

Sequence VH O&H Meeting
February 17th, 2025 at 3:00 PM EST via MS Teams

Attendees: Al Lopez, Joe Anthony, Bill Du Chene, Tony Catanese, Christian Exposito, Mike Deegan, Todd Dvorak, Dylan Beck, Pat Lang, Rob Zdrodowski

Overview:

1. Hardware
 2. Operation
 3. Fuel
 4. Other
-

1. Hardware

- a. Oil Pump part number supersessions
 - i. Procedure: 5L3Z-6600-AA (Service), 5L3E-6621-AA (Engineering)
 - ii. Ford Parts supplied 5L3Z-6600-A
 1. 5L3Z-6600-A observed to have larger diameter inlet and a bigger gear
- b. It was found that the wrong pump was packaged incorrectly and mislabeled
 - i. Ford identified this could be a larger issue and have elevated internally

2. Operation

- a. Ford requested commentary on Industry Zi charts
 - i. Per TMC:

Parameter	ns	size	Zi Value	Zi Warning Limit	Zi Action Limit	Zi Alarm Status
AES		215	0.62452573	± 0.775	± 0.859	InControl
RAC		215	-1.0456848	± 0.775	± 0.859	Action
AE50		215	-1.1927466	± 0.775	± 0.859	Action
AP50		215	-1.2044004	± 0.775	± 0.859	Action

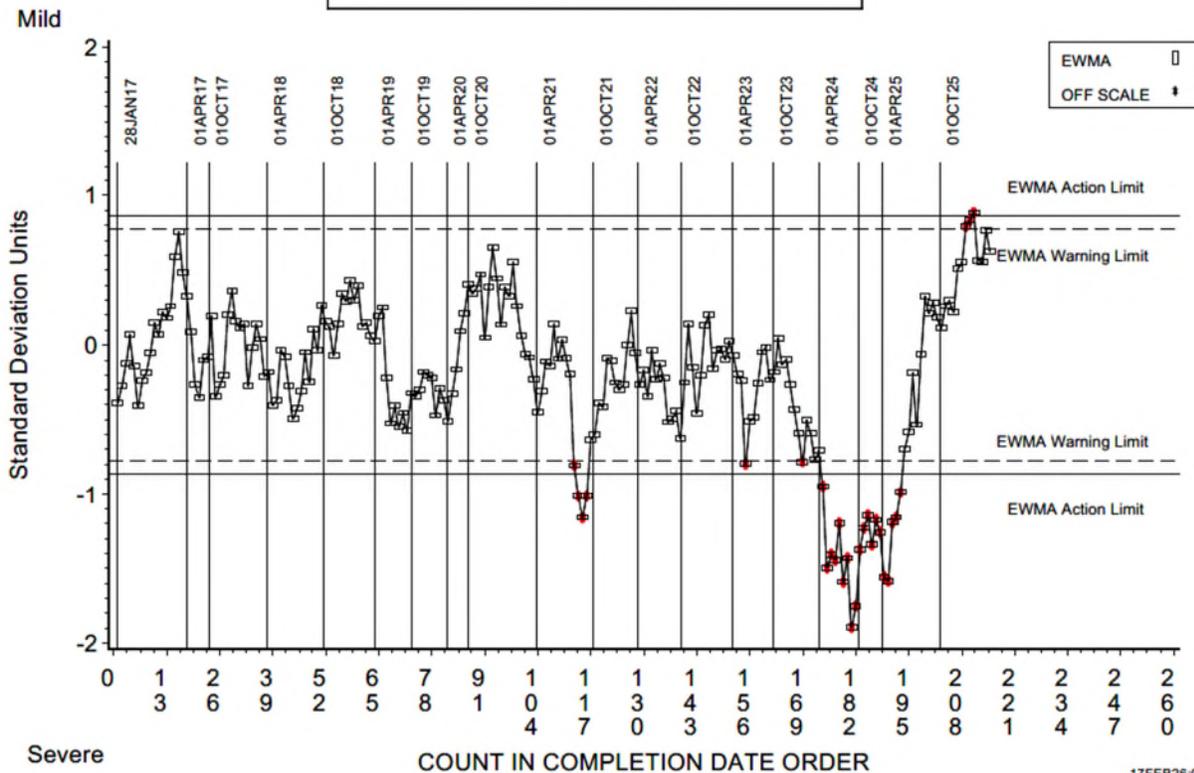
ii.

SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA



AVERAGE ENGINE SLUDGE

LTMS Severity Analysis

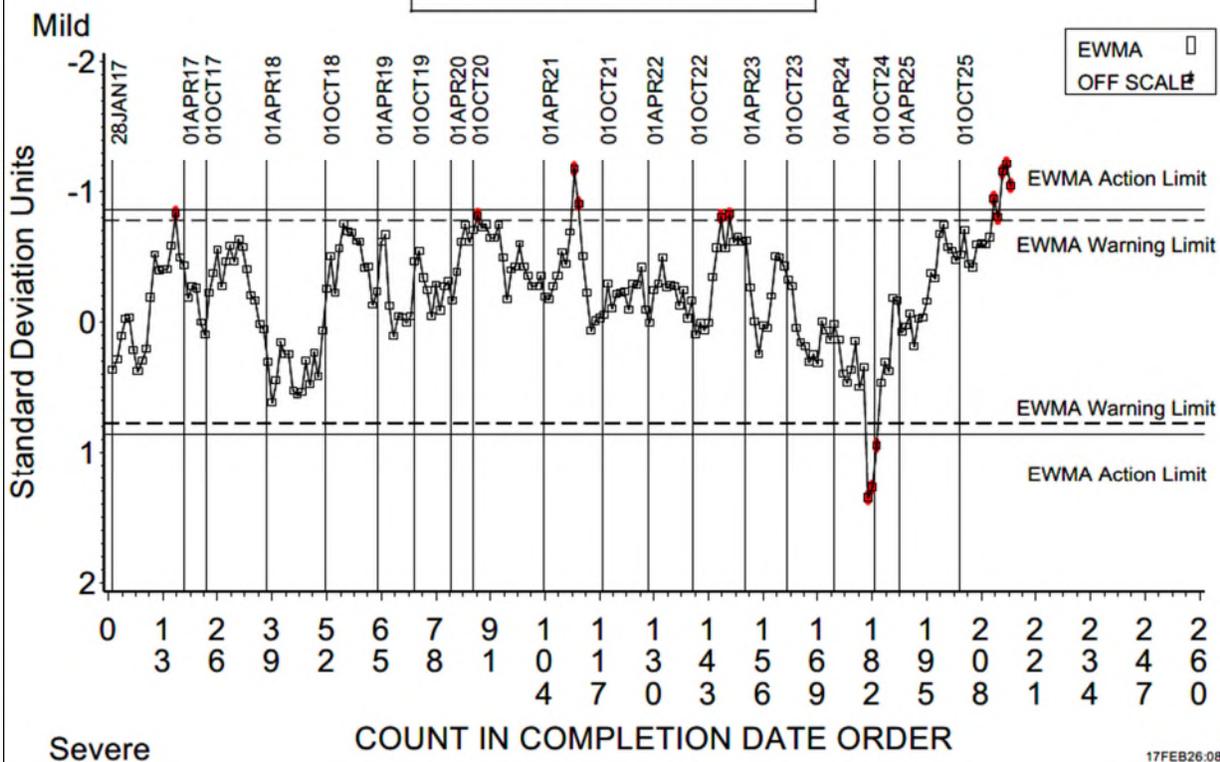


SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA



AVERAGE ROCKER COVER SLUDGE

LTMS Severity Analysis

