

Comparison of Test Conditions

- Mack T-9 Ring and Liner Wear Test - 500 hr., 1.75 % soot @ 75 hr.

	Fuel Flow, #/h	Speed, rpm	HP	Torque, #ft	BMEP, psi
Stage 1	139	1800	352	1027	213
Stage 2	121	1250	381	1600	331
- Mack T-10 Ring and Liner Wear Test - 300 hr., 4.8 % soot @ 75 hr.

Stage 1	130.5	1800	345	1007	209
Stage 2	140	1200	434	1900	394
- Cummins M11- EGR Test - 300 hr., 4.6 % average soot.

Soot Con.	127.6	1800	329	960	216
Wear Con.	141.7	1600	434	1425	320

T-10 Liner Wear

- Statistical analysis of the T-10 matrix data shows no impact of technology, even with the designed-in D.I. uptreats and downtreats.
 - Suggests parameter is not responsive to formulation variables.
 - Only response is to test conditions and statistical variability.
- T-10 loads to significantly higher soot @ 75 hr with higher BMEP, but test is shorter.
 - Model one: $25.4 \text{ microns} * 4.8\% / 1.75\% * 225 \text{ h} / 425 \text{ h} = 36.9 \text{ microns}$ as the one test pass / fail target.
- Oil E is a “good” oil, therefore it should pass at the two sigma level.
 - Model two: oil E averages 25 microns liner wear, using the sigma for the full data set equal to 5, mean plus 2 sigma = 35 microns as the one test pass / fail target.
- Infineum suggests the slightly more conservative 35 micron target.

T-10 Ring Weight Loss

- Like liner wear, the statistical analysis of the T-10 matrix data shows no impact of technology.
 - Following the same logic as liner wear, we present two models.
- Model one: $120 \text{ mg} * 4.8 \% \text{ soot} / 1.75 \% \text{ soot} * 225 \text{ h} / 425 \text{ h} = 174 \text{ mg}$ as the one test pass / fail target.
- Model two: oil E averages 114 mg top ring weight loss, and the sigma for the full data set is 27, mean plus 2 sigma = 168 mg as the one test pass / fail target.
- Infineum suggests a limit of 170 mg max.

T-10 Lead / URBWL / Oxidation

- Analysis of the T-10 Matrix data shows a significant degree of correlation among delta lead, upper rod bearing weight loss and oxidation. The measurement of any one parameter defines the others.
- Matrix data show that technology is significant.
- Historically, control of delta lead in the T-9 has been the true heavy duty category oxidation test.
 - TMC 1005 average performance near the 3 test pass fail limit correlates to 15 to 20 ppm of lead in 50 K mile drains.
 - Related technology at same site, which averaged 25 to 35 ppm of lead in 50 K drains, yielded 1,000,000 mile bearings with no copper exposed.
- Although shorter, the T-10 operates at higher temperature and greater NOx exposure for the oil than the T-9. (continued)

T-10 Lead / URBWL / Oxidation (continued)

- TMC 1005 lead control “breaks” at about 225 hr in the T-10, but the final lead level is artificially low due to high oil consumption.
- Oil A is the featured oil in this test.
 - Model one: oil A averages 24 ppm, log transform = 1.38, and the root MSE of the data is 0.29. $1.38 + 0.29 = 1.67$, anti-log = 46.8 ppm.
- Oil E is a “good” oil and therefore should pass most of the time.
 - Model two: oil E averages 27 ppm, log transform = 1.43, and the root MSE of the data is 0.29. $1.43 + 0.29 = 1.72$, anti-log = 52.5 ppm.
- Infineum suggests that delta lead should be the measured parameter for oxidation and bearing weight loss, and the pass / fail target should be 50 ppm max.