

Improvement through Innovation

■ Filter versus Full Spectrometer

In a typical IR absorption spectroscopy setup, the output from an infrared source is collimated, the resulting IR beam is directed through the sample, and the IR intensity of the beam after passing is measured as a function of the wavelength.

There are two fundamentally different methods to obtain the relevant information:

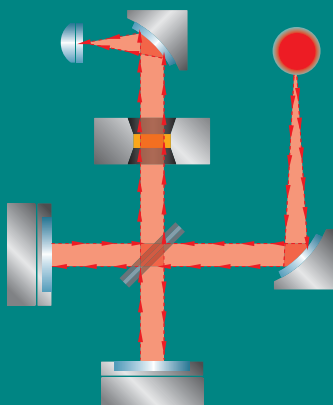
■ **1) Filter Instruments:** Absorption filters that transmit IR radiation only at one specific wavelength are placed in the IR beam. For each wavelength at which the absorption has to be determined, one filter is necessary. No information at any other wavelength and no information of the line shape are obtained.

■ **2) Full-range Spectrometers:** The IR radiation is dispersed in its wavelengths, either by a grating or with an interferometer. The entire spectrum over a certain wavelength range is measured. The full information in this wavelength range, including information on line shapes, is obtained. In complex mixtures such as fuels, there are certain overlapping lines from different molecules because the substances are chemically quite similar (the different ethers MTBE, ETBE, and TAME are examples of substances found in gasolines that do have overlapping lines even in the Mid-IR spectrum). However, a molecule usually has more than one absorption line. If the entire spectrum is recorded, all other lines can be used as well. From filter instruments, this additional information is not available.

Furthermore, the line shapes can be used to discriminate between molecules that have similar spectra. This information is missing, if the filter technique is used.

Since at least one filter has to be used for each analyte, the number of analytes is limited by the number of absorption filters. For a full-range spectrometer, this limitation does not exist.

If new analytes have to be added, a new absorption filter is needed for filter instruments. This is hard to do. For full-range spectrometers, any new analyte that has absorption lines in the wavelength range covered by the spectrometer can be added



any time by a simple software upgrade.

A full-range spectrometer is the preferred instrument for complex mixtures, such as gasoline, and diesel fuel, because of its superior discriminating power, the detailed information it provides, and its flexibility.

■ FTIR spectroscopy

FTIR spectrometers use an interferometer to determine the full IR spectrum in a certain wavelength range. These instruments do not record the spectrum directly, but the spectrum can be calculated from the recorded detector signal by a mathematical operation called Fourier transformation (FTIR is the abbreviation for Fourier Transform Infra-Red).

FTIR spectrometers provide distinct advantages. They are smaller and faster than more conventional grating spectrometers of similar performance. They can be designed to be very rugged and thus can be applied in the field.

■ IROX 2000 and IROX DIESEL

IROX 2000 and IROX DIESEL are full-range, Mid-IR FTIR spectrometers and therefore combine all the above discussed advantages. This technique makes IROX the superior fuel analyser series for fast and highly accurate quality test in the laboratory as well as directly in the field.

PORTABLE FTIR FUEL ANALYSIS



**GRABNER
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IROX 2000 IROX DIESEL

AMETEK®



IROX 2000

Portable Gasoline Analysis with MID-FTIR

IROX 2000 is an extremely compact, robust and easy to use MID-FTIR spectrometer for the fully automatic measurement of the concentrations of the most important components in gasoline. Thanks to a sophisticated mathematical model and the use of a built-in density meter the instrument additionally provides highly accurate results for the determination of key gasoline properties such as Octane Numbers, Distillation Properties and Vapor Pressure. A large number of country specific calibration samples is stored in the memory of IROX 2000. Outlier fuels are automatically detected and can be easily added to the memory in less than 4 minutes even without the use of a PC. Due to the small, rugged housing, the true portability and the optional battery operation, the IROX 2000 also is the ideal solution for fast quality checks directly in the field.



