

PC-9: Oxidation

- **Thin Film Oxidation: Use Cat 1Q to Measure Piston Deposits as an Indicator of Thin Film Oxidation**
- **Corrosive Wear Due to Oxidation: Measure Lead Increase as an Indicator of Oxidation and Corrosion in Mach T-10**
- **Oil Thickening Due to Oxidation: Use Integrated IR, Measure Oxidation as a Precursor to Oil Thickening in Mack T-10**



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PC-9: Oxidation

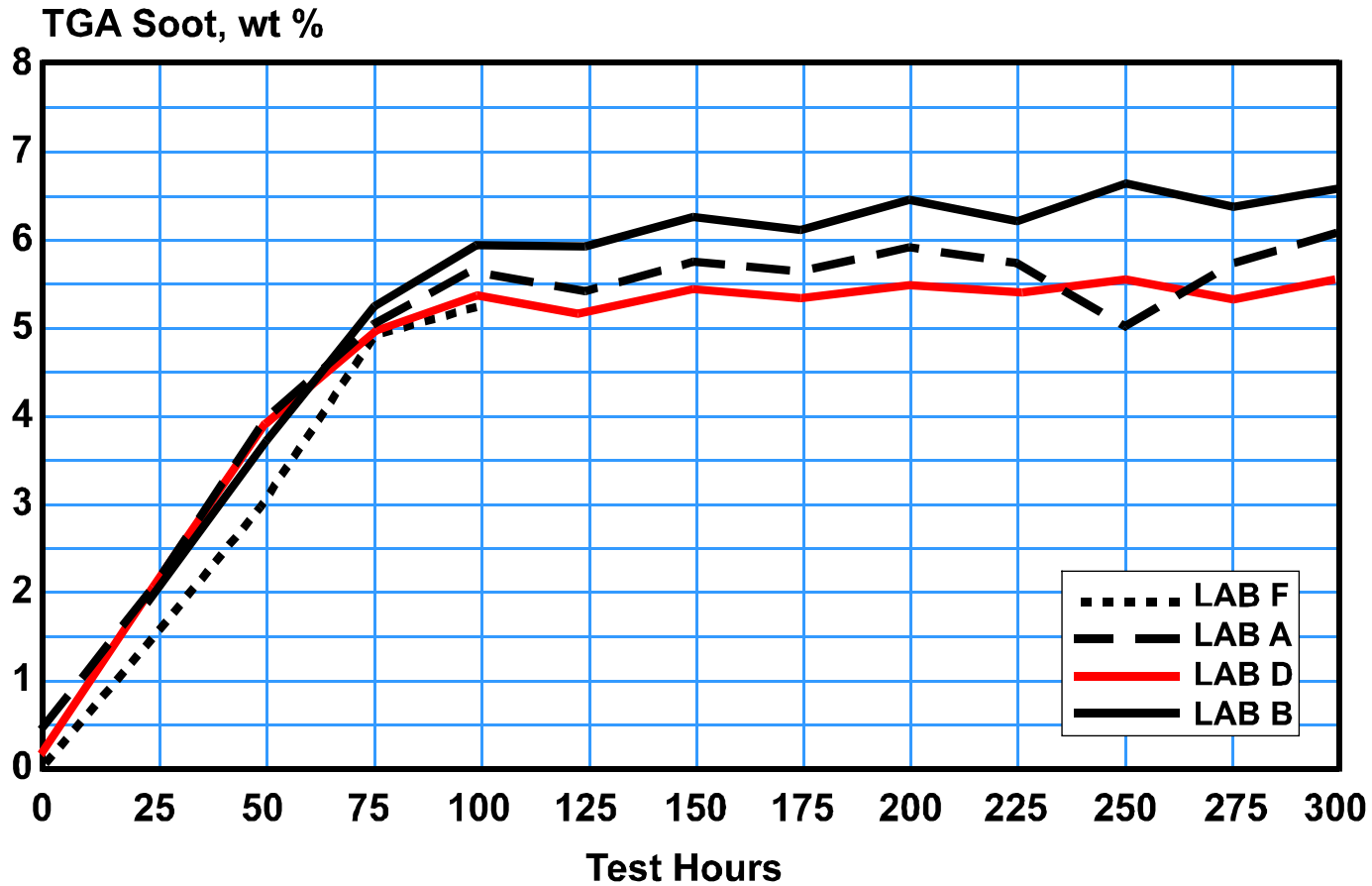
- **Caterpillar 1Q Test On Hold Due to High Oil Consumption in Some Labs**
- **In Four Labs the Mack T-10 Lead Varies Between 33 to 11 ppm**
- **Integrated IR for Oxidation, With 5.5-6.5% Soot in the Oil, Has Major Problems as an Accurate Predictor of Oxidation**



