M11 EGR Test

Presentation to
HDEOCP
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M-11 EGR Test Status

- **Proposed Limits**
  - ✓**CWL 20 mg**
  - ✓**TWL 175 mg (no ring gap correlation)**
  - ✓**OFDP 275 kPa @ 250 hrs**
  - ✓**ASR 8.0**
  - ✓**BWL, IAS: Report Value**

Cummins Top Ring Weight Loss Limit - Why?

- The current proposed top ring weight loss limit for a one test pass is 175 mg for CI-4
- The limit is based upon modeling and correlation work performed on internal EGR tests and comparative liner/ring wear studies resulting in calculated acceptable engine life.
  - ✓The data analysis provides a top ring weight loss limit of 150 mg.
- Oil E is the borderline passing oil for the M11 EGR test.
- Using ASTM E-178 at 5% significance level none of the Oil E rings are excluded
  - ✓The average of this data set is 134.1 mg with a standard deviation of 20.2
  - ✓Using two standard deviations a limit of 174.5 mg is calculated.
  - ✓Based on M11 engine modeling work, Cummins requests a top ring wear limit of 175 mg.

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Evaluation of Beaded Filters

- Concern over number and spacing of pleats
- Questionable used filters returned to FG
- Statistical sampling (36) of 550 filter batch returned to FG
- Perform flow vs. restriction
- Examine extremes for pleat count and spacing
- Perform dust capacity testing on extremes
- Refer to O&H Panel

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O&M Panel Activities

- 7 runs on oil E ranged from 46 kPa to 87 kPa with a mean of 63 kPa.
- This compares to a matrix mean of 137 kPa.
- The labs will use the mean from these runs as target for oil E with the standard deviation from the matrix.
- Passing limit will remain 275 kPa.
- There will be only minimal lab severity adjustments.

Analysis of Returned Filters by Fleetguard

Oil	Filter	# Pleats	Area Cm2	Gm/100 cm2	Total Contamina Gm
E	A	61	5243	2.00	105
E	B	55	4727	1.65	80
E	MCD1 Even			1.6971	
E	MCD1 Bunched			1.3855	
E	MCD1 Average	59	5071	1.5413	78
E	MCD7 Even			0.9663	
E	MCD7 Bunched			0.8132	
E	MCD2 Average	56	4813	0.88975	43
Test	Even			4.7729	
Test	Bunched			4.4734	
Test	Average	60	5157	4.6232	238

Observations from Filter Analysis

- Pleat count is from 55 to 61 with a target of 55 min.
- Bunched pleats do remove slightly less material, but...
- Bunched pleats can remove a lot of deposit with less variation than expected
- The relationship with sludge ratings and filter deposits suggests that when an oil exceeds its capacity to hold sludge, it comes out all over the engine… filter, pan, valve covers etc.