GR 1

GAS LASER REFRACTOMETER

Interference refractometer
for the **precision measurement**
of the **refractive index**
of **air** and **gases**

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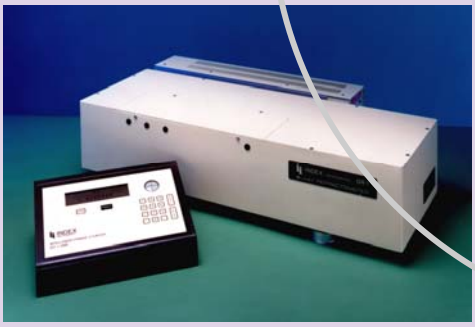
The GR1 Laser Gas Refractometer is a high accuracy optical interferometer which is extremely sensitive to very small changes in the refractive index of gases. Subject to stable conditions, changes in RI of a gas of the order of 10^{-8} or even 10^{-9} can also be detected. As well as making these difference measurements, the GR1 can also measure the absolute refractive index of a gas. Published information (ref. 1) has shown that the GR1 can achieve an absolute accuracy of better than 6×10^{-8}.

Operating Method

This very high accuracy interferometer counts the number of fringes that are created by the change in optical path length through the sample cell as the refractive index of the gas within it changes.

The GR1 has its own special counting unit (ICF 1/1000) to carry out this exacting task. The unit displays and outputs the results in terms of fringe count, refractive index (RI) or, if the appropriate scaling factors are entered, gas concentration.

At the heart of the GR1 lies a special type of self-compensating Jamin interferometer (ref 2). This ensures that besides being an extremely sensitive instrument, it is also ultra-stable. The GR1 incorporates a patented operating system, developed by the UK National Physical Laboratory (NPL) and manufactured by Index Instruments under licence from the British Technology Group (BTG). The entire system is engineered into a high quality, robust, main frame, designed to withstand the rigours of an industrial environment. It is therefore equally at home in both a research and manufacturing quality control situation.



Applications

The GR1 Laser Gas Refractometer has a number of important applications: Firstly, it has a major role in the calibration (and recalibration after routine maintenance) of vaporisers used in the administration of anaesthetic gases during human and veterinary surgery. Many hospitals throughout the world could not perform any surgical procedures were it not for their vaporisers, which are calibrated using the GR1. As such, the GR1 can truly be said to be at the forefront of patient care.

Index Instruments were the first commercial company to produce a refractometer of this level of precision and hold the original manufacturing licence granted by BTG. Working in close co-operation with the NPL, Index Instruments took the original concept and turned it into reality as the world's highest accuracy commercial refractometer.

The overall accuracy of anaesthetic gas measurement depends on many factors. These include the accuracy to which the refractive index of the active agent is known and the overall stability of the system. Experience has shown that $^{1}/_{10th}$ of a fringe, which is easy to measure on the GR1, corresponds to an anaesthetic gas concentration of approximately 0.01% The ultimate sensitivity of the GR1 is $^{1}/_{1000th}$ of a fringe (approximately 0.0001%).

Other applications for the GR1 are any situation where it is necessary to measure the absolute refractive index of air and other gases throughout industry and research (ref 3,4,5).

A full specification for the complete instrument is given on the back page of this leaflet.

Gas Tube

The standard gas sample tube normally supplied with the GR1 is a trilateral stainless steel type and is an original Index Instruments' design. The windows are flat and parallel to interferometric standards. All the tube connections are resistant to anaesthetic agents. The tube length is 316.4mm and the volume is approximately 16ml. The reference tube has a volume of approximately 33ml. Other types of sample tube can be supplied to special order, contact us with details of your precise requirements.

