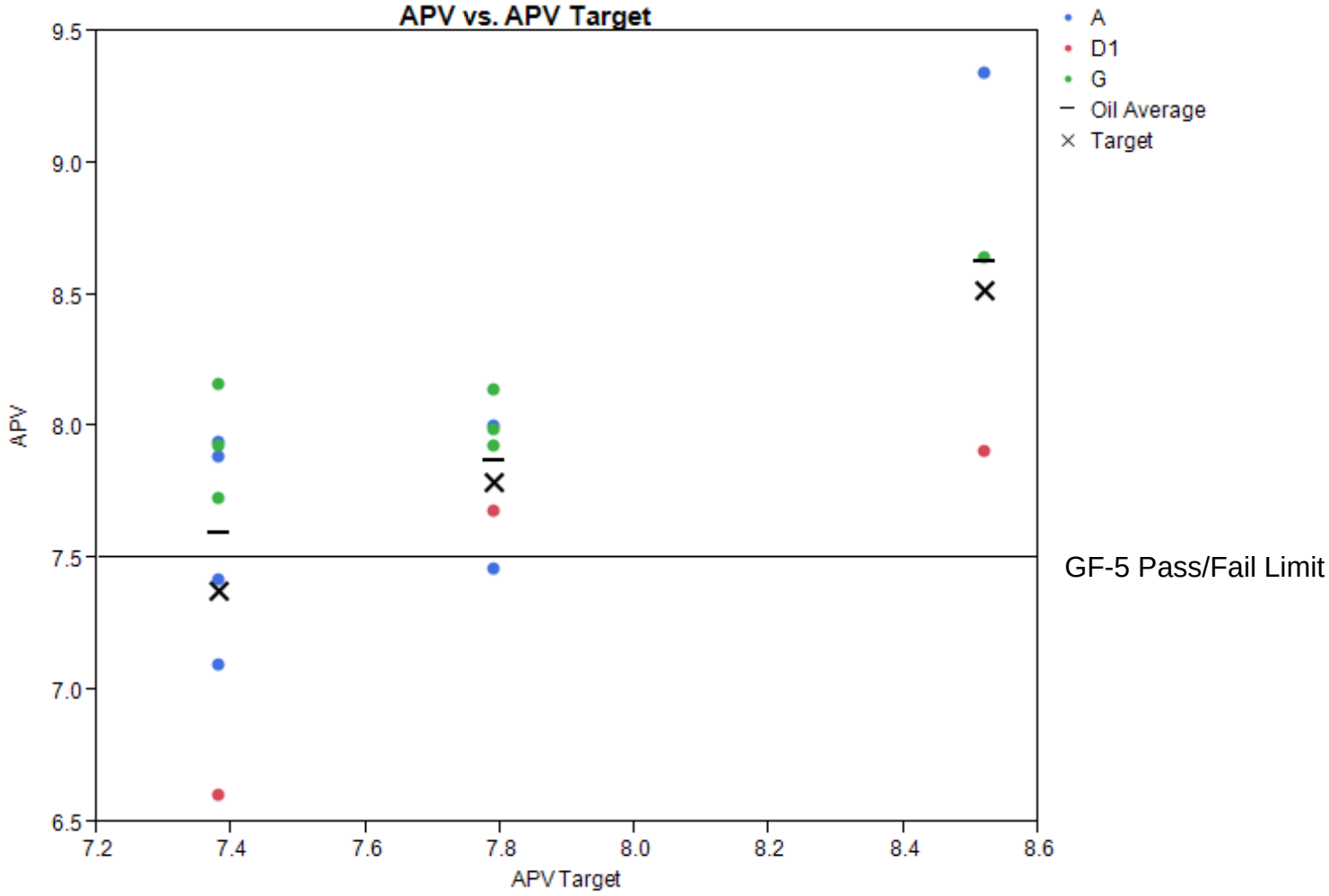
- For RO 925-3 and 1006-2, all adjustment methods result in 2 and all passes relative to GF-5 limits, respectively.

AEV Adjustment Method Recommendation

Recommend no adjustments for AEV as none are statistically significant.

