



Options Remaining for ESCIT to Consider for GF-5

ESCIT Meeting

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Midland, MI

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Given GF-5 Timing Constraints, Only 2 Viable Options Remain

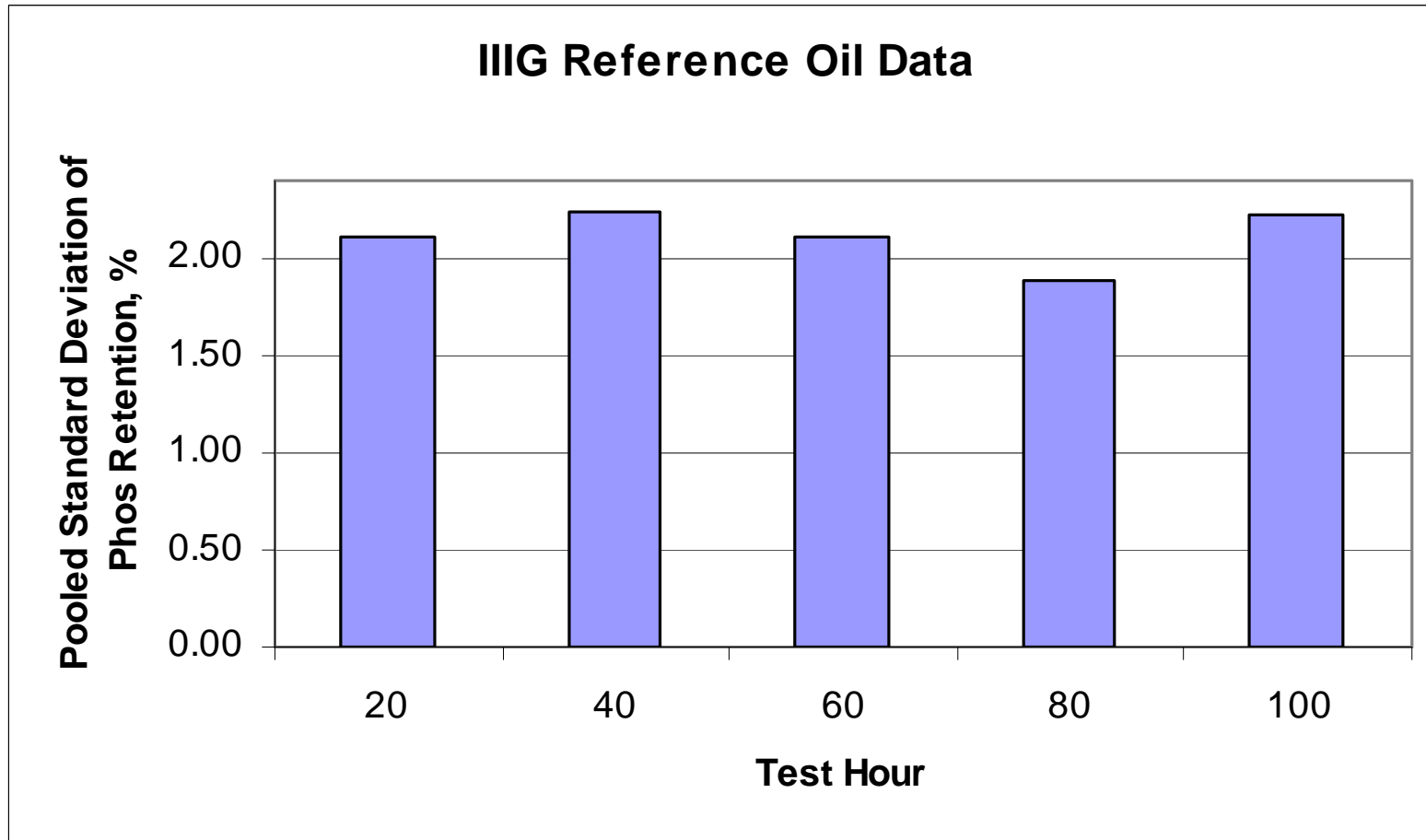
1. Bench Test: PEI165-X, where X = 16, 32, 48 or 64 hours
 - Preference order:
 1. PEI165-16
 2. PEI165-32
 3. PEI165-48
 4. PEI165-64

