Oxygen Sensor Installation Issues

For optimum performance the oxygen (or lambda) sensor should be **carefully positioned**. This will also improve its life expectancy, and ensure trouble-free and accurate operation. **Bosch** (and **NTK**) are careful in their specifications to spell out what must be done and what should be avoided.

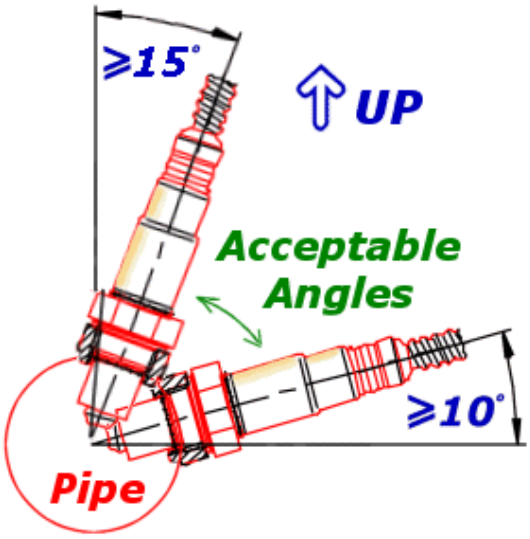
Here's the official Tech Edge (PDF) Sensor Installation Guide *that's worth printing* (6 pages) and reading. It includes **vitally important positioning information**

Below are some basic warnings and a quick summary of the points in the installation guide.

Sensor Handling Precautions

During operation the sensor runs at very high internal temperatures. The 6066 sensor image above shows the dull **orange glow** visible through the end of the senor. Other sensors (like the better shrouded 7200) may not have visible internals, but they get just as hot inside. *** WARNING *** When operating a sensor, be aware it can get **too hot to touch** in a very short time, and will continue to get hotter, possibly becoming a **fire risk** in a non-engine environment. Treat the operating sensor as you would a **naked flame** as there is an explosion risk if the sensor is used near flammable substances.

The sensor is manufactured from high temperature ceramic substances (modified Zirconium Oxides, etc.) and, although quite robust when used correctly, it is susceptible to thermal shock. This can occur if droplets of a liquid are sprayed onto the hot surface, as can occur during engine startup when water (that is produced during combustion) condenses on cool exhaust components.



Sensor Placement

Sensor **operating temperature** should be attained in **20** to **30** seconds when the control unit is attached to a 12 Volts (and up to 19.5 volt) supply. A longer warm up phase indicates either a problem with the sensor, the controller, or where the sensor is positioned. Controllers have in-built diagnostic LEDs and documentation for your controller should be carefully read to determine what your controller is saying.

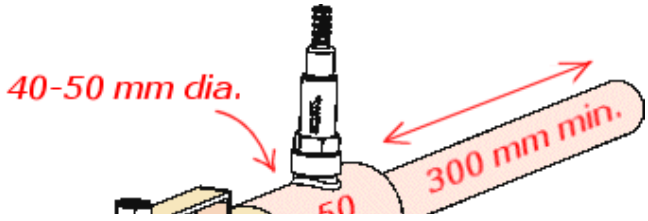
The image shows the range of acceptable mounting positions. A vertical position can get too hot in confined spaces, so we recommend at least 15 degrees from the vertical. The horizontal position can cause condensation to drip onto the sensor, so we recommend at least 10 degrees from the horizontal. In all cases the sensor should be perpendicular to the gas flow, ie. the bung should sit square over the pipe - this ensures adequate but not an excessive amount of gas enters the sensor.

We recommend placing the sensor around 1 m (40") from the closest exhaust valve. Where this cannot be achieved then spacing the sensor away from the direct exhaust by using a longer M18x1.5 bung, or a nut welded over a standard bung, is recommended.

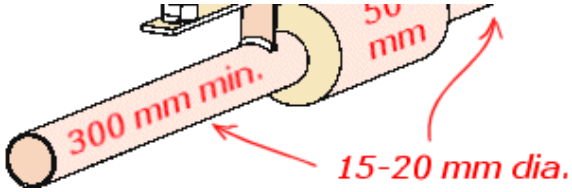
Tailpipe Sniffing

When the sensor is used in the **tailpipe sniffing** position, then we recommend a special pipe (shown at right) be made to reduce the chance of excessive **sensor cooling**.

