NIRFlex N-500

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Buchi NIRFlex N–500 – the modular FT–NIR spectrometer for highest flexibility

NIRFlex N-500 with improved polarization interferometer

The Buchi NIRFlex N-500 is the result of systematic development of the proven Buchi NIR instrument line. Thanks to its individually configurable software and hardware modules, the NIRFlex N-500 satisfies the needs of the pharmaceutical industry as well as those of global leaders in the production of foods, feeds and chemicals. Selecting Buchi means choosing more than a mere hardware provider. Our NIRSolutions are integral products that have been thought out down to the last detail. All Buchi solutions combine state-of-the-art instruments with reliable software and outstanding services. They are maintained by excellently trained staff and distributors.

The crucial advantages of the Buchi NIRFlex N-500

Robust
The unique polarization FT-NIR spectrometer is more than 40 times less shock-sensitive than a classical Michelson interferometer.
NIRFlex N-500 – the industry-proven solution for laboratory, warehouse, and production.

Modular
The modular concept comprising one spectrometer unit and various measurement options allows individual configurations to satisfy all your requirements.
NIRFlex N-500 – options exchangeable within seconds.

Flexible
Five different measuring cells with more than ten different add-ons.
NIRFlex N-500 – the most flexible concept in NIR spectroscopy.

Compact
Best performance with small footprint.
NIRFlex N-500 – the optimum solution for todays laboratories.

Reliable
Thanks to its unique twin lamp module, the spectrometer doesn't stop working if one lamp fails.
NIRFlex N-500 – always fully operational.

Economical
NIR source and HeNe laser can be exchanged by users themselves.
NIRFlex N-500 – the clever solution for minimizing your operating expenses.

Secure
Internal standards continuously control the perfect condition of the spectrometer and ensure full transferability of calibration between instruments at any times. All data are securely saved in the NIRWare database.
NIRFlex N-500 – the secure solution.

Buchi's NIRSolutions
Global precalibrations, spectral libraries, Buchi's chemometric software NIRCal with the patented calibration wizard, worldwide application support centers.
NIRFlex N-500 – your gateway to the world of seamless NIRSolutions.

Robustness and modularity …for harsh environments

The Buchi NIRFlex N–500 has been designed for applications using various measuring cells. The measuring cell can be exchanged quickly to suit a particular application. Each individual measuring cell has been precisely optimized to fit your individual application.

NIRFlex Fiber-Optic Solids
The probe is mainly used for on-site raw material control within seconds, e. g. for powders, granular materials, solid substances, pastes, gels, and liquids (using a transflectance adapter). The probe handle with integrated remote control feature has two LEDs for displaying the status and the measurement result. In combination with a barcode reader, it is possible to start measurements independently of the location of computer, keyboard, and NIRFlex spectrometer.

Ideal for the food and feed as well as pharmaceutical and chemical industries
- For the determination of solid samples directly in the original container, e. g. in the warehouse
- Can be expanded to accommodate liquid samples using a transflectance adapter

NIRFlex Fiber Optic Liquids
Rugged design with integrated remote control feature, allowing measurements of even highly corrosive liquids. Applicable especially for on-site checking of liquid raw materials within seconds. The probe handle with integrated remote control feature is provided with two LEDs for displaying the status and the measurement result. In combination with a barcode reader, it is possible to start measurements independently of the location of computer, keyboard, and NIRFlex spectrometer.

Ideal for the pharmaceutical and chemical industries
- For the determination of liquid samples directly in the original container, e. g. at goods receiving
- For applications in rough industrial environments

…for laboratories

NIRFlex Solids
NIRFlex Solids is the ideal configuration for the determination of solid samples (e. g. meat, animal feeds, powders) and pasty products (yogurt, mayonnaise, jellies, creams). The measuring cell offers different measurement options: Petri dishes, autosampler for six vials, autosampler for ten tablets, and a top-mounted device for accommodating any type of container, such as sample bags. With an additional accessory, even liquids can be measured.