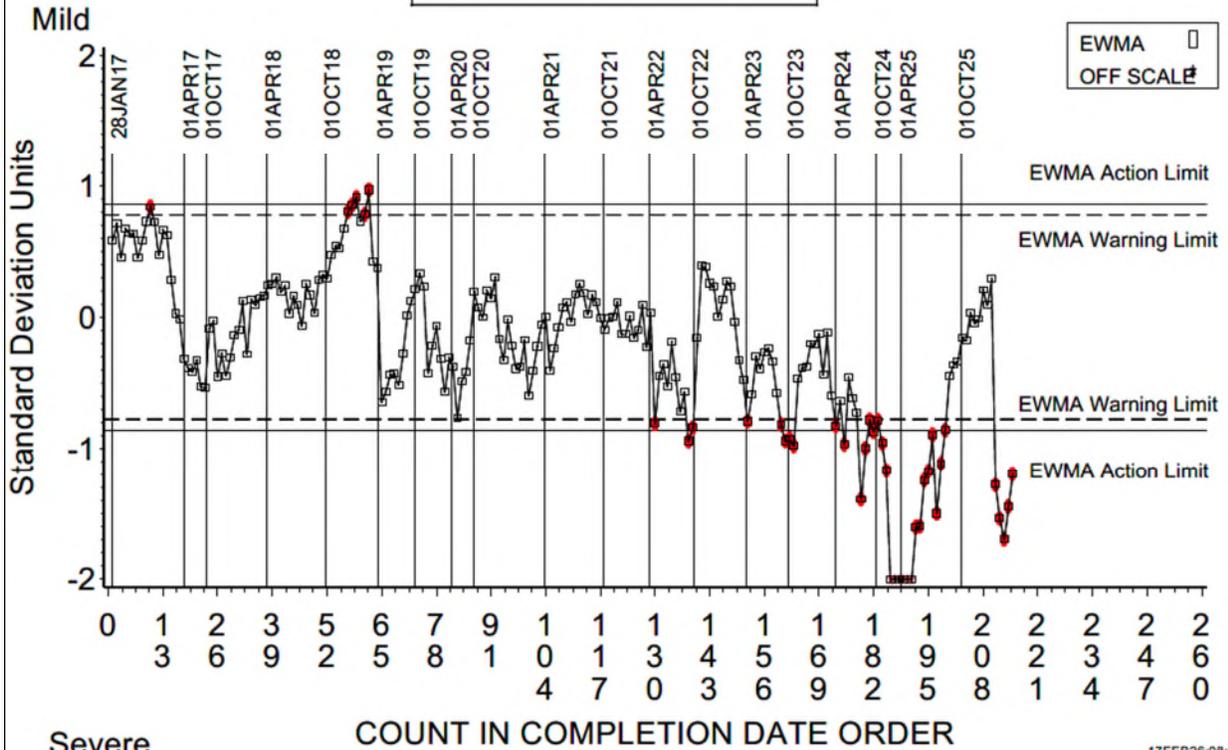


SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA



AVG. ENG. VARN. 50% RATING

LTMS Severity Analysis

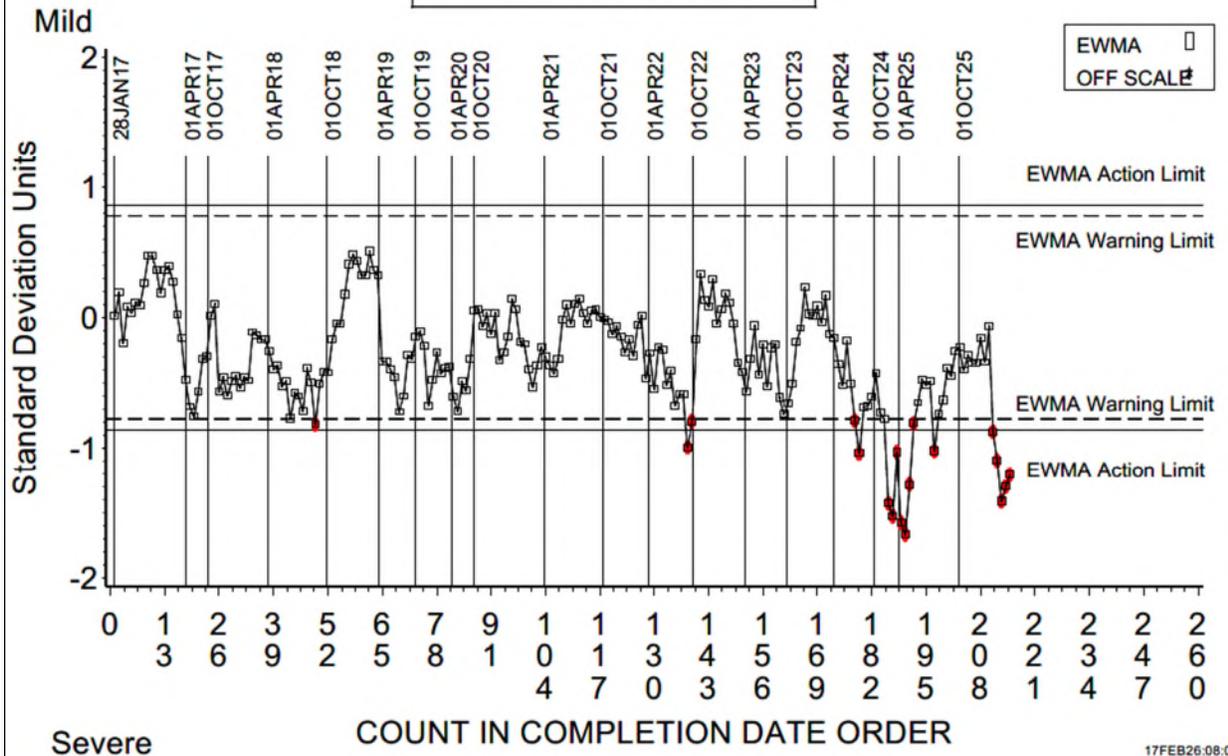


SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

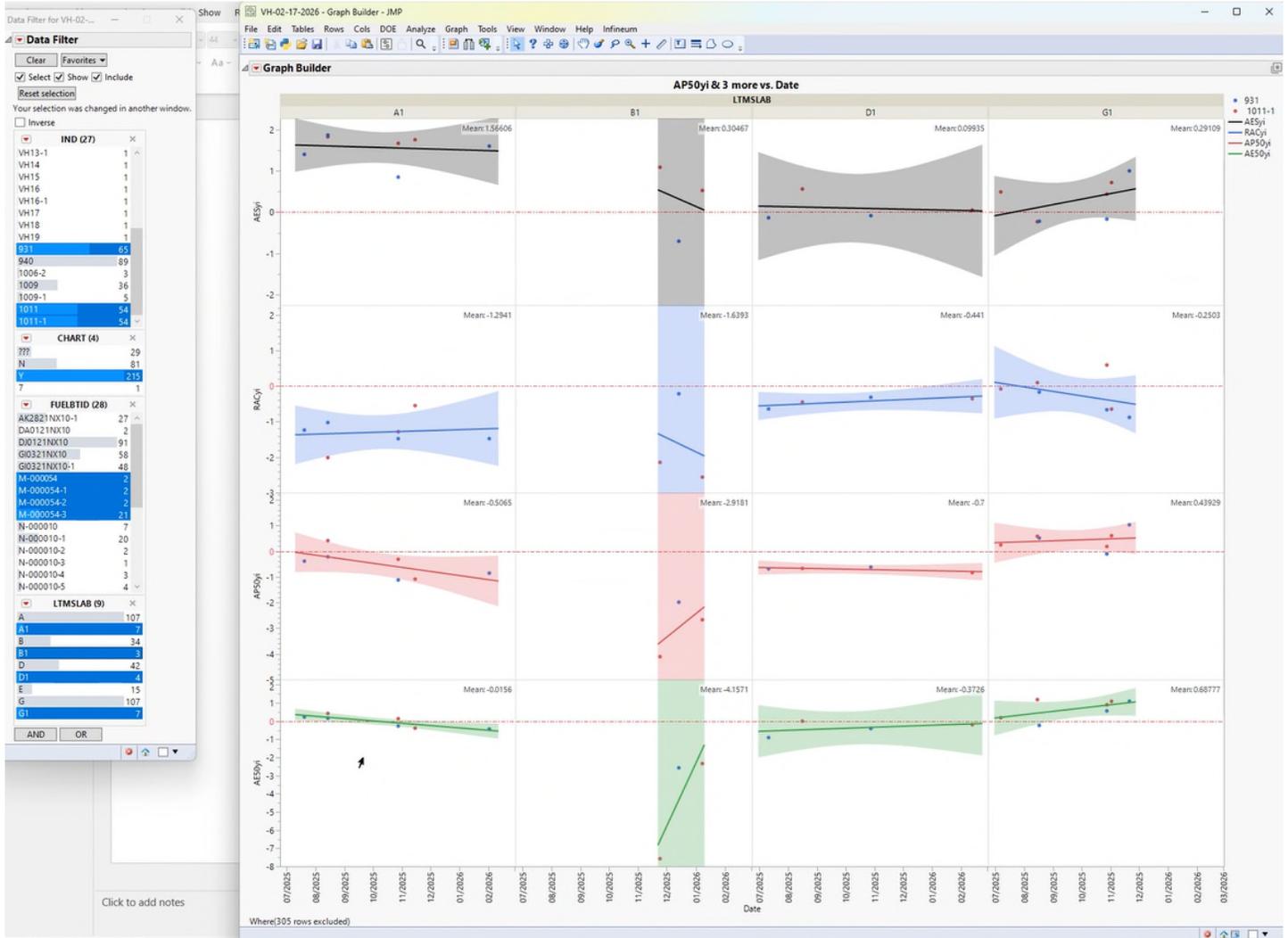


AVG PISTON SKIRT 50% RATING

LTMS Severity Analysis



- b. Todd Dvorak performed a lab analysis of the four parameters and found that in summary:
- i. AES - Lab issue
 - ii. RAC - Mild, may be a candidate for an ICF
 - iii. APV - Mixed, lab issue
 - iv. AEV - Mixed, lab issue



