

## 2009 SAE OBD Symposium – Notes from Sensor Technology Breakout Session

Sept 23 2009 1:30 PM

Objective is to discuss relevant points identified by the group. Generically, we are here to talk about sensors and sensor technology.

Summary –

- A) industry is in poor position because suppliers don't know what to commit to because OEMs do not know what to commit to. Suppliers may not want to take the risk if the market capacity is unknown or small, and life of product is unknown or short.
- B) Especially with the addition of Nox sensors, the total engine cost spent on sensors has been going up significantly.
- C) Diesel control system complexity does not appear to be converging upon a few control concepts. This poses significant challenges for suppliers designing and refining sensors that can be used on a large volume basis.

Topics identified for discussion:

- 1) Ethanol sensor and how to do a rationality check

One OEM approach: have convinced ARB that the best rationality diagnostic is the fuel trim diagnostic, not a specific sensor rationality. Some suppliers provide some on board smart sensor diagnostics to cover some of the failure modes. Group comment - reported a recent meeting with ARB indicated that they would foresee the bar being raised in the future. Action item: continue discussions with ARB to understand more specifically about when and if the expectation will change.

- 2) Humidity sensor a) for the purposes of eliminating an engine out Nox sensor for diesel applications b) how to do a rationality check.

In production for diesels. HVAC sensors have been in production for a long time. Being used in one OEM's natural gas (diesel based) products.

Time response to changes in humidity – what is required? Diesel and gas may need different time response, and may be differently concerned about the direction of humidity change (wet to dry – gasoline most concerned about, wet to dry – diesel may be most concerned about).

Humidity sensor suppliers may be able to provide some internal diagnostics.

Rationality might not be required if you convince ARB that a rationality is not a possibility, but possibly a rationality diagnostic is required depending upon failure modes associated with an irrational sensor.

- 3) HC sensor – sensor availability and production readiness – ran out of time and did not discuss.

4) PM sensor for mass / numbers – sensor availability and production readiness

Currently only plan to use tailpipe, but this would require that the EO PM is modeled accurately (there is concern with this assumption).

What is required of the sensor? We need low PM sensitivity.

There are analog and CAN options. CAN options are good for ECMs that do not have extra pins. Analog is preferred because of cost reduction in not including CAN.

Current sensors available is accumulate PM types.

Do all sensors work on the same principles? Circuit grid – PM gets deposited, resistance goes down, sensor decides when it is going to regen. Regen frequency is indicative of DPF PM bleed through. An alternative is to charge the particles themselves, then measure the voltage on the PM (Honeywell supplier – unsure when second step prototype is available).

Another supplier that may show promise can be found at [www.dekati.fi](http://www.dekati.fi).

If it takes too long to accumulate enough particulates, then how does this affect rate-based monitoring?

Sensor rationality is a concern.

note – when sensors are added for diagnostics purposes only, the sensors need to be significantly more reliable than the component that they are diagnosing to avoid fiascos.

Consensus is that work is continuing for PM sensor implementation in 2013.

Is there a viable sensor available for 2013? Yet unknown.

5) Urea quality sensor – sensor availability and production readiness

Sensors are available and production ready. Rumor is that some OEMs will be adding this within a year.

6) Nox sensor alternatives

Need improved Nox sensor to be not cross sensitive to NH<sub>3</sub>

No Nox sensor technology competition – this is a problem.

Nox sensor design integration considerations: how to package to read representative average Nox for downstream sensor location. Some information that sensors should be installed in pipes, and the smaller the better for better mixing.

7) Intake EGR - wide range oxygen sensor – ran out of time and did not discuss.

8) EGR mass flow sensor

What do want them for? Idea is to get an accurate flow measurement for control and OBD that doesn't introduce a pressure sensor.

Intake EGR wide range oxygen sensor could also do this and would have the same type of response exhaust response would be.

There was one in production but is no longer due to de-contenting / cost reduction / new combustion and engine controls. This early concept worked and was durable. Some recent experience is that thin film was not durable.

9) In cylinder pressure sensors for control strategies – misfire detection (diesel and gasoline), HCCI, cylinder charge measurement, combustion control (timing of spark or injection), reduction of combustion noise (knock), compensate for cetane composition, compensation for noise and engine out Nox.

Technology challenges – cost, integration issues, packaging, durability of base engine, durability of the sensor, accuracy of measured pressure.

What sensors are available? Pressure sensors integrated into the glow plugs – some applications do not have glow plugs. Gasket integrated pressure sensor

10) Ammonia sensor

Nox vs. NH<sub>3</sub> sensor – a sensor is needed which is not cross sensitive. Do we need an ammonia sensor?

Are there any ammonia sensors production ready? Delphi has a prototype available.