Features

- 9 Specific Oxygenates (ASTM D5845)
- 14 Specific Aromatics and Benzene (ASTM D6277, EN238)
- Total Aromatics, Oxygen, Olefins (incl. Di-Olefins) & Saturates
 - Octane (RON, MON)
 - MMT, Nitromethane and DCPD determination
 - Distillation Points
 - Vapor Pressure
 - Automatic Sample Introduction
 - Optional 6-position sampler
 - Calculation of AKI and Drivability Index
 - Built-In Density Meter
 - Small sample volume: 7ml
 - Fast & easy on-site calibration without PC
 - Laboratory and Field Applications
 - MINIWIN IROX-PC software

ONLY 3 MINUTES FOR A COMPLETE GASOLINE ANALYSIS PROPERTIES

RON	70-105 / 0.5 @ 93	Distillation	IBP, T10, T50, T90, FBP
MON	70-95 / 0.5 @ 83	RVP	35 - 95 kPa
AKI	80-100 / 0.5 @ 90	Density	0.500 - 1,999 g/cm ³ [integrated density meter]
Driveability Index	950 - 1380	2 freely programmable parameters	

COMPONENTS

Oxygenates	Range / Accuracy in weight %	Aromatics	Range / Accuracy in weight %
MTBE	0 - 20 / 0.5 @ 10%	Benzene	0 - 5 / 0.2 @ 1% / 5 - 10 / 0.4 @ 5%
TAME	0 - 20 / 0.5 @ 10%	Toluene	0 - 20 / 0.8 @ 5%
ETBE	0 - 20 / 0.5 @ 10%	o-Xylene	0 - 20 / 0.8 @ 5%
DIPE	0 - 20 / 0.5 @ 10%	p-Xylene	0 - 20 / 0.8 @ 5%
Methanol	0 - 15 / 0.5 @ 10%	m-Xylene	0 - 20 / 0.8 @ 5%
Ethanol	0 - 25 / 0.5 @ 10%	Ethyl benzene	0 - 20 / 0.8 @ 5%
Iso-Propanol	0 - 20 / 0.5 @ 10%	Propyl benzene	0 - 20 / 0.8 @ 5%
2-Butanol	0 - 25 / 0.5 @ 10%	2-Ethyl toluene	0 - 20 / 0.8 @ 5%
tert-Butanol	0 - 25 / 0.5 @ 10%	3-Ethyl toluene	0 - 20 / 0.8 @ 5%
		4-Ethyl toluene	0 - 20 / 0.8 @ 5%
		Mesitylene	0 - 20 / 0.8 @ 5%
Total Parameters			
Aromatics	0 - 80 / 2 @ 20%	Pseudocumene	0 - 20 / 0.8 @ 5%
Olefins	0 - 50 / 1.5 @ 10%	Isodurene	0 - 20 / 0.8 @ 5%
Oxygen	0 - 8 / 0.1 @ 2%	Naphthalene	0 - 10 / 0.8 @ 5%
Saturates	20 - 100 / 3 @ 40%	Additional components on request	

Octane Boosters: e.g. MMT, Nitromethane, DCPD, etc.

IROX 2000 IROX DIESEL

General Features

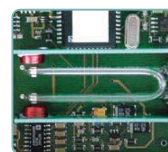
■ Mid-Infrared Spectroscopy

The heart of both instruments, IROX 2000 and IROX DIESEL, is an extremely compact, robust and user friendly mid-FTIR spectrometer. Fully automatic optical realignment during the short warm-up time ensures high stability even after long period of use or transport of the tester.

■ Complete IR - spectrum

Instead of a few discrete filter-lines, the entire MID IR absorption spectrum is measured. This provides complete information about the substances present in the fuel, eliminates variations of the baseline and minimizes interferences. The detailed analysis in combination with the patented mathematical model, based on cluster analysis and multi linear regression (patent nr: 411936), make IROX 2000 and IROX DIESEL the superior mid-IR fuel analyzers to directly measure the concentration of the fuel components, like e.g. Aromatics, Oxygenates and Olefins as well as to determine such important fuel properties like Octane- and Cetane Numbers, Distillation Points, etc.

