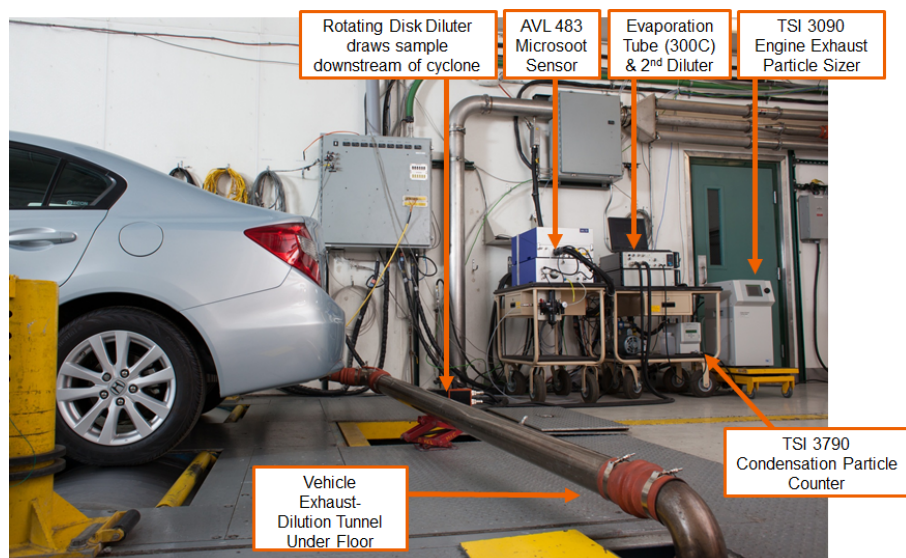


PARTICULATE MATTER CHARACTERIZATION



SGS Environmental Testing Corporation has made a significant investment in particulate matter (PM) instruments and measurement techniques for the development of next-generation engines.

SGS offers an array of instruments to characterize particulate emissions, including condensation particle counters, a particle size spectrometer, research-grade diluters, thermodenuders, photoacoustic microsoot sensors, and 40CFR Part 1065-compliant PM samplers. The instruments are used in SGS engine and vehicle chassis dyno emissions labs to develop new products and to perform certification tests.

The engineer can use these instruments to understand the make-up and variability of PM emissions, the source of the emissions, and pathways to emissions reduction:

- Diesel Particulate Filter (DPF) filtration efficiency
- Soot slip past particulate filters on cold start and during active DPF regenerations
- DPF materials/porosity evaluation
- Filter damage assessment on filtration efficiency (missing plugs, cracks, segmentation, and matting defects)
- Contribution of unburned fuel and oil to PM
- Catalyst sulfate-make and sulfur purge effects
- Strategies to meet PM regulations without a particulate filter

Particle Counters

Particle Size Spectrometer

Research Grade Diluters

Thermodenuders

Microsoot Sensors

Part 1065/1066 PM Samplers

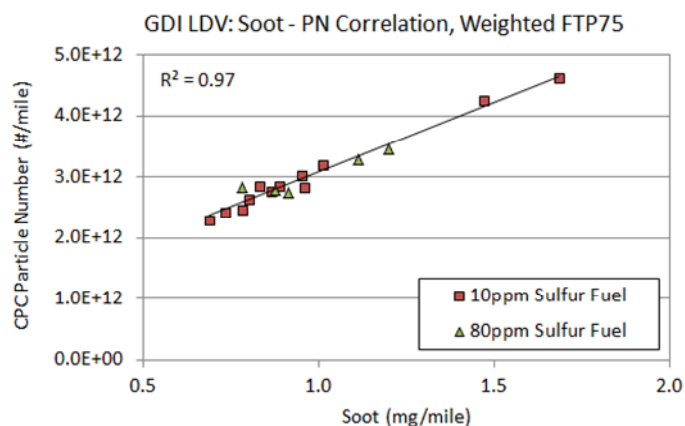
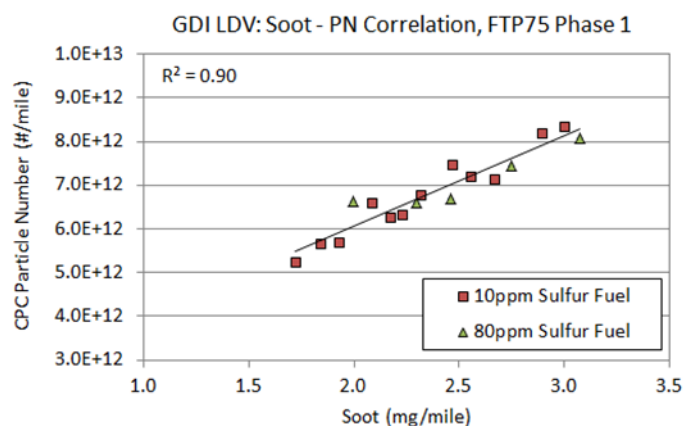
EC/OC/Sulfate Fractionation

