T-13: Discussing a transformation for IRPH

06/07/2023

Request

- A request was made by an PC-12 NCDT member to determine if a transformation should be used for the FTIR parameter for the Volvo T-13 as the expected limits will lower in PC-12

- Shown, are evaluations from one party, using LTMS data

Option 1: Since Adoption of Fuel Flow Control

- Data considered:
  - All the oils tested after fuel flow adoption (from 3/7/2015)
  - 88 tests
  - Includes technologies with results near the API CK-4 pass/fail limit
  - Includes oils from one technology (PC11 B, PC11 E and PC11 KK) with oxidation around 50

- Using the usual model: Lab, Stand within lab, Oil and Liner Batch
  - There is no indication that a transformation is needed
  - Currently, there is no transformation for IRPH

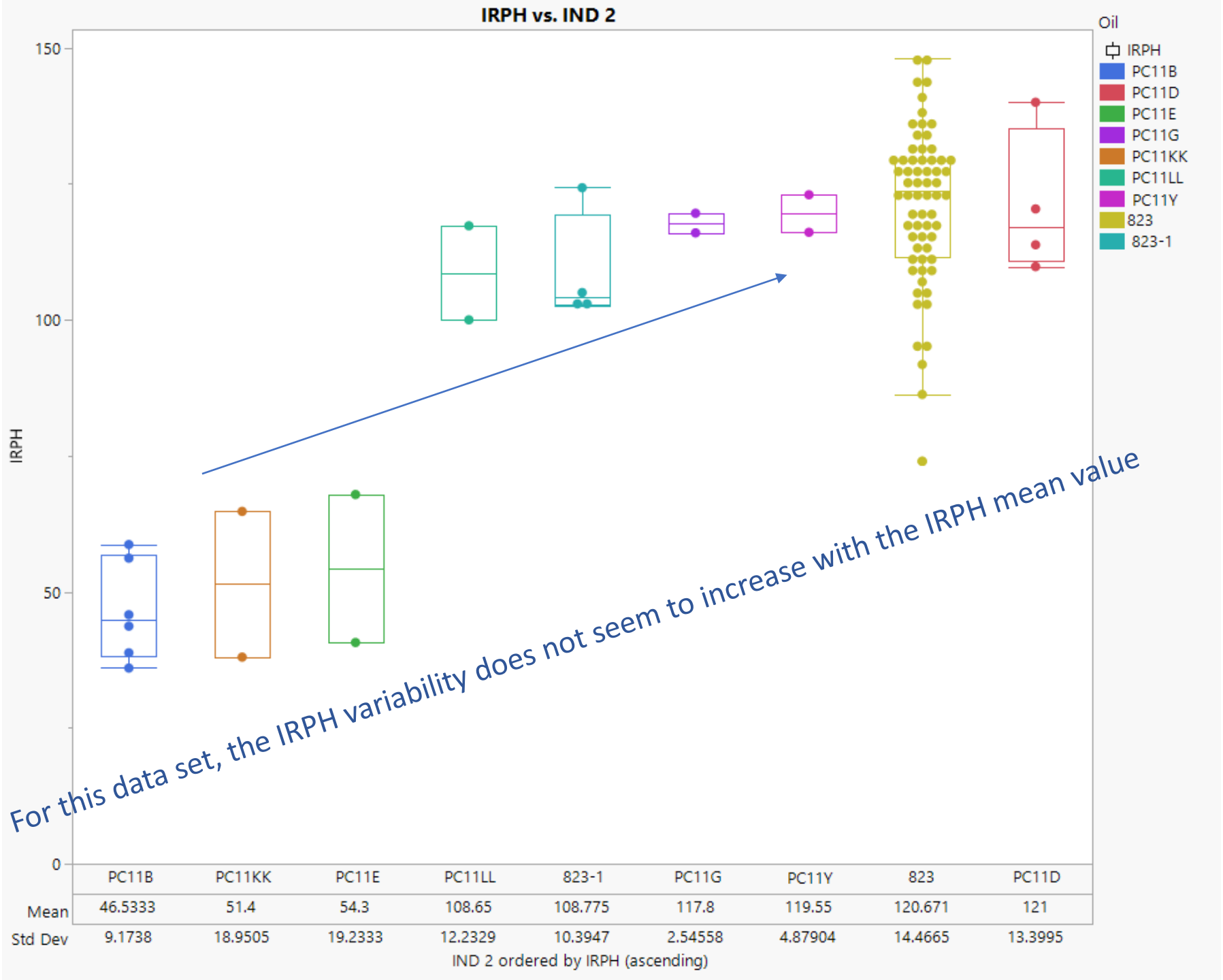
- Plot of the data and details about the model are in the appendix