2. IIIG Test: IIIG-Y, where Y = 20, 40 or 100 (EOT) hours
 - Beyond 40hrs, may as well select EOT
 - Preference order:
 1. IIIG-20hr
 2. IIIG-40hr
 3. IIIG-EOT
 - Separation is best for IIIG-20, but still good for IIIG-40 and IIIG-EOT.

- Choices should be guided by the following:
 - Correlation with field oils
 - Amount of phosphorus volatilized should be > 90% of the total at EOT. Preferably it should be very close to 100%.

- ESCIT could endorse both test options allowing for a combination of the PEI165-X and IIIG-Y methods to approve GF-5 products.

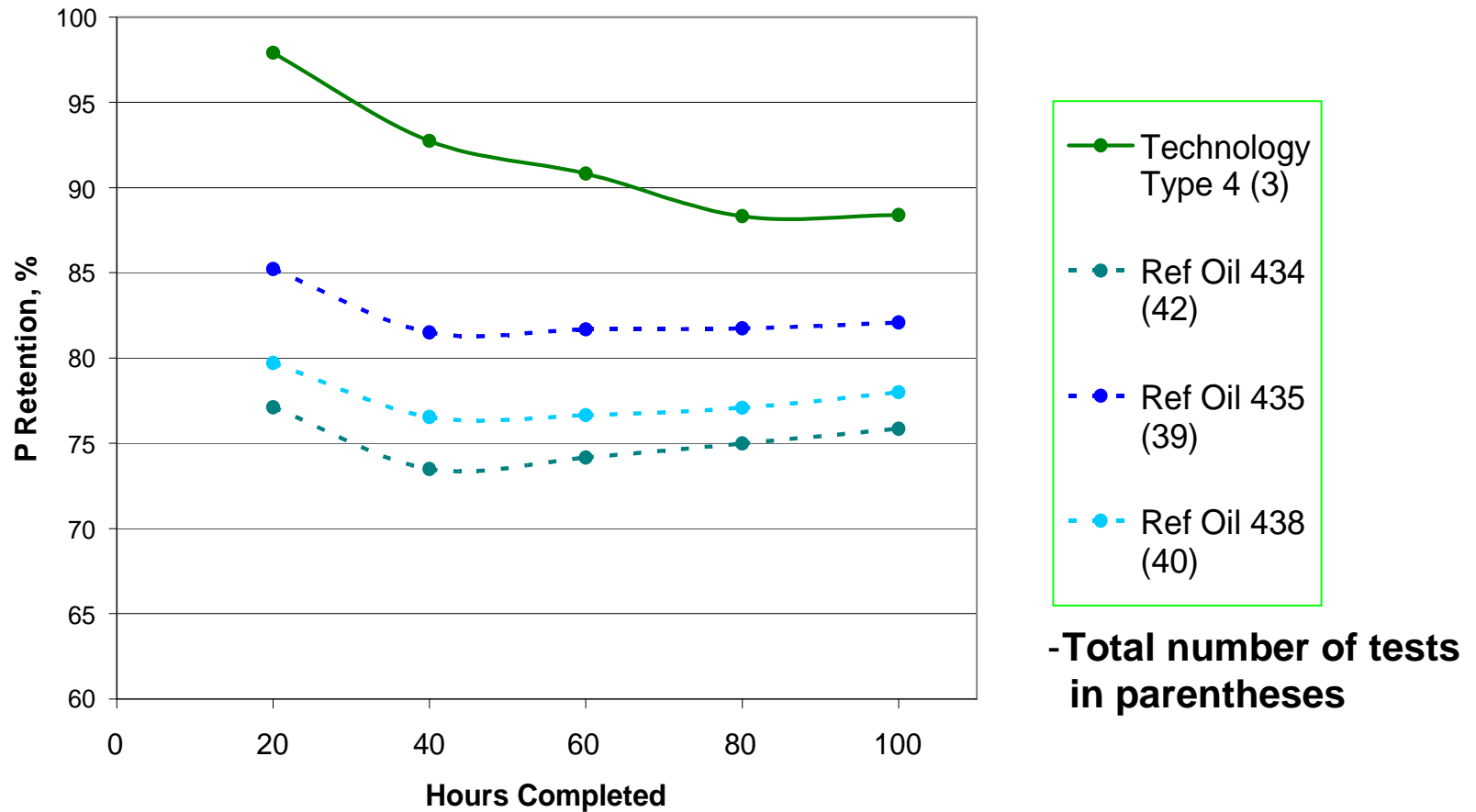
Pooled Standard Deviation of Phosphorus Retention in IIIG Tests



