Measuring Particle Absorption with the CAPS PMssa Monitor

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**SOOT CONCENTRATION MEASUREMENTS USING THE CAPS PMssa MONITOR**

- Incorporates Optical Scattering and Extinction Measurements Using Same Sample Volume
- Minimizes Sampling Errors
- Absorption = Extinction/(1-SSA) where SSA = Single Scattering Albedo
- High Accuracy When SSA is Small (<0.3)
- [M] = Absorption/ MAC (MAC = Mass Absorption Coefficient)

**ENGINE SOOT COMPLIANCE MONITOR (ESCOM)**

- Development of a Monitor To Meet the AIR 6241 Standard for Measurement of Aircraft Engine Soot
- CAPS PMssa Provides Real-Time Measurement of Aerosol Absorption by Measuring Total Optical Extinction and Single Scattering Albedo
- Soot Mass Derived from Absorption Measurement
- Can It Meet Accuracy Specifications Under Real World Conditions?

**VARIAnT2 Details (VARiable Response In Aircraft nPM Testing)**

- Held August 17-31, 2015 at AEDC/ UTSI Propulsion Research Facility, Tullahoma, TN
- Probe configuration: 4 parallel probes (one to each system, one for “near source” particle sizing and mass determination, and another for smoke number measurements
- J85-GE-5 Turbojet
- Jet-A (w/AF additives) and 50/50 Camelina blend
- Mass concentrations ranging from ~5 to 110 μg m⁻³ at the instrument
- Camelina fuel blend to achieve lower mass concentrations and alter organic carbon content of PM

**MEASURING AMBIENT ABSORPTION**

- Biofuel Mixture Appears to Produce Less Soot per Mass Fuel Burned at All Thrust Levels
- Soot from Biofuel Mixture Exhibits Higher SSA than Soot From Jet-A Fuel

**CONCLUSIONS**

- CAPS PMssa Monitor Agrees with NIOSH Method 5040 for the Measurement of Soot Concentration
- Current Development:
  - Incorporation of CO₂ Monitor to Provide Real Time Soot Emission Index Information
  - Undergoing Further Testing in Variant3 Campaign National Vehicle and Fuel Emissions Laboratory (EPA)
  - Diesel Engine - SSA = 0.15 ±0.02
  - University of Tennessee Space Institute
  - Jet Engine - SSA = 0.10 (65 nm)
  - APU Engine - SSA = 0.13 (65 nm)

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