

Design of an accurate 'tailpipe' probe for Lambda sensors

Aim of this article:

After dealing with damaged sensors and struggling to get reliable idle calibrations (using one of the most commonly available probes) we decided we could easily do better without breaking the bank. Some quick 'back to back' testing soon showed the extent of the errors we had been experiencing.

We needed a probe that-

- 1) Was long enough and large enough diameter to avoid being influenced by the strong, infrequent pressure pulsations (and therefore corresponding flow 'reversions') that occur particularly at low RPM. These draw fresh air into the probe and dilute the exhaust gas creating the false readings.
- 2) Was adjustable so the sensor can be positioned close to vertical without fouling the vehicle

Why would you make one?

To get accurate readings and increased sensor life!

Poorly designed air/fuel ratio probes are common and lead to wildly inaccurate readings at low gas flows. This phenomenon is caused by exhaust gas pressure pulsations; it is nearly always overlooked by the tuner.

Besides incorrect readings a poorly designed probe will not allow the sensor to be positioned vertical due to the mounting clamp fouling with the vehicles bumper or spoiler. Being at the tailpipe and not vertical means large amounts of condensed liquid can flow into the sensor, this shortens sensor life and can cause 'thermal shock', basically a cracking of the ceramic element (it is approximately at 750°C in a wide band sensor such as the Bosch LSU variety).

Refer to www.dtec.net.au for information on DTec's Air Fuel Ratio Meter.

Features of an ideal probe:

- Large diameter for good unrestricted gas flow
- Adjustable length fitting into exhaust to allow maximum penetration
- Sufficient length after the sensor to stop air being drawn back over the sensor (during pulsations)
- Clamp is independent of sensor position
- Cheap and easy to build



Inaccurate, poorly designed probe (too small & fixed clamp position)!

Construction concept (guide only, use whatever material is at hand):

- Threaded Sensor 'boss' welded about 2/3 the way along tube, this allows the tube to be reversed if the exhaust length (therefore probe entry depth) is limited.
- Tube we used was approximately 410mm long and 25mm in diameter
- Clamp sleeve has an inside diameter that allows for a loose sliding fit over the main tube (can be 'sloppy' fit and it's still OK)
- A 'strap' is welded onto the sliding sleeve with a thread cut into it or a nut welded on for the clamping screw. You could even braze on half an old G-clamp onto the sleeve if practical.



Good probe design

Approximate size of complete assembled probe.



Sliding probe clamp and mounted sensor into main tube.



Probe design undergoing testing.

Summary:

Ideally a 'bung' welded into the manifold should be used for tuning, but tailpipe probes are common in the aftermarket tuning scene.

Don't settle for compromised designs. A small amount of thought into your probe design can save you time in fitting to vehicles, money from damaging sensors and can lead to improved tuning results, especially at idle and low gas flows.

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