- The pooled standard deviations in IIIG tests at each 20-hour testing period stay the same throughout the test.

IIIIG Phosphorus Retention Profiles for 4 Different Technologies

Average P Retention in IIIIG Engine Tests by Oil



IIIG Phosphorus Retention Profiles for 4 Different Technologies

- Chart shows for Oils 434,435 and 438, most of the phosphorus is volatilized at 20 hours, although phos retention 'minima' are reached around 40 hours.
- Oils with less volatile ZDDPs show continued phosphorus depletion over almost the entire 100hr IIIG test length.
 - Data for Technology Type 4 on the chart illustrates this well.
 - Phosphorus loss stabilizes around 80 hours.
 - Significant phosphorus loss continues well beyond 40 hrs.
 - Makes a strong case for selecting IIIG-EOT over IIIG-20 or 40.
- Precision is similar for all of the IIIG datasets (IIIG-20hr, IIIG-40hr and IIIG-EOT).

PEI165-X Data Shown to Date

- Data from Savant shows that PEI165-32, PEI165-48 and PEI165-64 values are generally much higher than PEI165-16 values.
- PEI165-16 test length is too short to be acceptable to screen all likely GF-5 formulations.
 - Phosphorus depletion is often less than 50% complete.
- Completed Savant test matrix will allow ESCIT group to assess the viability of PEI165-32, PEI165-48 and PEI165-64.

Summary of Options left for ESCIT to consider for GF-5

Option#	Title	Assessment	Notes
1	PEI165-16	Unacceptable	Not long enough
2	PEI165-32	Need more data	Looks to be too short based on early data. Need to establish field correlation
3	PEI165-48	Need more data	Might also be too short based on early data. Need to establish field correlation
4	PEI165-64	Need more data	May need to be this long. Need to establish field correlation
5	IIIG-20hr	Unacceptable	Not long enough
6	IIIG-40hr	Unacceptable	Not long enough
7	IIIG-EOT	Preferred	Long enough for all likely GF-5 technologies

Infineum Position on ESCIT Test Options

- Strongly prefer IIIG-EOT because
 - IIIG must be run anyway.
 - IIIG-EOT provides best assurance that all of the Phosphorus is volatilized.
 - Shows acceptable discrimination and precision.

- PEI165-X could be an alternative, if it meets the following terms:
 1. Shows a clear correlation with field oils.
 2. Shows acceptable discrimination and precision.
 3. X is a reasonable number of hours, while assuring most/all of the phosphorus is volatilized.
 - However, as X increases, the desirability of the bench test option decreases.

- One possibility is to endorse a bench test and an engine test.
 - Use bench test data for base oil and viscosity grade read across.
 - Use bench test as alternative to running an additional engine test, if original engine test passes all other parameters, but fails on P volatility.

In this particular case, GF-5, the IIIG is already specified for oxidation, deposits and wear and is acceptable for evaluating phosphorus volatility.