NIRFlex Solids with Petri dish add-on
– ideal for the food and feed industries
– can be expanded to accommodate liquid samples using transflectance devices
– for measurements using standard glass Petri dishes, the unbreakable or high performance sample cup

NIRFlex Liquids
NIRFlex Liquids is the ideal configuration for measurement especially of clear liquids in transmittance mode (e. g. solvents, soy sauce, oils). NIRFlex Liquids allows quantitative and qualitative determinations under controlled temperature conditions ranging from ambient temperature to 65 °C. The liquids cell can accommodate up to six cuvettes or small vials.

NIRFlex Solids with vial add-on
- for measurement of powder
- autosampler with six positions
- glass vials with diameters of 10 to 15 mm can be applied

NIRFlex Solids with tablet add-on
- for measurement of tablets in diffuse reflectance with a diameter of 5 to 10 mm
- autosampler with ten positions

NIRFlex Solids with XL add-on
- ideal for sample measurement in any required type of container
- powders, for example, can be analyzed directly in their sample bags
- special adapters for transflectance accessory, viscous cup and closed cup

NIRFlex Solids with flow-trough add-on
- for measurement of clear or opaque liquids
- measurement in a quartz cuvette with 0.5-mm layer thickness
- measurement of small volumes
- easy sampling in combination with a pump

...for PAT and product release

NIRFlex Solids Transmittance is optimized to perform transmission measurements of solid dosage forms, like tablets or capsules, in a very simple and convenient way.

The design of NIRFlex Solids Transmittance and its optimized detector ensure the best performance. NIRFlex Solids Transmittance uses a low energy source, which avoids any overheating of the samples, therefore enabling the analysis of temperature sensitive pharmaceutical active ingredients (API).

The extremely high dynamic photometric range of the system – one of its outstanding features – allows the generation of spectra with an optimized signal-to-noise ratio for all sample types. In addition, the sample plates are specially designed and coated to prevent stray light. All sample plates are customized for optimum measurement conditions for every kind of tablet.

The robust design of the measuring cell with its fixed detector position and the direct drive of the sample plate assure high reproducibility and extremely long lifetime. The legendary robustness of Buchi NIR spectrometers guarantees seamless calibration transfer from one system to another. As a result, method development can be easily centralized.

NIRFlex Fiber Optics SMA is optimized to perform diffuse reflection, transmission and transflectance measurements, depending on the connected accessory.
In combination with various types of third-party process probes or flow-through cells, both liquid and solid samples can be measured.
The additional accessory can be connected with single glass fiber or fiber bundle with standard SMA connectors. The NIRFlex Fiber Optics SMA and its optimized detector with autogain ensures the best performance.

The NIRFlex Fiber Optics SMA will move your quality control close to production. The continuous measurement mode enables you to control reactions online and get results in real time.

Legend

Sampling techniques

Transmission
This is the preferred method for testing liquids. NIR radiation is sent through a defined pathlength of the liquid and the transmitted light contains the spectral information. Advantage: Precisely defined conditions and high radiation yield.

Diffuse reflection
Primarily used for testing powders but can also be used for granules and other solids, gels and pastes. NIR radiation penetrates the sample and is diffracted and/or reflected. The reflected light contains the spectral information. Advantage: No sample preparation required to receive chemical and physical information (e. g. sample size).

Transflectance
With special accessories, reflection options can be used in transflectance mode as well. The NIR radiation passes through the liquid, is reflected and passes the sample a second time. Advantage: Reflection accessories can easily be used for the measurement of liquids as well.

Diffuse transmission
Primarily used for testing of tablets, capsules, powders and ointments. NIR radiation penetrates the sample and is diffracted and/or reflected. This process allows only a small amount of light to pass through the sample. The transmitted light contains the spectral information. Advantage: Spectral information from the whole cross-section of solid samples.