Average Piston Varnish (APV)

APV Matrix Results



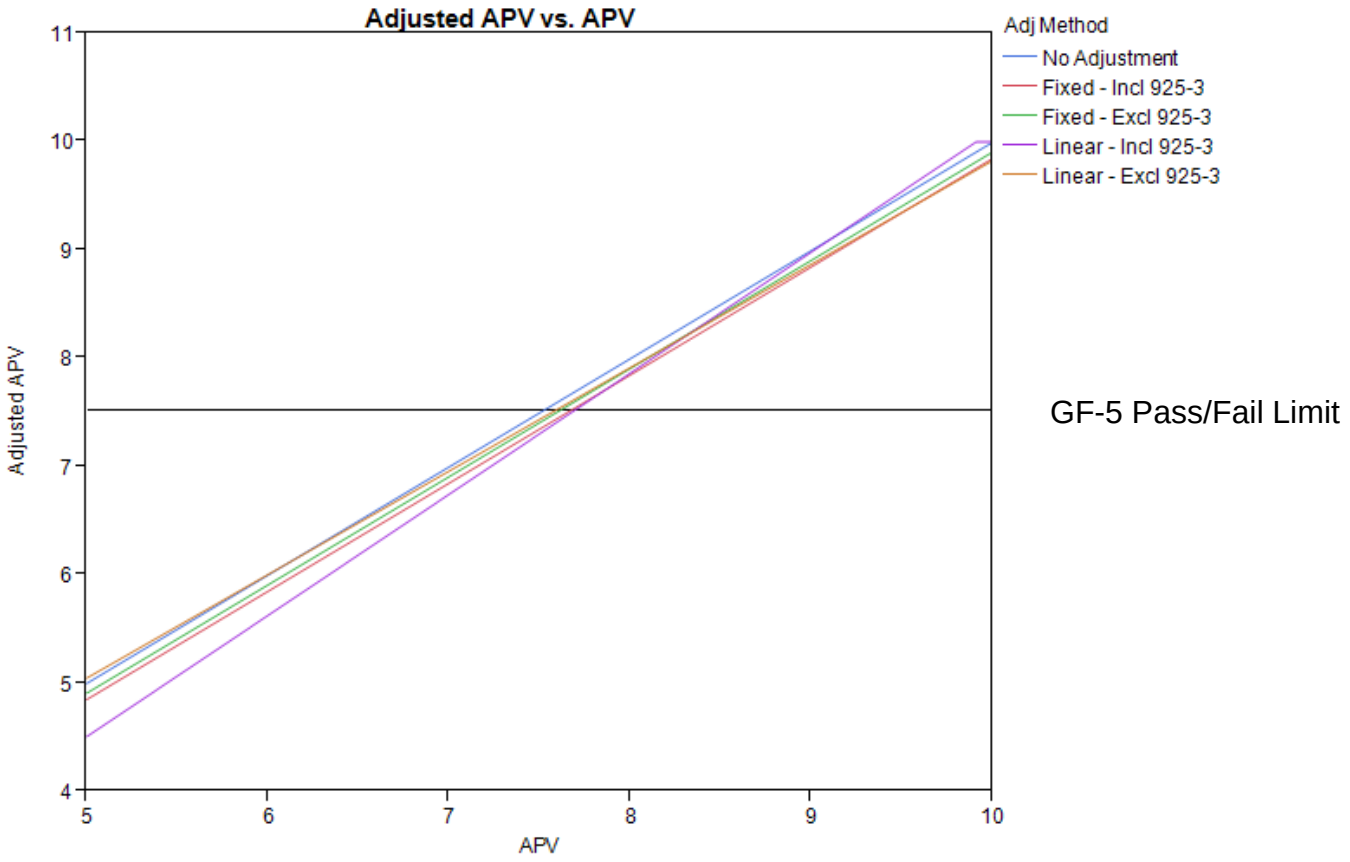
On average, APV is slightly mild for all three ROs.

APV Adjustment Options

Adjustment options:

1. No adjustment
2. Fixed adjustment including all results: -0.15 (not statistically significant)
3. Fixed adjustment excluding RO 925-3 results: -0.09 (not statistically significant)
4. Linear model adjustment: APV Adjusted = (APV – 0.97)/0.89 (not statistically significant)
5. Linear model adjustment excluding RO 925-3 results: APV Adjusted = (APV + 0.28)/1.05 (not statistically significant)