Note that the relatively small inlet and exhaust pipe (15-20 mm diameter) is designed to sample only some of the exhaust gas. The much larger diameter (40-50 mm) sensing chamber with the M18x1.5 bung is designed to limit gas

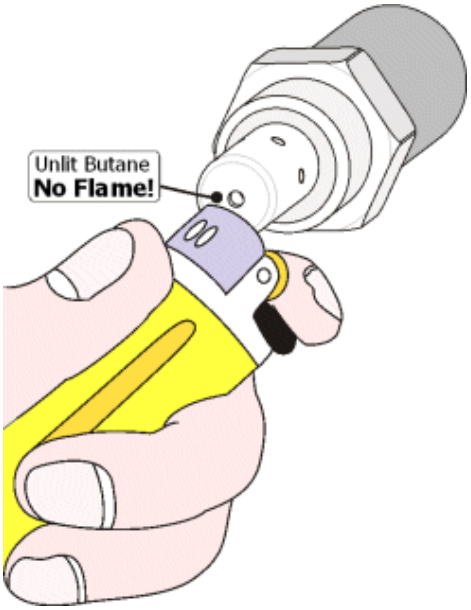


speed past the sensor, and the additional turbulence is for good gas transfer to the sensor body.



A guide to how much cooling is experienced by the sensor is how long the sensor heating phase takes to complete. To test, switch off the sensor for at least 30 seconds, and then switch on with a battery voltage of at least 13 Volts. If the sensor takes more than 40 seconds to reach operating temperature (determined by observing the status LED no longer flashing) then the sensor is probably being over-cooled, and should be positioned further out of the exhaust stream. Interestingly, the worst cooling effect can be experienced at low to medium RPM ranges where much of the exhaust gas heat is lost to the exhaust system before it reaches the tailpipe sniffer. At higher revs the gas can heat the sensor some.

Basic Confidence Tests



We recommend that all new users connect up their unit to power, a cable, and to the sensor to verify proper operation, before installing anywhere permanently. At this time a calibration procedure can be done and any logging or display software installed too. Please note the warning above about the sensor getting hot - we recommend you place the sensor in a ceramic/heavy-glass container or on a ceramic tile and don't leave the sensor unattended.

A basic test of the sensor and controller is easily performed with a low cost butane cigarette lighter. Simply squirt **unlit** butane down the nozzle of the sensor. Some of the air inside the sensor will be displaced and you should see a **rich** indication on the logger or display. As air slowly enters the sensor, and the butane escapes, the sensor will indicate increasingly leaner conditions. Blowing sharply on the sensor when it has been filled with butane will show a rapidly changing reading, demonstrating the speed of the sensor's response.

While the sensor is sitting in free-air* you will expect to see a very lean indication on the display. Free-air has an equivalent Lambda of around 208, and this is meaningless to display as such, so most of the displays will indicate **LEAn** or some similar indication.

free-air *is what we call clean ambient air with an oxygen concentration of around 20.9% and without any combustible hydrocarbons present.*

Free-Air Calibration

As part of the confidence test, a free-air calibration can be performed. It is worth noting that all Tech Edge controllers are designed to have long term electrical stability. They do not need to be re-calibrated at regular intervals like some lesser brands. In fact (except the economy **2J range**), they are designed to maintain their calibration even when a new sensor of the same type is swapped in. For best results however, we recommend you perform a free-air calibration when you first install the controller and sensor (or subsequent sensors), and perhaps 3 to 6 months later, depending on usage and operating environment.

It cannot be stressed enough that a free-air calibration can only be performed in free-air. The air in an exhaust pipe can remain very different to free-air for hours or even days. Always remove the sensor from an exhaust pipe, or for an exhaust sniffer-pipe, make sure you flow fresh air through the pipe before calibration. Your breath can have an 0xygen content of 15% rather than around 21% for free air, so don't blow on the sensor during calibration. Many of the newer models have an **auto-cal** button (or for older controllers, newer firmware uses the logger button to also act as a free-air auto-cal button when operated correctly). Refer to your controller's documentation for how to auto-cal, or otherwise, use WButil's free-air calibration function.

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