Sample types

Powders

Granulate

Tablets, capsules

Liquids

Gels

NIRFlex N-500 – modularity at a glance

Vial
Order no. N560-015

Special vial
Order no. 11055906

Add-on 6 vials
Order no. N510-002

Add-on 10 tablets
Order no. N510-004

Petri dish
Order no. 041583

Add-on Petri dish
Order no. N510-001

High-performance sample cup
Order no. 046259

Add-on XL with iris aperture
Order no. N510-005

Unbreakable cup
Order no. 11055058

Add-on XL
Order no. N510-003

Transflectance cover for High-performance cup or petri dishes

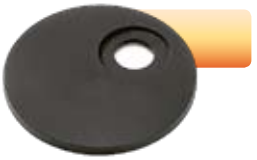
	Order no.
0.3 mm	041636

Transflectance cover for Unbreakable cup

	Order no.
0.3 mm	11055998

Transflectance cover for Hellma cuvettes

	Order no.
0.3 mm	11056376



Various sample cups (B+L, Foss, etc.)

Flow cell add-on
Order no. 11055051

Stamp for Hellma cuvette

	Order no.
5 mm	11056459

Spinner add-on
Order no. 11055087

NIRFlex Solids
Order no. N510-000

NIRFlex Fiber-Optic module

Fiber-Optic Liquids
Order no. N513-000

Fiber-Optic Solids
Order no. N512-000

Fiber-Optic SMA
Order no. N515-000

Transflectance adapter
Order no. N512-001
N512-006

NIRFlex N-500 Polarization
Interferometer
Order no. N505-003

NIRFlex Liquids
Order no. N511-000

Transmission cuvette
Order no. 046266

Vial adapter
Order no. N511-001

NIRFlex Solids Transmittance
Order no. N514-000

Sample plate 30 tablets*
Order no. N514-002

Sample plate 10 tablets*
Order no. N514-001

Sample plate with 10 iris apertures
Order no. N514-003

Sample plate 30 capsules*
Order no. N514-002

** Customized according for sample diameters*

Rugged crystal interferometer for superior performance

The Buchi polarization interferometer

Buchi has adapted the successful quartz polarization interferometer by using crystals with a very high refractive index. This leads to optimum resolution and a compact design maintaining the advantage of insensitivity to mechanical disturbances.

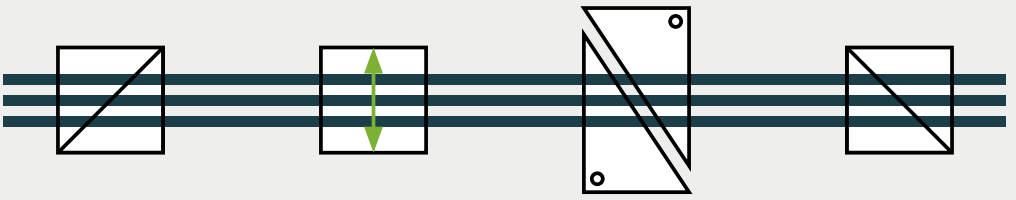
The reason for the superior performance of this interferometer even in rough environments is the fact that there is only one light beam travelling through the optical path. Thus, the risk of misalignment is eliminated. Whereas in a Michelson interferometer mechanical distortions directly affect the interference, such effects do not apear in a polarization interferometer.

Optimum resolution

Because NIR absorption bands are relatively broad for liquids as well as for solid samples, resolutions higher than 8 cm^{-1} do not improve the performance of NIR applications. On the contrary: Data collection with a higher resolution than the natural line width leads to a poorer signal-to-noise ratio within a given measurement time. Furthermore, the data sets become unnecessarily large. For optimum resolution it is therefore possible to keep the design of a polarization interferometer extremely compact without losing its intrinsic advantage of ruggedness.

Principle of the polarization interferometer

The heart of the interferometer consists of two crystal wedges. When 45° polarized light strikes an anisotropic crystal, it is split into two vectors, which traverse the crystal at different phase velocities. By moving one wedge relative to the other, the vectors undergo a systematically varied phase shift relative to each other. This changes the polarization of the combined beam. For monochromatic light this results in a sinusoidal variation of the radiation after the second polarizer, while for polychromatic light an interferogram is formed.