- c. TMC to investigate if industry charts are capped or not to avoid influence from large standard deviation results
- d. Lab D & G offered Lab A & B short blocks or some other creative approach to solve potential lab issues.
- e. ON HOLD - Tightened piston to bore clearance
- Current: 0.020 to 0.046 mm
 - Proposed 0.030 to 0.038mm, average of all eight cylinders

3. Fuel

a. M-000054-3 additional runs (*as of 2/17/26*)

Lab A: One more reference expected in March

200603: AES 1.75 σ mild

200607: AES 1.6 σ mild

Lab B: Possibly one more reference

198394: AES 1.09 σ mild, APV -4.1 severe

198391: AES -0.7 severe, APV -1.98 severe

203078: AES 0.52 mild, APV -2.67 severe

Lab D:

193863: AES 0.053 mild

Lab G: Two more references expected in March

201949: AES 0.7193 σ mild

199199: AES 1 σ mild

b. 13 tests were used to approve M-000054-3

i. Eight additional data points now available (n=21)

ii. Three to four more expected in March

iii. **Labs agreed April is now the correct time to request a Stats Analysis**

c. Fuel Properties

i. Fuel Supplier survey results

1. Labs need time to review and digest before taking action with any of these

2. Oxidation Stability

a. D525 clips at 1440 minutes, is there a better method?

b. Gage: D525 is designed and approved only for fuels with no oxygenates. D525 suggests **ASTM D873** for the oxidation stability of gasoline by potential gum as an alternative. We don't have any experience with D873, so we can't comment on how the methods compare.

i. The group should seek out a more 'intense' oxidation stability method so that the fuels produce a signal in the given test range. A result >1440 indicates the fuel did not exhibit signs of oxidation during the test. You could run the test longer, which might take 30 days or more – or you could run under more extreme conditions (heat, air, etc.) to produce a signal in less time. It might be possible to discriminate between the fuels as long as you can test them until their oxidation point. For diesel fuels, there exists an "accelerated" oxidation stability test (D2274). They use that when there is very little biodiesel and they need to get it to oxidize faster. We're not aware of an accelerated test for gasoline.

c. Haltermann Solutions: As you know ASTM D525 is widely used for gasoline oxidative stability and is just an indicator of start of the oxidation process under accelerated conditions. Since this is an indirect indicator of the fuel's tendency to form gum during storage then one could use **ASTM D873** direct measurement of potential residue formed by the fuel. Of course, this may not be an indicator of shelf-life of the fuel.

i. Not surprising that all batches show 1140+ minutes for the induction period. The fuel is fairly stable and has an antioxidant added to it. Wondering if **D7525 (Rapid Small Scale Oxidation Test) RSSOT** test

would tell us anything more. Yes, that is the faster and more modern test for Oxidative Stability.

- d. **Haltermann Carless: No better that we can advise. Ref CEC best practices Currently used and working**

3. Upper distillation curve

- a. Should we pursue improved resolution on the heavier end of the distillation curve? Supplemental to D86
- b. **Gage: As far as we know, there are no official test methods that provide better data in the over 80% range. We have encountered predictive models that offer calculated distillation measurements in increments of 0.1° up to 99.9%. One potential approach could be to evaporate 80% of the fuel and then distill the remaining 20% residue; however, we are not aware of any established test methods for this process. Some method for evaporating light ends and analyzing the residue would be helpful.**
- c. **Haltermann Solutions: D86 is widely used and the only other method currently approved for motor gasoline is D7345 but D86 is the referee method. Both these methods are not intended to tell you anything about the hydrocarbon class. Also, there is ASTM D2887 which is a simulated distillation method , not really suited for gasoline and only gives a distillation curve.**
 - i. ASTM D7096 gives a D86 profile but is based on the Detailed Hydrocarbon Analysis and is approved for ethanol containing fuels. Still D86 is widely used and is embedded in most fuel specifications.
- d. **Haltermann Carless: GC Piona to have better transparency distribution of components (D6839). Correct with the D6839 method will help maintain consistency in discrimination and showing (without giving away the formulation) a more detailed level of visibility to the material**