■ Integrated Density Meter



A density meter, based on an oscillating tube is integrated into IROX. When the sample is transferred, both the density meter and the absorption cell are filled. The density and the temperature, at which it was determined, are both displayed and available to be printed. The accurate density value is essential for the accurate conversion from volume to weight percent and for a significant improvement of the determination of the fuel properties.

■ Fast & Easy Calibration

In IROX 2000 and IROX DIESEL a large number of international calibration sample sets is stored. Outlier fuels are identified and indicated by an alarm message. They can easily be added to the sample library using the installed calibration menu (no PC necessary). Adding a new sample takes less than 4 minutes, immediately improving the accuracy of future measurements.

■ Laboratory and Field Applications

GRABNER INSTRUMENTS' fully automatic IROX FTIR-spectrometers have proven effective in refineries, pipeline companies, independent test laboratories, environmental enforcement agencies and various mobile applications, to ensure quality and compliance all over the world.





IROX 2000 IROX DIESEL

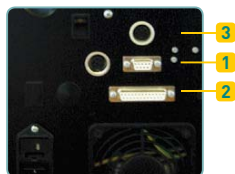
General Features

■ PC 1, Printer 2 & Keyboard 3 Interfaces

For fast programming and typing of the sample identifications a keyboard can be connected to IROX. GRABNER INSTRUMENTS offers a small laboratory keyboard with a protective cover.

For the transfer of the test results and the sample spectra, as well as for the upgrading of the calibration sample library, IROX can also be operated via the Windows Software MINIWIN-IROX.

IROX is equipped with sufficient data memory to store results of several hundred measurements. A printer can be directly connected to IROX for immediate printout of the results or of stored data from the memory.



■ Automatic Sample Introduction

IROX is equipped with a fully automated sample introduction system. The sample is automatically drawn in directly from the sample container through a flexible tube. To avoid outgassing, first it is drawn into an internal chamber and then carefully pressed into the built-in density meter and the absorption cell. After the measurement, the sample is automatically transferred into the connected disposable container. This truly automatic system also allows the use of an auto sampler with the IROX. GRABNER INSTRUMENTS offers a small 6-position auto sampler that can be attached to the instrument and is fully supported by the MINIWIN-IROX Windows software.



■ Solid Design

IROX was especially developed as a portable FTIR fuel analyser. The special design of the FTIR is extremely small, compact and rugged. The FTIR optical bench is manufactured from a solid aluminum block, resulting in highest possible stability. The entire spectrometer is mounted with anti-vibration rubber isolators, making the alignment of the instrument fully resistant against heavy vibrations and shocks e.g. during transport. This also ensures non-critical field operation, even on the hood of a car.

TECHNICAL DATA

Response Time	3 min
Warm-Up Time	10 min
Units of measurement:	Volume percent / Weight percent
Density measurement	built-in oscillating U-tube density cell
Communication	MINIWIN IROX-PC software via RS-232
Communication languages [user selectable]	English, German, Italian, French, Portugese
Display	large backlit graphics display
Power requirements	100/120/230 V AC, 50/60 Hz, 65 W
Field application	12 V / 4A DC (vehicle battery)
W x H x D	200 x 320 x 220 mm [7.8" x 12.6" x 8.7"]

For more information about IROX 2000 and IROX Diesel, please visit our website: www.grabner-instruments.com

IROX DIESEL

Portable Diesel Fuel Analysis with MID-FTIR

IROX DIESEL is a Mid-FTIR analyzer very similar to the IROX 2000. It only differs by the pathlength of the cell, the on-board software and the calibration library. Therefore, handling is as easy as with the gasoline unit. This instrument also uses a patented mathematical model, based on Cluster analysis and MLR. Key properties of diesel fuel, like the Cetane Number, Cetane Index and Distillation properties are determined with highest precision in less than 3 minutes. New calibration samples can be added to the large international sample library fast and easily directly on-site. The fully automated sample introduction avoids any sample preparation and allows the optional use of an auto sampler.