Adjusted APV

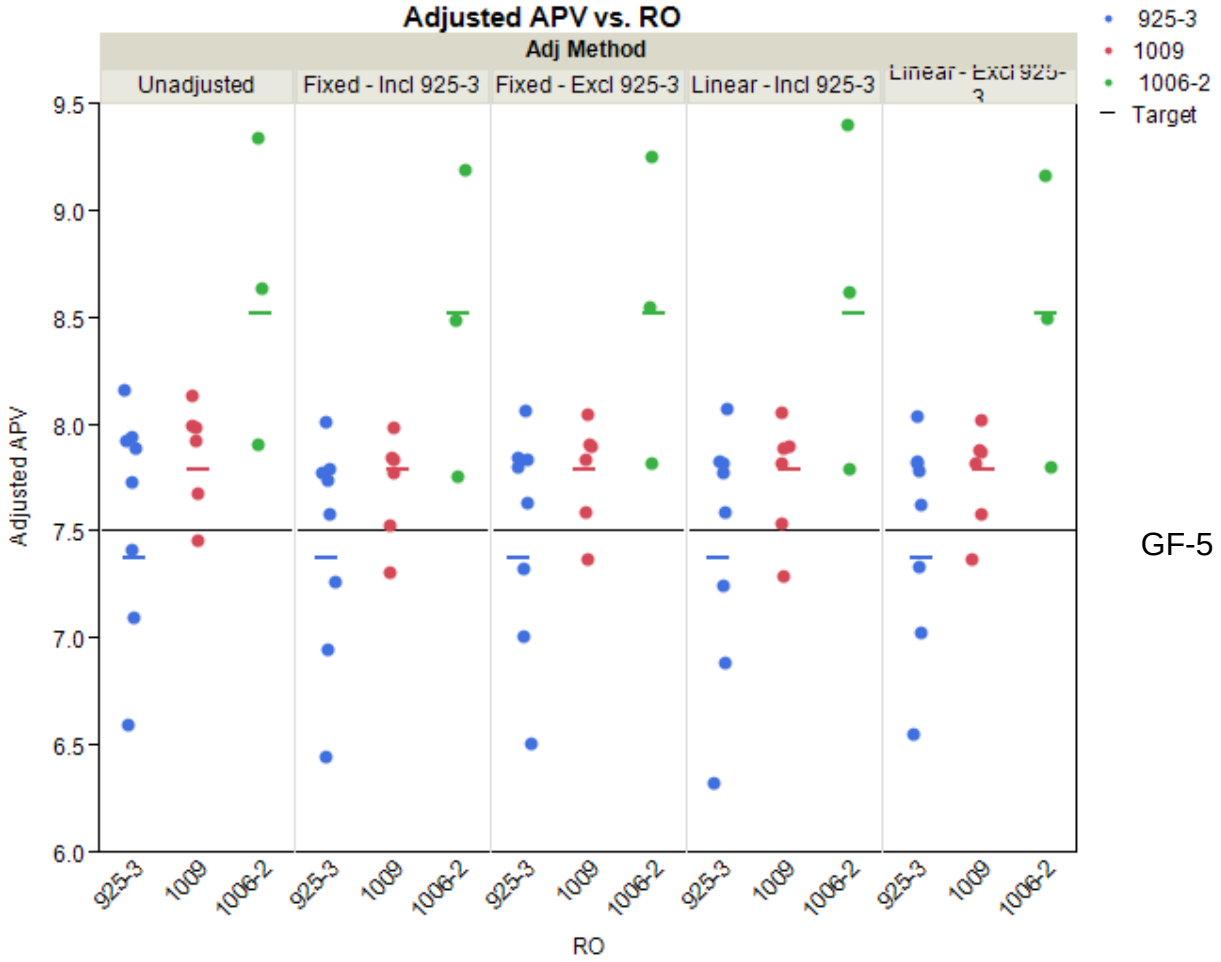


GF-5 Pass/Fail Limit

Passing raw APV values for each adjustment method:

2. Fixed – Including 925-3: 7.65
3. Fixed – Excluding 925-3: 7.59
4. Linear – Including 925-3: 7.67
5. Linear – Excluding 925-3: 7.56

