

TMC Analysis Summary of ROBO Round Robin Completed 20081015

Initial Design:

Seven labs: A, AM, AN, AO, B, D G

Ten Stands (rigs): Labs A, AM & G contributed two stands each, all others one stand each

Seven oils, each oil to be run blind, in duplicate and in random order (14 oil samples per rig)

Initial design n = 140 data points

Actual Execution:

Due to time constraints, not all labs completed running all oils.

Excluded five sets of results because labs reported as operationally invalid

Excluded three additional sets of results because MRV results were >400,000 cP (excluded ALL test results for these three, not just MRV).

Ended up with n = 131 operationally valid observations

TMC Analysis:

Five parameters analyzed:

Distillates % of Charge, Mass %

Drain Oil 40C Kinematic Viscosity, cSt

% Change in Kinematic Viscosity, cSt %

Drain Oil CCS, cP

Drain Oil MRV Overall, cP

Used Box-Cox analysis to determine if data is normally distributed. Found Distillates % of Charge is normally distributed without transformation. For all other parameters, either a 1/square root or natural log transform is suggested. TMC chose a natural log transform because the transformed values by natural log are, overall, not appreciably different from 1/square root, 1/square root values are generally very small numbers and therefore sometimes harder to analyze or interpret and Sequence IIIGA uses a natural log transformation to normalize the MRV test results, so using a natural log transform for ROBO MRV results will make comparisons to IIIGA simpler.

Reviewed for extreme outliers. Other than the three results removed for MRV >400,000 cP, the TMC chose not to exclude any other data points. While some analysts or software may screen outliers based on some confidence level treatment, the TMC did not see any transformed results that flagged as wildly alarming, and we chose to use all 132 observations as indicated. The TMC is reluctant to exclude data without operational cause. Some analysts may justifiably disagree with this position.

The TMC used PC based Statistical Analysis Software (SAS) General Linear Model (Proc GLM) with a lab, oil and lab-by-oil model to determine overall precision, lab biases and lab by oil interactions. (Also looked at rig by oil interactions).

The TMC used PC based Statistical Analysis Software (SAS) Means (Proc Means) to evaluate mean performance and precision by oil.

The TMC was asked to review the MRV results overall, combining only those MRV results reported with yield stress <35, and, separately, combining only those MRV results reported with yield stress >35.

TMC's Findings:

Lab G severity performance is statistically significantly different from at least four labs on ALL five evaluated parameters in the study, and statistically different from as many as all six other labs on some parameters. Analysis by stand approximated analysis by lab (since both significantly mild stands turned out to be from lab G, we can express this as a lab bias rather than a stand bias).

Excluding Lab G data, MRV **precision** gets worse compared to when Lab G data is included. So, while Lab G is significantly more mild compared to other labs, they are also generally more precise. That is, Lab G is found to be consistently mild.

MRV precision estimates using only results where yield stress is <35 is significantly better than MRV precision estimates using only results where yield stress is >35.

Recommendations:

The surveillance panel needs to evaluate if Lab G's data is to be included or excluded from the analysis. While Lab G stands out from a statistical standpoint, are their results practically (or alarmingly) so different? For example, in MRV, Lab G's transformed least squares mean (LSMEAN) is 10.4315, which calculates back to 33,911 cP (across all oils). The next mildest lab, Lab AM has a transformed LSMEAN of 10.6939, which converts back to 44,087 cP. The most severe LSMEAN, Lab D, is 11.2126, which converts to 74,327 cP. The overall average LSMEAN, including Lab G, is 10.76985, which converts to 47,565 cP. To summarize:

Lab G:	Transformed LSMEAN 10.4315, converted back 33,911 cP
Lab AM:	Transformed LSMEAN 10.6939, converted back 44,087 cP
Lab D:	Transformed LSMEAN 11.2126, converted back 74,327 cP
Overall:	Transformed LSMEAN 10.76985, converted back 47,565 cP

Natural log converts large numbers more dramatically than smaller numbers (non-transformed data distribution is skewed to the severe, so a natural log makes a more radical transformation to larger numbers to better normalize the distribution.) The question that needs to be answered is, are Lab G's results, for each parameter PRACTICALLY different?

The panel also needs to evaluate if the overall MRV precision should include results where yield stress was >35.

Respectfully Submitted to the ASTM D02.B0.07 ROBO Surveillance Panel, Alan Flamberg, Chair, on October 16, 2008, with Excel attachment.

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