Features

- Cetane Number
- Cetane Index
- Cetane Improver
- Total Aromatics
- Poly Nuclear Aromatics (PNA)
- Biodiesel content in Diesel Fuel
- Distillation Properties: T85, T90, T95
- Built-In Density Meter
- Temperature control
- Full automation: sample introduction, measurement, cleaning
- No sample preparation: just insert filling tube in sample flask and press RUN
- Measuring time: 3 minutes
- Fast and easy on-site calibration of the correlation library in less than 4 minutes/sample
- No complex technical training required
- Small sample volume: 7ml
- Optional 6-position sampler
- Portable for field applications (optional vehicle battery connector)
- PC/printer interface
- MINIWIN IROX-PC software



ONLY 3 MINUTES FOR A COMPLETE DIESEL FUEL ANALYSIS

Cetane Number	20 - 75
Cetane Index	30 - 70
Cetane Improver	0 - 5000 ppm
Total Aromatics	0 - 60 wt. %
Poly Nuclear Aromatics	0 - 40 wt. %
Biodiesel in Diesel Fuel	0 - 40 m%
Distillation Properties	T85, T90, T95
Density (built-in density meter)	± 0.001 g/ccm3
6 freely programmable parameters to determine properties like viscosity, cold properties, etc.	

IROX 2000 IROX DIESEL

■ EXPERTISE

GRABNER INSTRUMENTS manufactures a dedicated range of laboratory and process instruments for quality control testing of petrochemical products. The compact size, ruggedness and ease of use of our equipment makes it ideal for on-site testing.

■ STANDARDISATION

In 1993 GRABNER INSTRUMENTS was the first manufacturer of petroleum testing equipment to be certified according to ISO 9001 and most of our instruments are standardised according to ASTM, ISO, GOST or EN. Several worldwide patents and awards acknowledge our innovative direction of development.

■ CUSTOMER SATISFACTION

The lean structure of GRABNER INSTRUMENTS allows us to react fast and flexibly to find individual solutions for individual customers. With well trained sales and service engineers in more than 50 countries we ensure fast and effective service and short delivery times for all our customers.



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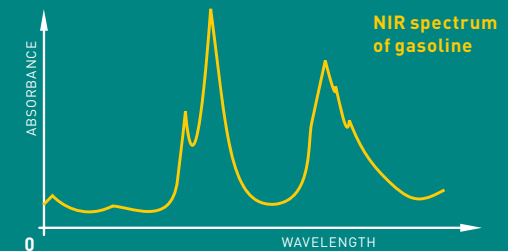
Improvement through Innovation

■ Mid-IR versus NIR

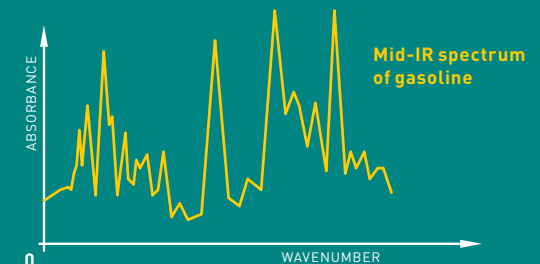
In Mid-IR spectroscopy, the fundamental molecular vibrations are excited. The resulting spectrum shows strong peaks, where peaks of different molecules are usually well separated and show only little overlap. Therefore it is possible to discriminate very efficiently between different molecules and perform very detailed and accurate analyses, even in complex, multi-component mixtures.

In NIR spectroscopy, overtones and combination vibrations are excited. The absorption peaks are usually much weaker than in Mid-IR and very broad. Therefore the spectra of different molecules show many common features, and peaks of different molecules overlap very strongly. This makes a detailed analysis in complex, multi-component mixtures very difficult or impossible.

■ Mid-IR is a wavelength range of typically 2.5 μm to 20 μm , while NIR is the range 0.75 μm to 3 μm .



IROX 2000 IROX DIESEL



Fuels are very complex mixtures with many different components that are chemically quite similar. A Mid-IR spectrum provides much more detailed and accurate information than a NIR spectrum for such samples. Mid-IR spectroscopy is therefore the preferred method for the analysis of gasoline, diesel, jet fuel and other complex mixtures.