Adjusted Matrix APV Results



GF-5 Pass/Fail Limit

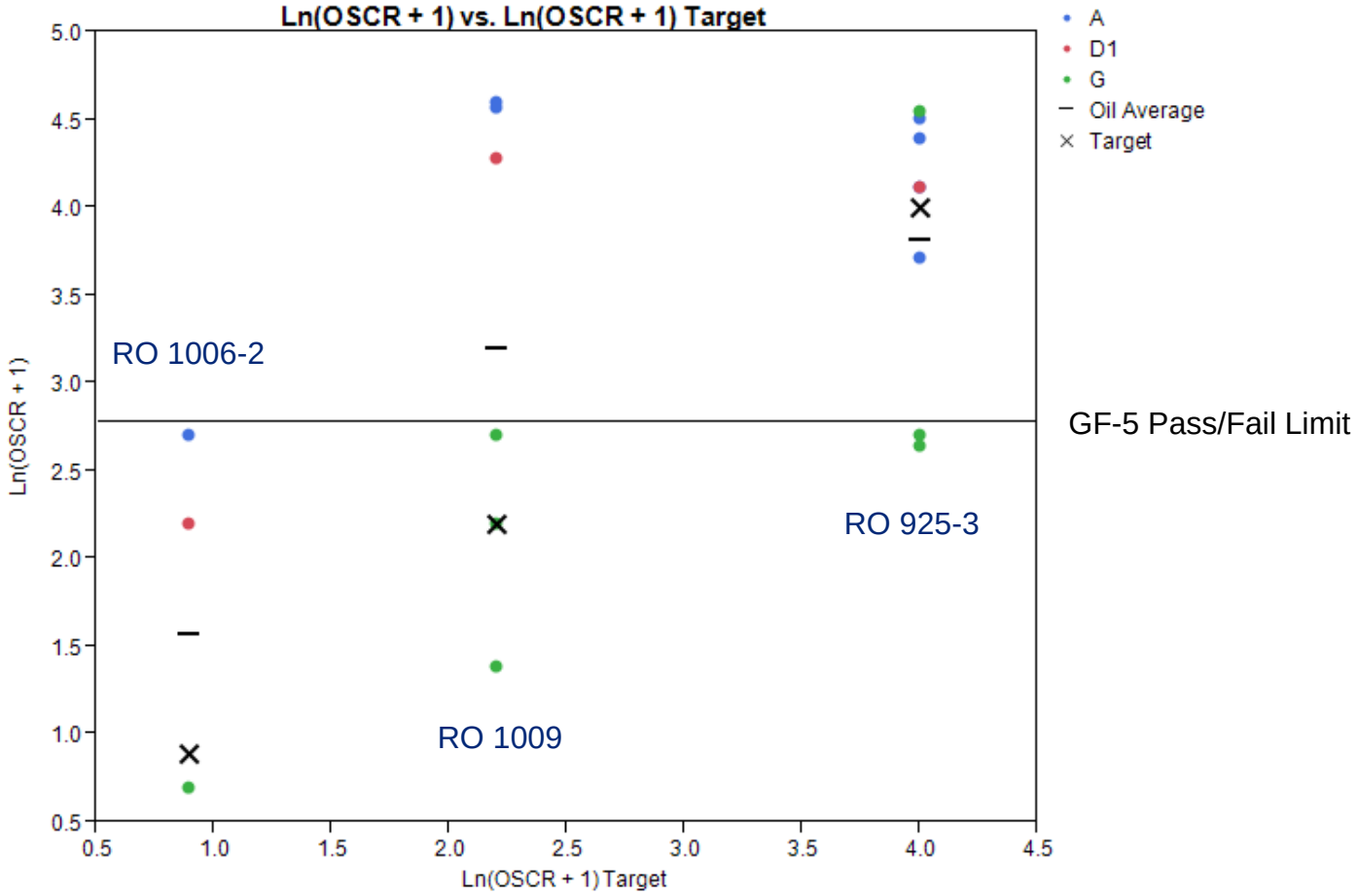
All adjustments are minimal.

APV Adjustment Method Recommendation

- Recommend no adjustments for APV as none are statistically significant.

Oil Screen Clogging (OSCR)