4. Ethanol handling

- a. Splash addition when transferring to truck for shipment
 - i. **Gage: No, we blend products altogether in tanks.**
 - ii. **Haltermann Solutions: No, we do not splash blend ethanol into a finished E0 fuel. Ethanol is part of the fuel formulation and then the CofA testing is done.**
 - iii. **Haltermann Carless: No, we can control the Ethanol content better if it is blended with the batch**
- b. Max batch size for fuel grade ethanol?
 - i. **Gage: Our biggest blend tank is 30,000 gallons.**
 - ii. **Haltermann Solutions: We produce our own version of fuel grade ethanol from anhydrous UN- denatured ethanol. Typically, we produce about 7000-gallon batches.**
 - iii. **Haltermann Carless: +500K gallons**
- c. Shelf life?
 - i. **Gage: We guarantee a 2-year shelf life from the date of manufacture for an unopened container that is stored properly**
 - ii. **Haltermann Solutions: This is dependent on the water content, how the ethanol is stored and what the denaturant was. Therefore, we believe E10 fuels are prone to water absorption leading to corrosion, sediment, and other problems. E10 fuel is likely half as stable as E0 fuel.**
 - iii. **Haltermann Carless: We recommend 2 years**
- d. Does the denaturant used vary by batch or supplier?
 - i. **Gage: The denaturant type stays the same. The amount will vary slightly from lot to lot, but the target is 2% denaturant for fuel-grade ethanol**

- ii. Haltermann Solutions: YES, the denaturant can vary by supplier. Few suppliers do a good control of type and amount of denaturant, and the law allows for many denaturants with a wide range of amount allowed. This is OK for street fuel but introduces variability and poor stability for certification fuels.
 - 1. We have a license to handle and stock UN-denatured ethanol and from that we make our own very controlled and legal fuel grade ethanol which does not vary from batch to batch.
 - iii. Haltermann Carless: Not for Haltermann Carless but the denaturant can change in the industry, batches and or suppliers
- e. How to manage ethanol fuels shipping? Totes? Drums? Truck tanker?
- i. Gage: We are able to ship products in 1-gallon Containers, 5-gallon Pails, 54-gallon drums, and bulk tankers.
 - ii. Haltermann Solutions: We can handle all the above.
 - iii. Haltermann Carless: Truck loads would be best, Totes and drums would add a layer of cost and logistics to the end user which could be prohibitive

d. Supplier contacts:

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- iii. Phone: 281-740-6811

Historical Logbook

Date	Topic	Description	Comments
2/12/24	-	O&H formed.	
2/29/24	Hardware	Cam cap anaerobic sealant	IL24-1
3/5/24	Hardware	Cam bearings resolved with King Bearing supply to TEI.	Incl. SwRI bearing analysis
3/12/24	Fuel	N-000010-1+ CofA data integrity review.	Included lab samples to Saybolt
3/26/24	Fuel	Quarterly samples now from test cell	
4/9/24	Hardware	Piston oil hole size differences by piston size not statistically significant to APV	
4/16/24	Operation	Build Workshop conducted	IL24-3 and IL24-4
5/21/24	Fuel	AO content depletion in transit	
5/21/24	Operation	Honing data analysis uninterpretable due to measurement differences	This will be revisited after 2025 fuel approval matrix
6/4/24	Hardware	OHT3G-096-1 brushes explained	IIIG efforts
7/9/24	Operation	OSCR raters group imprecision reviewed	
8/27/24	Hardware	FCS order placed on pistons and rings	
8/27/24	Operation	N-10-1 approval vs PM statistical analysis	
1/7/25	Fuel	RVP adjustments vs fuel dilution	
4/29/25	Operation	Blowby Cart Questions - 5/16" orifice	Equation difference, ~0.1 L/min
8/19/25	Hardware	2024 FCS order has completed	
9/16/25	Operation	Engine Swap experiment Lab A & G	Fuel dilution moves with build
10/28/25	Fuel	M-000054-3 fuel batch approved.	
12/17/25	Operation	Updated report form to capture piston dia.	Version: 20251222