SPILBA

User manual

Air Fuel Ratio

NARROWBAND

User Manual V2.0

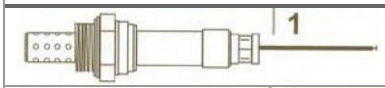
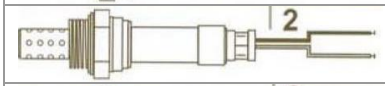
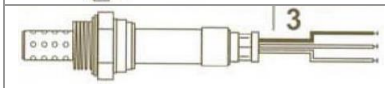
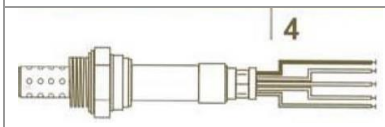
Contents

Intro

Knowing the proportion in the air-fuel mixture is essential to obtain maximum performance in high-performance engines. Poor carburetion can result in a rich mixture, where consumption is very high, and performance is not maximum. On the contrary, a lean mixture can cause pre-detonation (self-ignition) which, when repeated for a few seconds, will alter the pressure and temperature of the chamber causing irreversible damage to the engine.

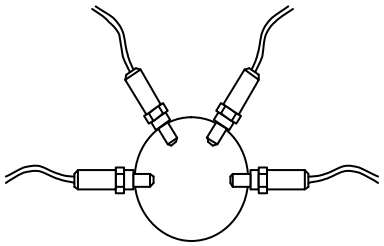
The AIR FUEL RATIO INDICATOR of SPILBA was designed to measure the air-fuel ratio present in the exhaust gas outlet of a four-stroke engine. Its fine design, ultra-compact size and high-brightness LEDs are ideal for referencing what range the mix is in.

It is compatible with 1, 2, 3 and up to 4-wire probes. Below is a reference table with the typical color codes and differences between them.

Lambda probes	**Description of the cables**
	- Black – Signal
	- Black – Signal - Grey – GND
	- Black – Signal - White – Heater (+12 Vcc) - White – Heater (GND)
	- Black – Signal - White – Heater (+12 Vcc) - White – Heater (GND) - Grey – GND

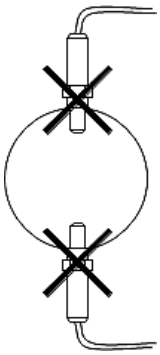
Probe installation

The lambda probe should be in the exhaust system of each vehicle with the end protruding above the gas flow. The probe should be at an angle of between 10 and 90 degrees from the vertical, with the tip pointing downward. This ensures that water condensation does not accumulate between the metal casing and the ceramic. It should not be placed vertically due to excess heat in this position.



Correct probe locations

Incorrect probe locations

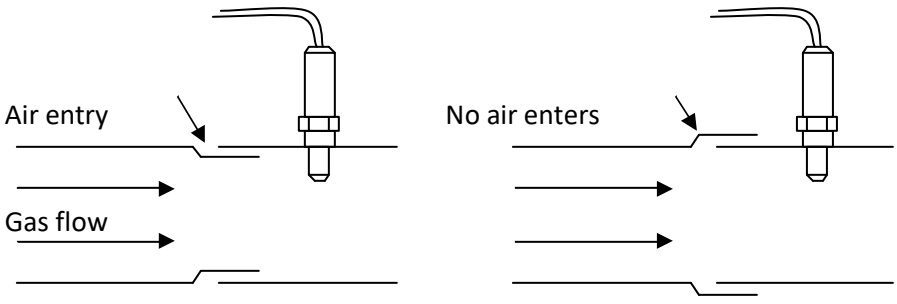


It is recommended that, if possible, the probe be placed in the exhaust pipe at least 1 m from the exhaust valves, to avoid excessive temperature, and 1 m from the end of the exhaust pipe, to avoid contamination with atmospheric oxygen. This is not mandatory and if necessary, can be located closer to the engine on short exhaust systems.

The location of the probe should ensure that it is away from any cylinder head deflagration and in areas where gases from a single cylinder are **dominant**.

Slip joints on exhausts should be avoided near the sensor as some designs allow air to enter. In these cases, the joints can be reversed to make them compatible with the use of the sensor.