Buchi NIRSolutions – systems and solutions for your applications

For years, FT-NIR spectroscopy has proven to be the ideal tool for routine checks in pharmaceutical and chemical industries as well as in food and feed processing plants. Numerous applications have already been successfully implemented using Buchi NIRSolutions.

The NIRFlex N-500 is at the heart of Buchi NIRSolutions. With its associated measurement options, NIRWare Software Suite and NIRCal Chemometric Software it will match your specific needs. Our offer is rounded out by a range of comprehensive services – from feasibility studies and application support to qualification, training and continuing education, after-sales service and maintenance support in routine operations.

Method development is an important aspect to consider when planning your near-infrared project. Buchi offers a range of tools to enable you to apply NIR in routine use immediately.

Applications and solutions for the food and feed industries

- In the field of food production, Buchi offers a number of quantitative calibrations with ready-to-use applications, for instance for meat and sausage products, various dairy products, cereal grains, and more. Thanks to the high sample variance obtained from different countries and companies, the NIRFlex pre-calibrated applications are extremely robust.
- Besides the Buchi precalibrated applications for feed and feed ingredients, the INGOT® calibrations offer a very wide range of comprehensive calibrations for the feed industries incorporating thousands of spectra.

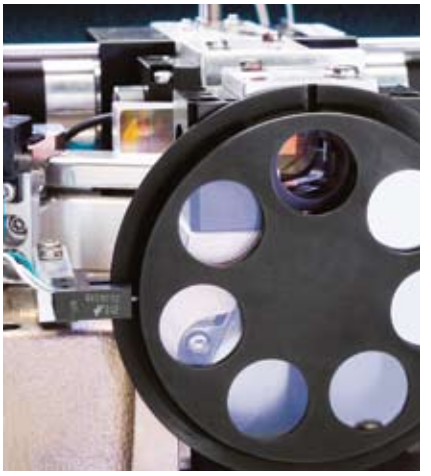
Applications and solutions for the pharmaceutical and chemical industries

- NIR has proven to be the fastest and most reliable method for raw material acceptance and quality control. For direct implementation of NIR, Buchi offers a range of spectral libraries and methods for identity verification as an essential part of our NIRSolutions concept. The scope ranges from a small library containing spectra of pharmaceutical compounds up to the Buchi Fluka spectral library containing more than 4000 spectra of predominantly organic chemicals.
- Every Buchi software package and all Buchi systems fully comply with GAMP 4 requirements and fulfill the provisions of 21 CFR Part 11. In addition to that, Buchi offers specialized support for compliance with all regulatory requirements and system qualification.

Buchi extras for safe and uninterrupted performance – and for reduced service costs

The twin lamp module
With the NIRFlex N-500, Buchi has set a new standard for NIR spectrometer availability. It is the only NIR system equipped with a twin lamp module, which will automatically switch to a second integrated lamp in the event of a failure of the primary source. This minimizes the risk of an instrument failure, and sufficient time is left to order a replacement lamp. Meanwhile you can continue your measurements without further intervention.

Reduced costs
Users can exchange the light source themselves; no maintenance costs are generated.
The instrument's design enables operation without any need for consumables or desiccants.



Checking the spectrometer against the integrated standards
Each NIRFlex N-500 is equipped with various gray filters and a wavelength standard. They enable wavelength accuracy, signal-to-noise ratio, and linearity to be checked using specially designed software modules. These measurements form the System Suitability Test (SST), which is indispensable in the pharmaceutical industry in order to meet regulations. The NIRWare Automatic Diagnose (NADIA) enables a complete, extended overview of the general condition of the NIRFlex N-500. NADIA can be recorded very easily with just one mouse click by the user.
Remote diagnostics are possible by sending the NADIA file via email to the responsible service technician – making servicing more efficient.

