# AFS-1 AIR FUEL RATIO METER / SENSOR


**The Air-fuel Ratio**

The AFS-1 air fuel ratio meter has been developed to measure the air fuel ratio of petrol engines. It is very important to measure the air-fuel ratio when seeking maximum engine performance or alternatively, good fuel economy.
The function of the AFS-1 is based on the measurement of the amount of oxygen present in the exhaust gas, and is dependent on the air-fuel ratio.
The difference in the oxygen content between the exhaust gas and the open-air causes a variance in voltage at the Lambda sensor (oxygen sensor). This voltage difference, which reflects the air-fuel ratio, is sent to the meter where it is λ-value (Lambda).
The λ-value reflects the amount of air, in kilograms (kg), per 1 kg fuel compared to the ideal (stoichiometric) ratio, which is 14.7 parts air per 1 parts fuel. The λ-value 1.00, means that there is 14.7 kg air per 1 kg fuel in the air-fuel mixture. A rich air-fuel ratio means that there is less than 14.7 kg air per 1 kg fuel and the λ-value is smaller than 1.00. A lean air-fuel ratio means that there is more than 14.7 kg air per 1 kg fuel and the λ-value is greater than 1.00.

For example:

$$\text{Lambda } (\lambda) = \frac{13.2 \text{ kg air}}{14.7 \text{ kg air (ideal)}} = 0.9 \text{ (rich)}$$

**Installation Of Meter**

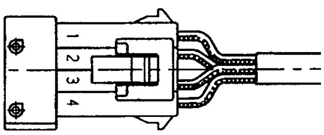
The meter can be fastened using Velcro tapes, which are included in this kit. This method of installation will allow the meter to quickly and easily be removed and reinstalled if required.
Clean the mounting surface carefully before installation (remove all traces of grease and dirt).

**Instructions for wiring**

1. Connect red (+) to the positive power supply, which must be protected with a fuse. (A 7.5 Amp fuse, fuse holder, 2 x male lucar connectors and 2 x insulation covers (for the lucars) are supplied in this kit).
2. Connect black (-) to earth (ground), directly to the negative battery terminal (if possible).

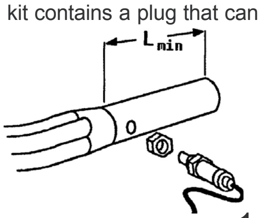
**Connector pinout**

| | | | |
|---|---|---|---|
| Pin 1: | Heater | (+) | White |
| Pin 2: | Heater ground | (-) | White |
| Pin 3: | Signal ground | (-) | Grey |
| Pin 4: | Sensor signal | (+) | Black |




**Installation Of The Sensor**

1. Ensure that the engine and exhaust is cold.
2. Drill a 16mm hole into the exhaust pipe as close as possible to the engine (*See diagram below: Lmin = 0.5m (20") or longer*)
3. Place the sensor boss over the hole and check that the hole is big enough for the sensor. Weld all around the boss. Check that there is no leak in the seam or the exhaust pipe.
4. Install the sensor into the sensor boss. The kit contains a plug that can be used when the sensor is removed.
5. Tighten the sensor to a torque of 50Nm.




**Notes**

- The signal wire connectors must always be protected against short circuits to earth (ground).
- Do not locate the signal wires near the ignition leads as interference may cause inaccurate meter readings.
- Leaded fuel can be used, but will slow the sensor reaction rate and will ultimately lead to sensor failure.
- The sensor can be used for the tuning of two-stroke engines, but may become sooty when used for long periods of time.
- The exhaust gas must reach a temperature of 200°C before the sensor starts to operate. Usually it takes 1 to 3 minutes to reach that temperature.

**Instructions For Use**

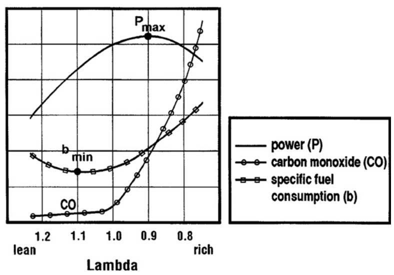
When the power is applied, about half of the LED's on the bar should be lit. When the exhaust gas reaches a temperature of 300°C, the LED-bar starts to operate (if the air-fuel ratio is lean, fewer LED's are lit, or if it is rich, the number of lit LED's increases). After the sensor has reached normal operating temperature (600°C), the LED-bar on the meter shows the correct air-fuel ratio (Lambda-value).
Warm up the engine to it's normal operating temperature, before starting to measure. Load the engine, so that the sensor becomes sufficiently warm (for example, carry out a few full throttle accelerations).
On deceleration, all the LED's may switch off. This simply means that the air- fuel ratio becomes extremely lean during deceleration. When the accelerator is depressed quickly, the LED-bar may indicate a richer mixture for a short time. This means that the air-fuel ratio moves to the rich-side for a while as the acceleration enrichment circuit provides extra fuel.
This diagram will help you choose the air-fuel ratio that best fits your application. The curves illustrate the effect of the variation of the air-fuel ratio of power output, fuel consumption and carbon monoxide emissions.

**Power**

Green LED's #8-12 indicate the best ratio when seeking power. Usually maximum horsepower is achieved when the second or third green LED is lit. Turbocharged and racing engines may need a richer air-fuel mixture in order to prevent excessive cylinder temperature, which may damage the engine.
Red LED's #13-14 indicate a very rich mixture, which means poor fuel economy and loss of power.

**Fuel Economy**

Red LED's #1-3 indicate a lean air-fuel mixture. LED's #6-7 indicate the best




**Emissions**

When the 5th LED is lit, the Lambda-value is 1.00 and then the air-fuel ratio is stoichiometric. The yellow LED's are close to the Lambda-value 1.00, which is the best ratio if seeking low emissions.

| LED # | Description |
|---|---|
| 1 - 3 | Lean |
| 4 - 7 | Normal (Stoichiometric) |
| 8 - 12 | Rich (Best Power) |
| 13 - 14 | Too Rich |

**AFS-1 Specifications**

| ***Meter*** | | ***Sensor*** | |
|---|---|---|---|
| *Supply voltage* | *8.5 – 18 V* | *Thread* | *M18 x 1.5* |
| *Current consumption* | *150mA max* | *Tightening torque* | *50Nm* |
| *λ-value (Lambda)* | *0.75 – 1.20* | *Operating temperature* | *200°C – 930°C (continuous)* |
| *Dimensions* | *70 x 40 x 15mm* | *Maximum temperature* | *1000°C (in 10 minute intervals)* |
| *Weight* | *100g* | *Heating voltage* | *12 - 15V* |
| | | *Current consumption* | *6A max (cold sensor)* |
| | | | *1.5A (typical)* |

| Part No. | Description | Qty. |
|---|---|---|
| 9990296500 | Fuse Assembly (7.5 Amp) | 1 |
| 9990200700 | Lambda Sensor Mounting Boss | 1 |
| 9990200800 | Mounting Boss Blanking Plug | 1 |
| WLS181 | Lambda Sensor | 1 |
| 9990296700 | Lambda Display (Small) | 1 |
| FL0392-AFS-1-7p5.pdf | Fitting Instructions | 1 |
| 9990249600 | Alpha Sticker | 1 |

| Readings Table | |
|---|---|
| Date | |
| Engine | |
| Carburettor | |
| Ignition Advance | |
| Air Temperature | |
| Air Cleaner | |
| Emulsion Tube | |
| Accelerator Pump Jet | |

| RPM | Main Fuel Jet | Air Corrector Jet | LED # |
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