Option 2: Since Adoption of Fuel Flow Control, Humidity Control and Single Coolant Filter Usage

- Data considered: all tests after April 18th2017, using final procedure – fuel flow control, humidity control, coolant filter used once
  - Only TMC 823 and 823-1 have been tested since final procedure has been set on April 18, 2017
  - The current LTMS data based on 823 and 823-1 does not support the need for a transformation
- The reference oil TMC 823 refers to a CK-4 target level performance
- It is possible that VDS-4.5 & VDS-5 performance level oils could exhibit lower variability when compared to CK-4 performance oils, however no oils of this performance level are available in the LTMS database to compare
- Requesting Non-Reference data from ACC to collect blind testing data could be an alternative to obtain this data
- Question for TMC: is there precedent for adopting a transformation for LTMS data (severity adjustments), based on external source data, i.e. candidate data?

appendix

Data: all tests after adoption of Fuel flow control forward



Response IRPH

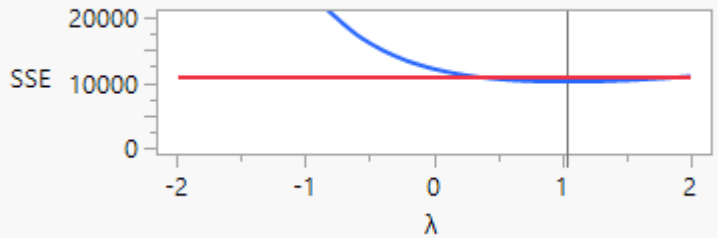
Summary of Fit

RSquare	0.824429
RSquare Adj	0.732023
Root Mean Square Error	13.35563
Mean of Response	112.3477
Observations (or Sum Wgts)	88

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	4	4	594.306	0.8330	0.5099
LTMSAPP[LTMSLAB]	15	15	1885.863	0.7048	0.7691
IND 2	8	8	34217.634	23.9790	<.0001*
Liner	3	3	1280.496	2.3929	0.0779

Box-Cox Transformations

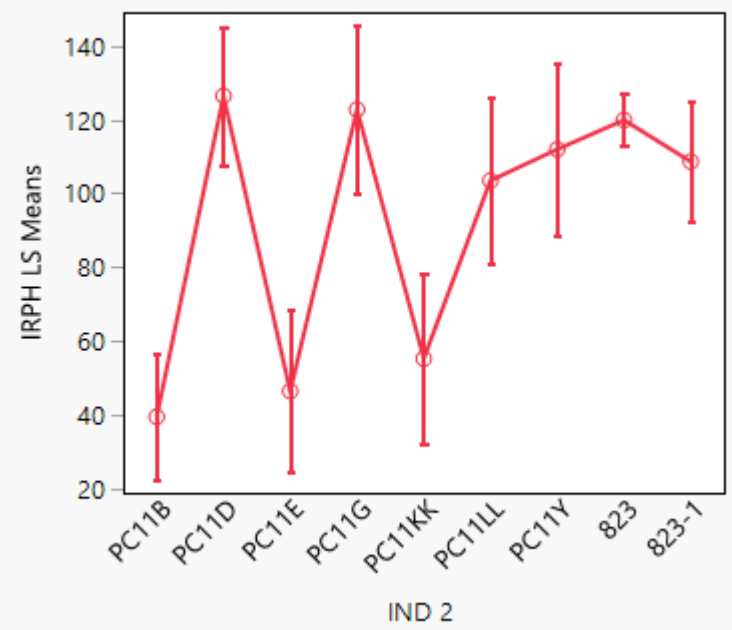


Best λ=1.043

Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
PC11B	39.36348	8.500006	44.100
PC11D	126.46918	9.318199	121.000
PC11E	46.32556	11.067819	54.300
PC11G	122.78046	11.327386	117.800
PC11KK	55.15539	11.625331	51.400
PC11LL	103.50027	11.294908	108.650
PC11Y	111.96497	11.763933	119.550
823	119.94685	3.561891	120.671
823-1	108.65405	8.123194	108.775

Least Squares Means Plot



Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
A	95.089822	3.581667	110.852
B	84.776322	5.584967	112.473
C	96.007861	6.928139	118.956
D	94.863862	10.099789	118.533

Least Squares Means Plot