Performance verification
The General Information Chapter "1119" of the US Pharmacopeia (USP) and the Chapter 2.2.40 of the European Pharmacopoeia (EP) on Near-Infrared Spectroscopy contains a section on the qualification and performance verification of NIR spectrometers. Our Performance Verification Kit includes all the required standards and simplifies test routines with the aid of a specialized software module. It guides users step by step through the test and documents the results in compliance with 21 CFR Part 11.

Additional safety items
An internal reference is automatically measured in regular intervals. Thus, operation and prediction performance are permanently controlled and kept optimal.

Any opening of the NIRFlex N-500 is detected and logged. Manipulation of the instrument will cause a notification by the software and has to be acknowledged by an authorised user.

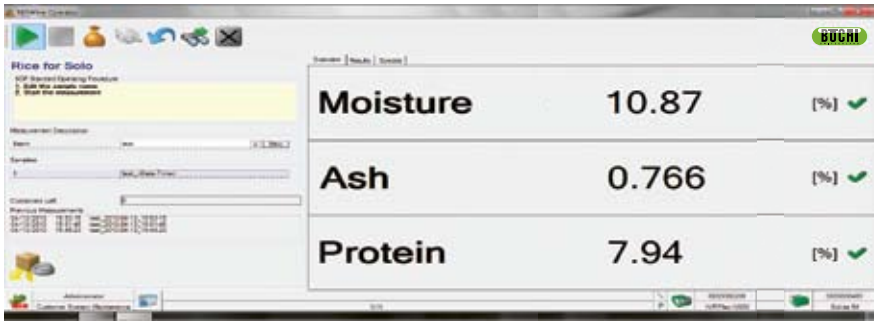
The replaceable laser unit
It only takes minutes to replace the HeNe laser module. Just loosen four screws to exchange the pre-aligned laser module.

Buchi NIR software solutions

NIRWare Software
The system uses the latest version of the NIRWare Software Suite **NIRWare**. Our customers are used to the ergonomic and intuitive use of Buchi products. This is one of the core features of the NIRWare software.

The NIRWare Software Suite comprises both an easy-to-use operator interface for routine and a bundle of powerful tools for administration and calibration build-up. Depending on the user level you can choose between wizards, advanced tools compressed to the most important functions and the full functionality of Buchis NIR software.

The **Operator** of NIRWare is your daily tool when measuring with NIRFlex N-500. Its interface has a clear and intuitive structure, which can be tailored to every user's specific requirements, including several entry fields for sample information and SOP information. One of its key features is that results can be displayed directly in report format or in big digits on the computer screen.