OSCR Matrix Results



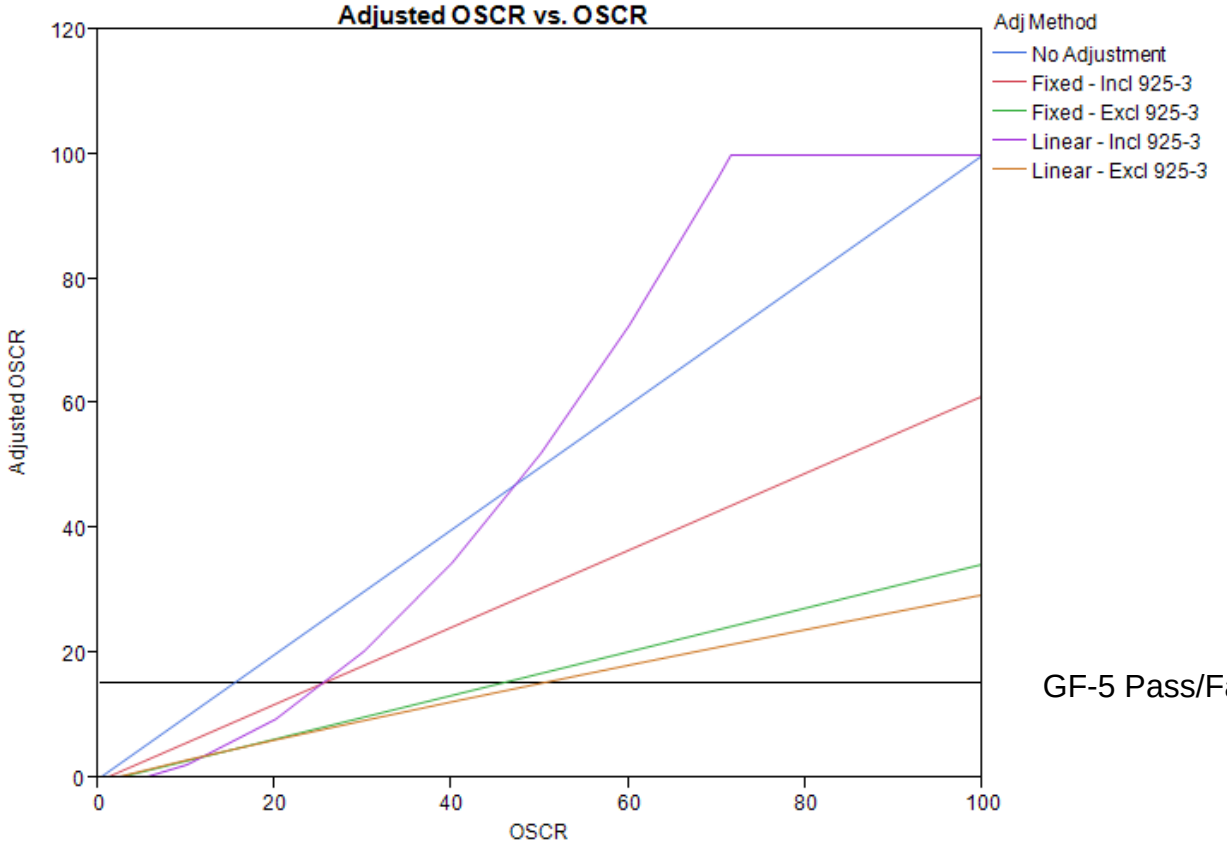
- On average, OSCR is:
  - On target for RO 925-3
  - Severe for ROs 1006-2 and 1009

OSCR Adjustment Options

Adjustment options:

1. No adjustment
2. Fixed adjustment including RO 925-3 results: -0.482 (not statistically significant)
3. Fixed adjustment excluding RO 925-3 results: -1.049 (statistically significant)
4. Linear model adjustment including RO 925-3 results: Ln(OSCR + 1) Adjusted = [Ln(OSCR + 1) – 1.755]/0.548 (borderline statistically significant – p-value = 0.053)
5. Linear model adjustment excluding RO 925-3 results: Ln(OSCR + 1) Adjusted = [Ln(OSCR + 1) – 0.889]/ 1.090 (not statistically significant)