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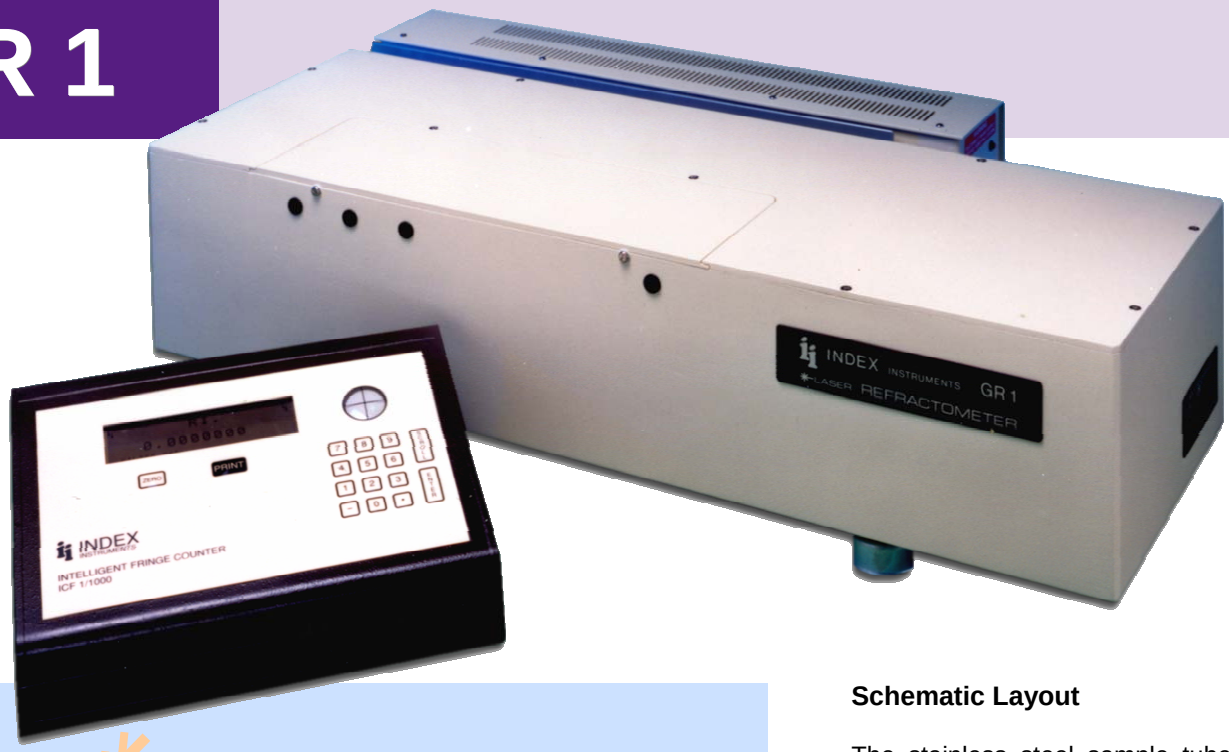
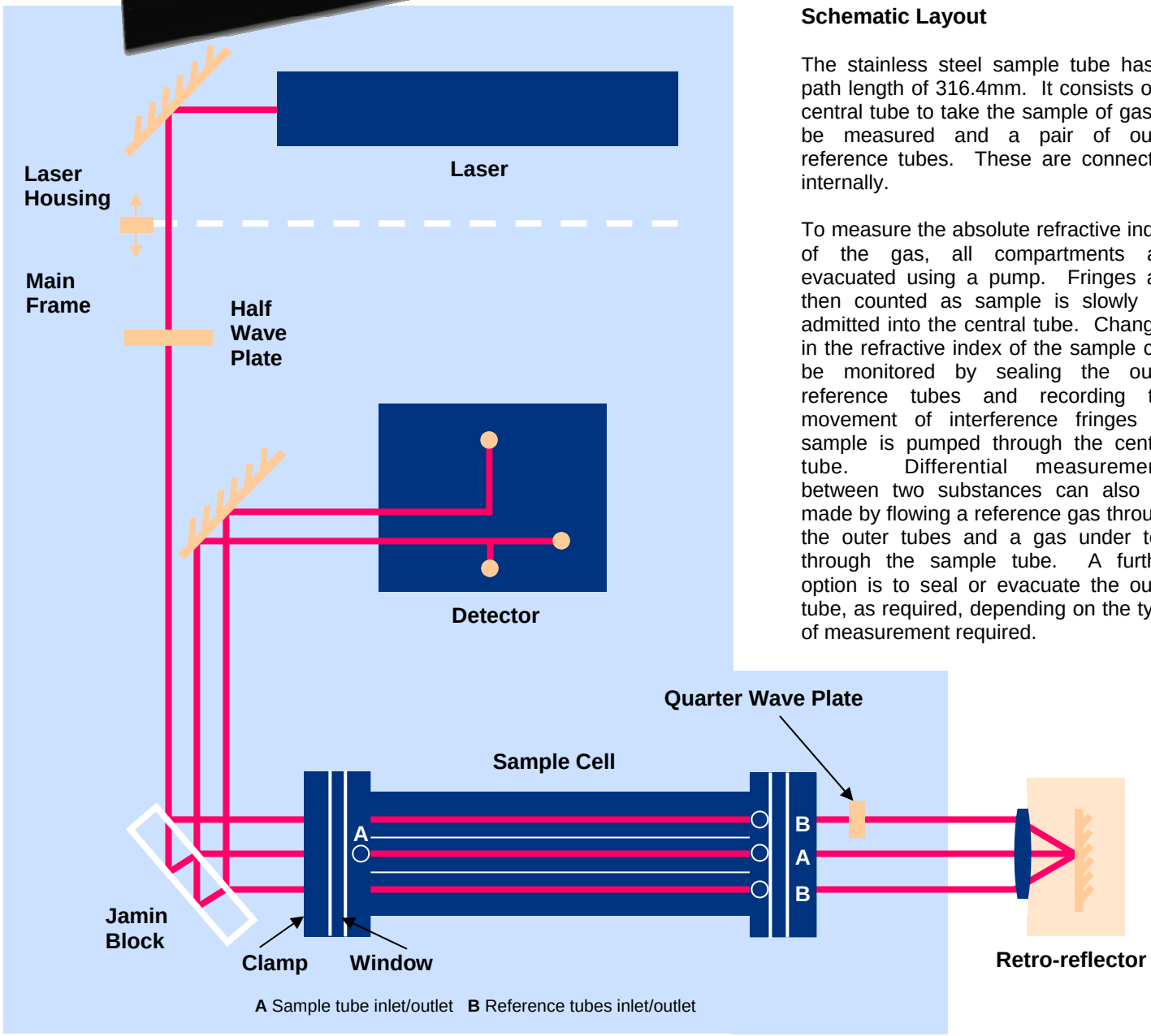
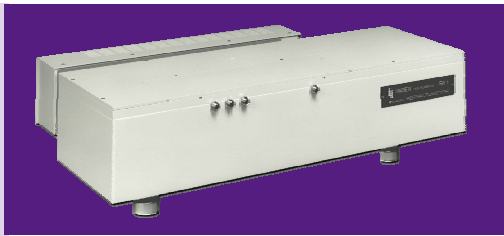