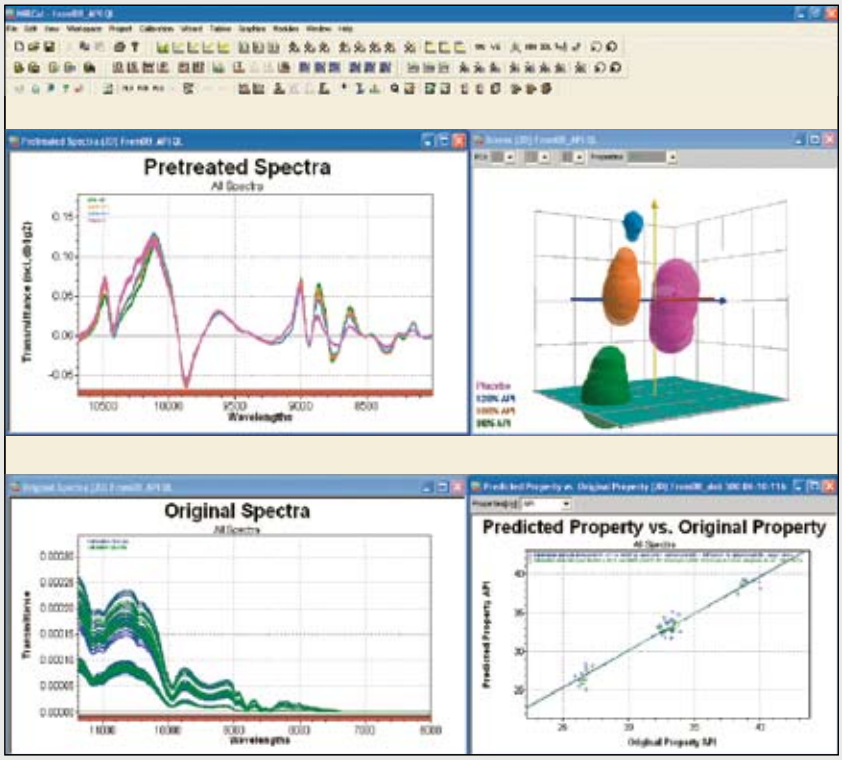


The **Application Designer** of NIRWare allows the development of all possible NIR applications with NIRFlex N-500 in an easy and convenient way – all within seconds. A wide range of settings ensures that the application can be specifically tailored to all of your needs. The database-oriented architecture of the software in combination with a life-cycle concept ensures full traceability and is fully compliant with **21 CFR Part 11.**

With the **LIMS-Interface** the user can exchange data with an existing data management system for the greatest ease of data handling in the laboratory.

The powerful **NIRAnywhere** enables administrators to roll out applications and back up the measurement data and results in multi-site installations.

NIRWare 2EX permits selection of results in customized format for further analysis, for example with Microsoft Excel.



NIRCal for chemometrics
This very powerful software tool has been improved even further. One outstanding feature is the patented Calibration Wizard for quantitative and qualitative calibrations. You will be impressed by its speed and extended wavelength selection. With NIRCal, calibrations for identity control and quantitative calibrations can be developed quickly and straightforwardly.

The **NIRCal Toolbox** is a NIRCal add-on that provides quick and easy access to all necessary calibration parameters.
The intelligent concentration of functionality and immediate visualization with interactive plots simplifies the calibration development drastically.

Technical data of NIRFlex N-500

NIRFlex N-500

Housing dimensions (W x H x D)	350 x 450 x 250 mm
Spectral range	800–2500 nm (recommended 1000–2500 nm) 12 500–4000 cm^{-1} (recommended 10 000–4000 cm^{-1}) (if not specified differently for measuring cell)
Resolution	8 cm^{-1} (with boxcar apodization)
Type of interferometer	Polarisation interferometer with TeO_2 wedges
Wavenumber accuracy	± 0.2 cm^{-1} (measured with HF gascell at an ambient temperature of 25 °C ± 5 °C)
Signal-to-noise ratio	10 000 (peak-to-peak noise of a linear corrected baseline between 5600–6000 cm^{-1}, measured with NIRFlex Liquids, 2 x 64 scans, Blackman apodisation)
Number of scans/sec.	2–4
Analog digital converter	24 bit
Ambient temperature	5–35 °C (25 ± 5 °C recommended)
Type of lamp/lifetime lamp (MTBF)	Tungsten halogen lamp/12 000 h (2 x 6000 h)
Type of laser	12 VDC HeNe, wavelength at 632.992 nm
Ethernet connection	100 Mbit/s
Electric power supply	100–230 VAC ± 10 %, 50/60 Hz, 350 W

NIRFlex Solids

	Petri dish/ Cup drawer	**Vial**	**Tablet**	**XL**	**Flow cell**
Detector		Extended range InGaAs (temperature controlled)			
Max. number of samples per sequence	1	6	10	1	1
Measurement based on diffuse reflection	x	x	x	x	–
Measurement based on transflectance	x	–	–	–	x
Measurement with petri dishes	x	–	–	–	–
Measurement with vials	–	x	–	–	–
Measurement of tablets	–	–	x	–	–
Measurement using small plastic bags	–	–	–	x	–
Environmental working conditions 5–35 °C	x	x	x	x	x
Internal reference	x	–	–	–	x
External reference	x	x	x	x	x
Illumination spot diameter	9 mm	8 mm	4 mm	9 mm	9 mm
Sample dimensions	Petri dish 100 mm	Glass vials 10–15 mm	Tablets 5–10 mm		>0.3 ml
	Cup drawer 34 mm				