Adiusted OSCR

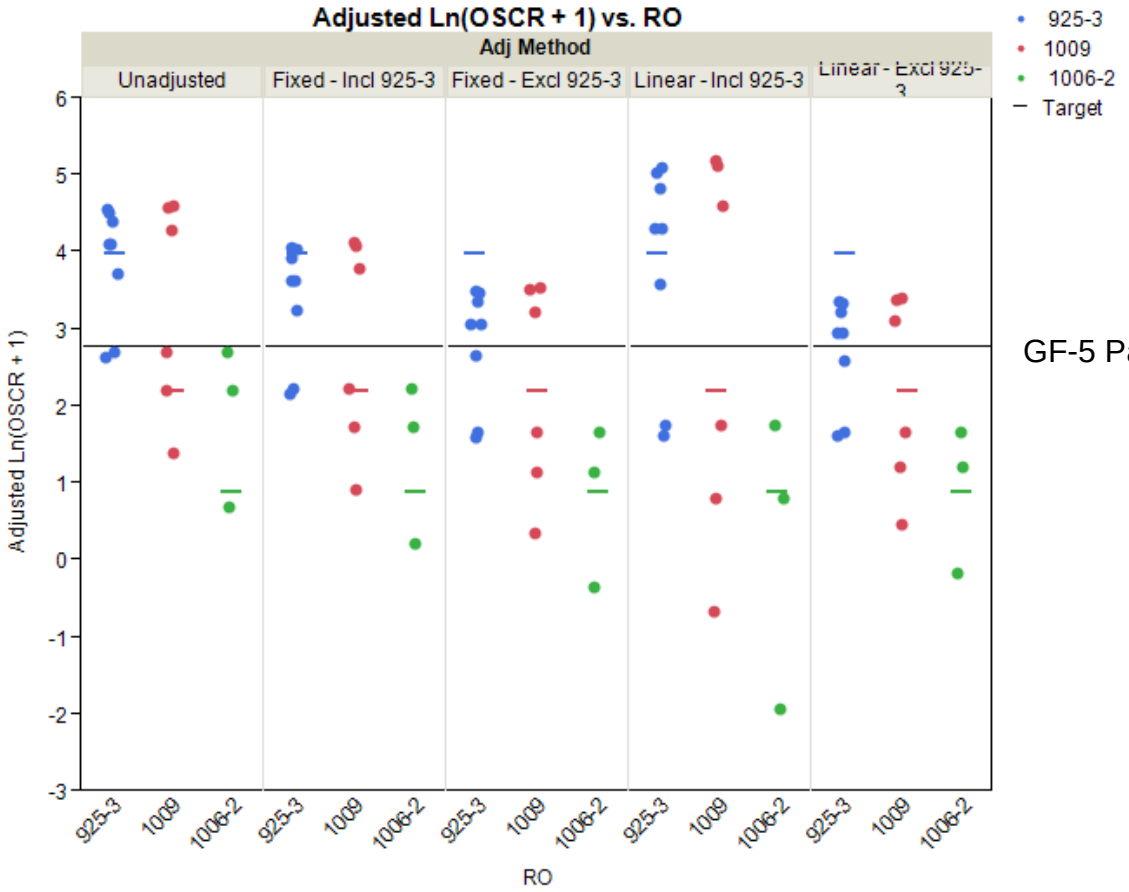


GF-5 Pass/Fail Limit

Passing raw OSCR values for each adjustment method:

2. Fixed – Including 925-3: 26
3. Fixed – Excluding 925-3: 46
4. Linear – Including 925-3: 26
5. Linear – Excluding 925-3: 50

Adjusted Matrix Ln(OSCR + 1) Results



GF-5 Pass/Fail Limit

For each of the adjustment methods, the adjusted results for ROs 1006-2 and 1009 are better centered about the target than the unadjusted results.

OSCR Adjustment Method Recommendation

- Option 2 - If SP suggests including 925-3, recommend Fixed Adjustment: – 0.482
  - Though not statistically significant, this adjustment is not as large either at low or high OSCR.
  - However, the Linear adjustment including 925-3 centers the adjusted matrix results about the target better than Option 2, especially for RO 925-3.
- Option 3 - If SP suggests excluding 925-3, recommend Fixed Adjustment: -1.049
  - Option 3 is statistically significant – Option 5 is similar but not statistically significant.
  - This represents a very large adjustment.

Calibration Rates for Adjusted Matrix Test Results

Calibration Rate of Matrix Tests

Number of VG Fuel Batch Matrix Results Meeting Calibration Severity Criteria ($|y_i| \leq 1.8$)

Adjustment	Oil	AES	RAC	AEV	APV	OSCR	All
No Adjustments	925-3 (8)	7	3	5	6	6	1
	1006-2 (3)	3	2	1	1	1	0
	1009 (6)	5	6	5	6	3	3
	Total (17)	15	11	11	13	10	4
Adjustments Including 925-3	925-3 (8)	6	7	5	6	6	1
	1006-2 (3)	2	0	1	1	2	0
	1009 (6)	3	4	5	6	4	1
	Total (17)	11	11	11	13	12	2
Adjustments Excluding 925-3	925-3 (8)	1	3	5	6	5	1
	1006-2 (3)	3	2	1	1	2	0
	1009 (6)	6	6	5	6	6	5
	Total (17)	10	11	11	13	13	6

Number in parenthesis is sample size.

- Precision criteria was not considered in the above counts.
- None of 1006-2 results were within severity limits.