Schematic Layout

The stainless steel sample tube has a path length of 316.4mm. It consists of a central tube to take the sample of gas to be measured and a pair of outer reference tubes. These are connected internally.

To measure the absolute refractive index of the gas, all compartments are evacuated using a pump. Fringes are then counted as sample is slowly re-admitted into the central tube. Changes in the refractive index of the sample can be monitored by sealing the outer reference tubes and recording the movement of interference fringes as sample is pumped through the central tube. Differential measurements between two substances can also be made by flowing a reference gas through the outer tubes and a gas under test through the sample tube. A further option is to seal or evacuate the outer tube, as required, depending on the type of measurement required.



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References

1. Commission to European Communities Report, BCR Information, Applied Metrology EUR 14103 EN 1992 (ISSN 10185593). Evaluation of the effect of variations in the refractive index of air upon uncertainties of industrial length measurement. K P Birch, R E Ward, G Wilkening & R Reinboth

2. Precision Engineering, Vol 5, 1983, pages 105 - 110. Bi-directional fringe counting interference refractometer. M J Downs & K P Birch.

3. NPL Report MOM90 1988. The precise determination of the refractive index of air. K P Birch & M J Downs.

4. J Phys. E,Vol 211988, pages 694 - 695. The results of a comparison between calculated and measured values of the refractive index of air. K P Birch & M J Downs.

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A new angle on refractometry

Specification

GR1 Laser Gas Refractometer with ICF 1/1000 Intelligent Fringe Counter

Resolution:	1, 0.1, 0.01, 0.001 fringes, equivalent to refractive index 1×10^{-6}, 1×10^{-7}, 1×10^{-8}, 1×10^{-9}. Switchable noise reduction filter on displayed result that shows average reading if result is unstable
Range:	±2.09715175 Refractive Index equivalent to ±2097151 fringes
Display:	Liquid Crystal Display showing the following: Fringe count, differential refractive index, at least 50 gas concentration scales The display also indicates if any fringes have been missed (error detection), available menus and other advise and information as required
Keyboard:	16 keys: 0 - 9, minus, Dot, Scroll, Print, Enter, Zero
Outputs:	Two RS 232 full duplex serial ports: Port 1 - printer Port - 2 PC
Connection:	A user entered serial no. can be output along with the result
Housings:	Optical unit: precision aluminium casting Counter: desktop console with membrane keypad
Size:	Optical unit: W 775 mm x D 385 mm x H 165 mm Counter: W 290 mm x D 200 mm x H 130 mm (rear) 60mm (front)
Voltage:	110 or 230 V AC, 50 or 60 Hz
*** Note:**	In addition to storing up to 50 gas concentration scales, each scale may be given an identifier of up to 10 characters. Without the correct security code, the programmed confidential concentration factors cannot be altered. Resolution of the gas concentration scale can be user set after entering the calibration factor. A separate security code is required before the resolution can be altered.

Specification subject to improvement without notice

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