

Moto-Tech *Diagnostics*

An Introduction to Gas Analysis:

The tightening up of exhaust emissions regulations has now accelerated the introduction of fuel injection and engine management systems for the motorcycle industry. The fact that virtually all new bikes are now fitted with fuel injection means that gas analysers are now essential tools for motorcycle workshops. However, a gas analyser can also be extremely useful as a faultfinding tool, even with older bikes with carburettors.

While not all manufacturers specify Carbon Monoxide (CO) outputs yet, gas testing will prove indispensable when tuning any motorcycle and is essential with any fuel injected machine. If you are involved in competition or performance tuning work, a gas analyser will eliminate guesswork from carburettor jetting and engine set-up. For normal day to day service work a gas analyser is equally indispensable for pinpointing mixture problems, whether caused by fuel system problems, altered exhaust systems, air filters etc.

Gas analysers come in two distinct types - Catalytic and Infra-Red.

Catalytic machines only measure Carbon monoxide and are known as **CO meters**. They are a low cost tool with a replaceable sensing element. Accuracy is **generally** no better than 5% **of the reading**, and is very much affected by heat - of both the workshop and even more so, the exhaust gas itself. We do not often recommend catalytic meters now as current injection systems are becoming so efficient that higher accuracy is required.

Infra-Red analysers are far more advanced and accurate - 2 or more gases can be measured simultaneously - Carbon Monoxide (CO), Hydrocarbons (HC), and Carbon Dioxide (CO₂). Oxygen (O₂). Accuracy is very good (typically 0.3%) but cost is higher.

Both types have pumps that draw exhaust gas along a sample hose to the machine. The gas is passed through a trap to remove water content and through filters to remove soot and condensation before reaching the sensor. Catalytic CO meters have a 'hot wire' sensor - a metal filament which changes resistance in reaction to the presence of Carbon Monoxide. Infra-Red analysers have a complex assembly called an 'Optical Bench' where modulated Infra-Red light is passed through the gas and the relevant wavelengths of light are absorbed by specific gases. This absorption is measured and the presence of each gas is calculated and displayed.

Lambda Sensors or rather, Oxygen sensors, have been mooted by some as a means of gas analysis. They can only sense oxygen, and can **imply** CO content only under **very** specific conditions. They **cannot** be considered as an alternative to a gas analyser - this is why your car is emissions tested with an infra-red analyser, despite having at least one oxygen sensor fitted to it.

In summary, a Catalytic CO meter will suffice when adjusting older, less efficient carburetted engines, and will give an indication of lean or rich mixture. An Infra-Red analyser should be used with modern efficient fuel injected engines and where more accuracy and information is required. It should be borne in mind that Infra-Red analysers will soon become the only way to measure exhaust gases as catalytic converter exhausts become standard on all bikes. Unless short term cost is the only consideration, or you only work with older bikes, infra-red is the only way to go.

In order to cater for the varying requirements of all our customers we offer 3 different gas analysers from a single gas CO Meter to 4-Gas Infra-Red analysers covering all possible eventualities, both now and in the future.

Diagnosing problems

The adjacent graph shows the relationship between the combustion gases. The ideal ratio is shown in the green band. Note how some gases rise while others fall either side of the ideal band. Fluctuations of each gas level can indicate different problems - see how any one gas on its own does not give the whole story.

Low CO (Carbon Monoxide)	Good
High CO (Carbon Monoxide)	Bad
Low CO ₂ (Carbon Dioxide)	Bad
High CO ₂ (Carbon Dioxide)	Good
Low HC (Hydrocarbons)	Good
High HC (Hydrocarbons)	Bad
Low O ₂ (Oxygen)	Good
High O ₂ (Oxygen)	Bad