Available in SGS engine and vehicle emissions labs

Further evolution of powertrain technology will be required to meet stringent government standards for particulate matter emissions.

- EPA Tier 3 has reduced light-duty PM emissions limits by 70% to 3 mg/mile
- CARB LEVIII has reduced light duty vehicle PM emissions to 3 mg/mile starting in 2017, and to 1 mg/mile starting in 2025
- European light-duty vehicles and on-road heavy-duty engines must be certified within a Euro 6 particle number limit starting in 2013
- Swiss OAPC requires DPFs and particle number certification for non-road engine applications

SGS engine and vehicle labs are compliant with US and European emissions certification testing standards.

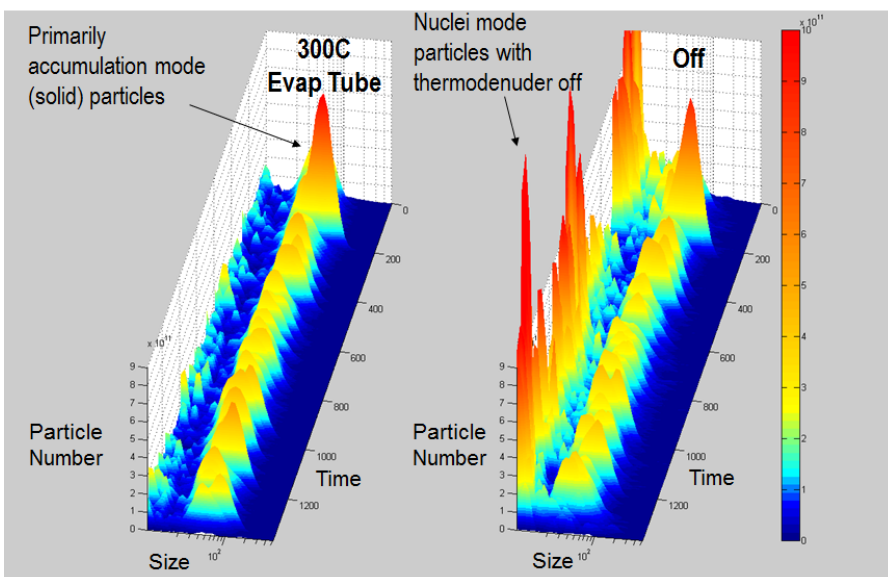


Case Study: Particulate Characterization for a GDI Engine

SGS has tested a range of passenger cars equipped with different gasoline direct injection (GDI) engine technologies to characterize particulate matter emissions. Results for a 2012 GDI vehicle are shown above. SGS used a TSI condensation particle counter (CPC) and AVL microsoot sensor for the tests, both independently measuring the elemental carbon portion of the PM.

The particle number emissions were highly variable for repeated FTP75 test sequences, and foreshadow the difficulty of certifying a GDI-equipped vehicle to an EPA Tier 3/ California LEVIII standard of 1 to 3 mg/mile. The strong correlation between the independent CPC and Soot measurements confirms that the emissions variability is indeed produced by the vehicle and not measurement artifact.

SGS offers statistically rigorous experimental designs to develop pathways for complying with stringent Euro 6 and US EPA Tier 3 PM standards with or without a gasoline particulate filter.



Case Study: Particle size distribution from a cold-start diesel engine test shows nuclei-mode particles from volatile and sulfate aerosols, and emissions reduction during engine warm-up.

For more information, please contact:

SGS ENVIRONMENTAL TESTING CORPORATION

2022 Helena Street

Aurora, Colorado 80011 USA

Phone: (303)365-7860

Fax: (303)361-6174

Email: sgs.etc@sgs.com

Web: www.sgsetc.com, www.sgs.com/etc

WHEN YOU NEED TO BE SURE

SGS