NIRFlex Solids Transmittance

Detector	InGaAs (temperature controlled)
Spectral range	12500–6000 cm^{-1} (recommended range 11520–6000 cm^{-1}) 800–1660 nm (recommended range 870–1660 nm)
Photometric dynamic range	0–6 AU
Photometric linearity	The “addition of filter technique” has been used with a 2% transmission filter and a wavelength standard (rare earth oxide mixture) for the addition. Both filters were measured individually and together in series. The addition of the individual measurements has been compared with the measurement of both filters in series. The difference was < 2 x 10^{-7} T at 7876 cm^{-1}
Typical signal-to-noise ratio – open beam – 5 mm Spectralon®	Rms for spectral segments of 300 cm^{-1} in the range of 11000–6500 cm^{-1} Mean 2 x 10^{-5} AU (16 scans; Blackman apodization) Mean 10 x 10^{-5} AU (64 scans; Blackman apodization)

NIRFlex Liquids

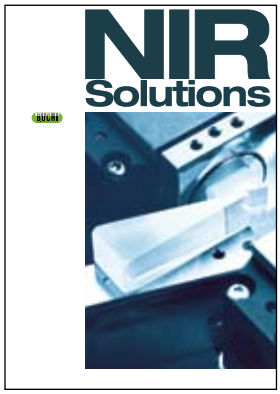
Sample temperature range	Ambient temperature plus 10 °C up to 65 °C
Reproducibility of set sample temperature	± 0.5 °C
Temperature overshoot	< 5 °C
Overheating protection, automatic switch-off	T > 90 °C
Detector	Extended range InGaAs (temperature controlled)
Diameter of measurement spot	2 mm
Type of cuvettes to be used	Cuvettes 12.5 x 12.5 x 45 mm with pathlengths of 1, 2 (standard), 5, and 10 mm using corresponding spacers
Time needed to achieve stable control of the set temperature	Ambient temperature to 65 °C: 15 min

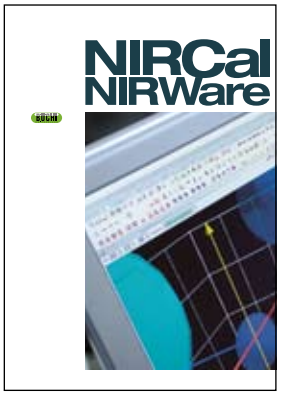
NIRFlex Fiber Optic Solids/Liquids/SMA

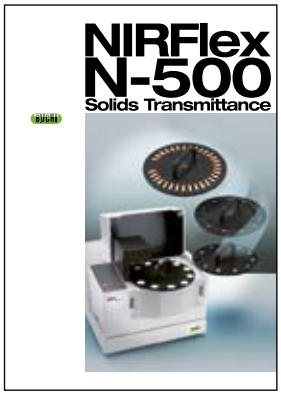
	Solids	Liquids	SMA
Temperature range at probe tip	0 °C–80 °C	0 °C–150 °C	depending on installed probe
Max. pressure at the probe tip		6 bar	depending on installed probe
Detector	Extended range InGaAs (temperature controlled)		
Standard lengths of fiber optic probes	2 m, 3 m, 5 m	2 m (available up to 7 m)	
Pathlength	0.5 mm, 1.0 mm, 1.5 mm (with transflectance adapter)	2 mm (other pathlengths available on request)	depending on installed probe
Number of optical fibers	> 560 (fiber bundle)	2 (single fiber)	2–14 (single or multi-fiber bundle)
Outer diameter of optical fibers	4 mm	600 µm	600 µm – 2 mm

Transflectance adapter

Max. operating temperature	120 °C
Material	Transflectance sleeve material: Steel no. 1.4435 Spacer ring material: Steel no.1.4305 Transflectance adapter window: Quartz glass (Infrasil 303) sealed with fluorine rubber O-rings
Available pathlengths	0.5 mm, 1.0 mm, 1.5 mm







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