Design of sliding joints to avoid incorrect readings:



Installation

The SPILBA AFR gauge was designed to be very easy to install. The enclosure has two M3 threaded holes on the back for fixing to the vehicle. On the other hand, it simply has 3 cables.

AIR FUEL RATIO INDICATOR	Connection
RED	+12 VCC
GREEN	GND
BLUE	Black cable probe (to ECU)

Recommendations for correct reading

Remember that the operating temperature of the lambda probe is between 360ºC and 900ºC, and keep in mind that for a correct reading it is necessary to reach that temperature. In the case of 1 or 2-wire probes, it is necessary to wait until the engine heats it up using the exhaust gases. If a 3 or 4 wire probe is used, the heating process will be accelerated with the help of the heating resistance. Once the temperature is reached, you are ready to measure!

V/λ ratio table

The following table shows an approximate relationship between the light indicators, their voltage level, and their lambda equivalent.

	SPILBA [mV]	LAMBDA [λ]
RICH	> 900 mV	0,78
	900	
	860	0,88
	820	0,93
	770	0,95
	720	0,97
STOICH.	680	0,99
	630	1,00
	580	1,01
	530	
	490	1,02
	450	
	400	1,05
	360	
	310	
	270	1,10
LEAN	230	
	170	
	120	1,12
	70mV	

Important observations

In vehicles with electronic injection, the connection of the Probe with the injection center must NOT be interrupted. Only the probe cable that goes to the ECU must be spliced to the cable indicated on the NARROWBAND SPILBA.

If the LED remains motionless on the gauge after warming up the probe, when the vehicle is idling or even when accelerating, there is likely a poor connection or the probe is faulty and needs to be replaced. It is recommended to use a 1 A fuse when installing the Narrowband power supply.

Probe life

The useful life of the sensor depends on the type of fuel used and the gas flow over the sensor. The probe can become contaminated by sealants used in the exhaust pipe. Sealants suitable for this type of application must be used.

Leaded fuels substantially reduce the useful life due to contamination of the sensing element. Typically, in high performance engines the sensor should operate for about 500 hours on unleaded fuel and 50 hours on leaded fuel. Service life is considerably longer in less demanding applications.

At the end of its useful life the sensor begins to respond more slowly and does not correctly indicate rich mixtures. For street vehicles, the Bosch LSU probes are designed to be accurate up to 50,000 km, so the above figures for competition teams are a very conservative estimate.

Sensor life is reduced by contaminants such as lead, oils, silicon, etc. Thermal cycling also produces premature aging, as does exposure to exhaust fumes if the heating control is not operating.

Specifications

Supply voltage	
Input voltage range	9 - 20 V
Input current	4 mA typical (+heating current from sensor heater)
Protection	Against reverse polarity

Probes	
Compatible types	1, 2, 3 o 4 cables
Maximum exhaust temperature	850 ºC
Normal temperatura range	150 – 800 ºC

Leds	
Poor	4
Ideal	10
Rich	6

Measurements	
Lambda	0.5 - 1.2
Relationship A/F	7.5 – 17.64

Appendix

Lambda	Air fuel ratio			
	Naphta	Alcohol	LPG	Diesel
0.70	10.3	4.5	10.9	10.2
0.75	11.0	4.8	11.6	10.9
0.80	11.8	5.1	12.4	11.6
0.85	12.5	5.4	13.2	12.3
0.90	13.2	5.8	14.0	13.1
0.95	14.0	6.1	14.7	13.8
1.00	14.7	6.4	15.5	14.5
1.05	15.4	6.7	16.3	15.2
1.10	16.2	7.0	17.1	16.0
1.15	16.9	7.4	17.8	16.7
1.20	17.6	7.7	18.6	17.4
1.25	18.4	8.0	19.4	18.1
1.30	19.1	8.3	20.2	18.9
1.35	19.8	8.6	20.9	19.6
1.40	20.6	9.0	21.7	20.3
1.45	21.3	9.3	22.5	21.0
1.50	22.1	9.6	23.3	21.8
1.55	22.8	9.9	24.0	22.5
1.60	23.5	10.2	24.8	23.2