Advanced Energy

Application Note

SHED EVAPORATIVE EMISSIONS TESTING

Evaporative losses from gas handling/storage system have to be tested and quantified for vehicle certification according to the most recent industry codes and standards. Our Photoacoustic Gas Monitors meet the stringent measurement specifications required to quantify the emitted vapors at low ppm levels with excellent accuracy and repeatability.

The Opportunity

Photoacoustic Gas Monitors are successfully used for direct measurement of evaporative emissions as part of the qualification testing procedures for vehicles.

In the automotive industry, regulatory requirements applying to qualification type testing procedures have been upgraded since the introduction of new gasoline mixes on the market. As an example, E10 (10% ethanol) is one of the specified blend now to be used in standard emission testing.

The new requirements to monitoring of ethanol in evaporative emission testing have raised new measurement challenges. In particular, the US EPA prescribes a conservative 1.08 correction factor on conventional FID measurements to account for ethanol emissions, unless its vapor fraction is directly measured by advanced instruments.

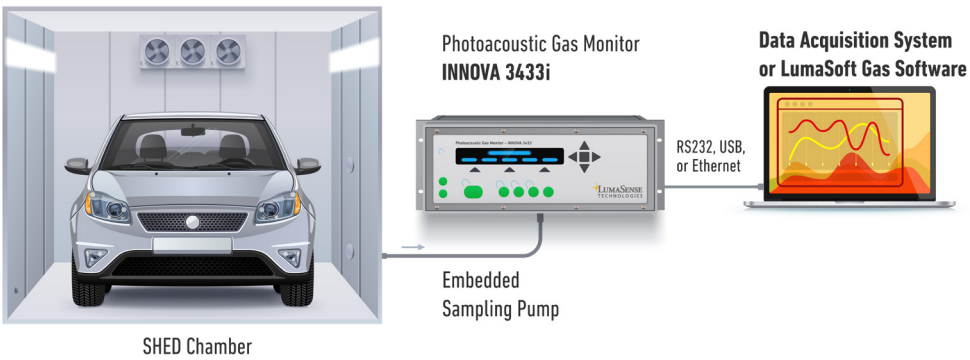
Innovative test methods relying on photoacoustic IR spectroscopy (PAS) were hence developed in the year 2000s. These methods have proven to give similar accuracy in the results than incumbent measurement methods, while differentiating from the latter with a significantly simpler setup and cheaper operating procedures.

Monitoring Needs

For SHED (Sealed Housing for Evaporative Determination) evaporative emission testing, the vehicle to be tested goes through pre-conditioning cycles followed by a hot soak test. Finally the evaporative emissions (mainly from the fuel handling/storage system) are measured during several days in the chamber environment that follows a well-defined temperature profile.

The emission test consists in quantifying those evaporative emissions, and as required, the ethanol emissions are discriminated from other hydrocarbon emissions.

Automotive makers and test contractors also value a measurement method with online monitoring capability, easy integration in a test bench, and minimal operating workload.



Unlike measurement methods requiring impinge benches and remote laboratory analysis, the 3433i performs direct reading inside the chamber. It can be integrated in a cabinet along with the control system which regulates the environment inside the SHED chamber.

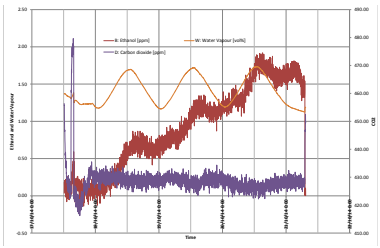
INNOVA 3433i Photoacoustic Gas Monitor.

Our Solution

The INNOVA 3433i Photoacoustic Gas Monitor is a very relevant solution to the automotive industry for its emission testing needs.

Built in a fixed 19" rackmount enclosure, the photoacoustic instrument enables an extremely simple integration in the test bench. No sampling bag or gas impingement is required. Gas samples can be drawn directly from the SHED test chamber through a sample port in its side wall and the concentration readings are available in-situ and in real-time.

Although the monitor can run on a fully standalone basis, the user-friendly LumaSoft 7820 application software can be used for the monitoring setup and supervision, providing online display and conveniently logging the readings in a SQL server database. Alternatively the gas monitor can be integrated to the existing automation system.



Example of direct Ethanol monitoring inside a SHED test chamber, with continuous measurement by the INNOVA 3433i over a representative 3-day test

Measurement Results

For best selectivity, the INNOVA 3433i is loaded with multiple optical filters corresponding to Ethanol but also with several IR active compounds and interfering compounds that can be found in the gas matrix sampled from the test chamber. Active cross-compensation is then used to improve the measurement accuracy.

During the qualification of the method by the US EPA (Environment Protection Agency) and CARB (California Air Resource Board), an extensive benchmark was carried out against the standard impinger and GC method. The PAS analyzer complied with the requirements for the detection limit (0.06 ppm for Ethanol) and for the linearity ($r^2 > 0.995$ over 9 concentration points between 0 and 75 ppm). Moreover, the PAS readings had less variability and showed a better ethanol percentage recovery than the impinge benches.

Your Benefits

- ✓ **Easiest integration: direct sampling, not requiring complex impinger benches**
- ✓ **Operational advantages: in-situ & real-time monitoring, calibration "free", no consumables/carrier gas needed, no extra sample-handling labor**
- ✓ **Stable, Reliable, and Repeatable Measurements**
- ✓ **PAS test method accredited by EPA and CARB (in US)**

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