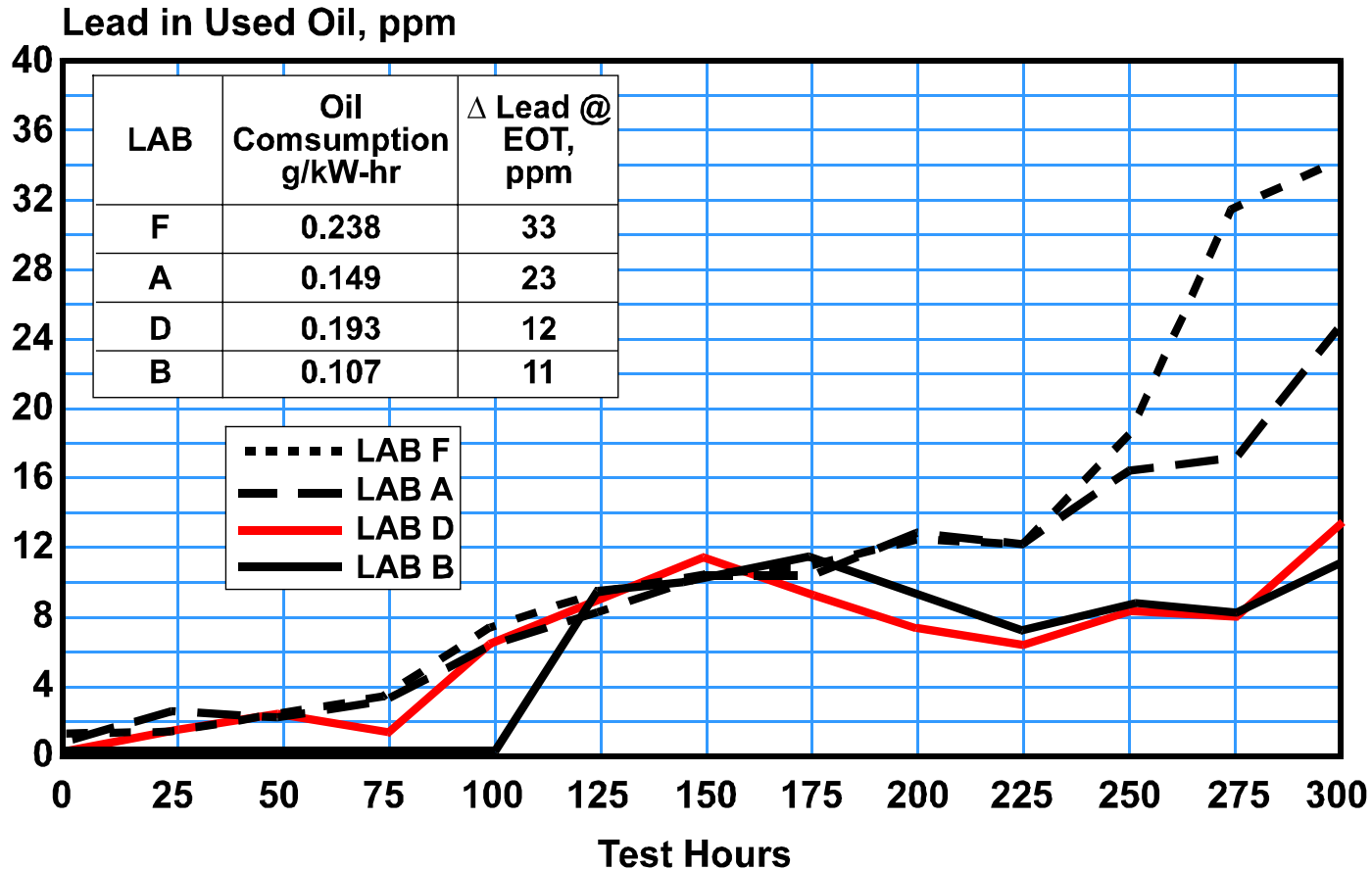
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Mack T-10: TGA Soot Versus Engine Hours, Using Feature Oil A in Four Different Laboratories



Mack T-10: Used Oil Lead, Using Feature Oil A in Four Different Laboratories



Integrated IR Method for Mack T-10

- **At 6% Soot Levels, Sample Requires Dilution**
- **Sample Dilution Adds Complexity to the Analysis and Increases Uncertainty in Measure Values**
- **Sample Dilution With Fresh Oil is Especially Challenging Since Oils Don't Mix Well and Must Be Heated to Become Homogenous**



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Integrated IR Method for Mack T-10

- **Soot Generated From Engine Tests is Itself Highly Oxidized. This Fact Makes it Especially Difficult to Separate Out the Individual Contributions to the 1720 cm^{-1} Carbonyl Stretching Band From Oil Oxidation, Additive Package (Succinimide Dispersant), and Soot.**



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Integrated IR Method for Mack T-10

- **The Baseline Underneath the 1720 cm⁻¹ Peak is Poorly Defined. If a Tangent Skim Method is Used Based on the Absorbances at 1665 and 1800 cm⁻¹, Then Negative Numbers Are Obtained Early in the Test Due to Additive Depletion Effects. But if the Baseline is Extrapolated From the Absorbances at 1870 and 2000 cm⁻¹, Then the Oil Oxidation Peak Includes Too Much Contribution From the Broad/Overlapping Absorbance Band Centered at 1600 cm⁻¹ That Results From Soot-Quinone Structures**



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Photoacoustic Fourier Transform Infrared Spectroscopy of Heavy Soot Diesel Oils

- **Photoacoustic FTIR Can Measure Oxidation by Carbonyl Increase in Heavy Sooted Oils**
- **The Carbonyl Increase Should Be Viewed as Trend, Not as Quantitative Data**
- **Using Identical Samples, Photoacoustic FTIR Data Are Not Comparable**
- **Further Work is Not Recommended**



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- **Recommend That Sequence IIF Be Considered for Bulk Oil Oxidation, Based on the Potential Problems With Integrated IR From Mack T-10**

