

# NIRFlex N-5000



# Buchi NIRFlex N-500 – the modular FT-NIR-Spectrometer for highest flexibility



# NIRFlex N-500 with improved polarization interferometer

3



The Buchi NIRFlex N-500 is the result of systematic further development of the proven Buchi NIR instrument line. Thanks to its individually configurable software and hardware modules, its underlying concept 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 laboratories with lack of space.

### Reliable

The unique twin lamp module prevents downtime in case of lamp failures. NIRFlex N-500 – fully operational without interruption.

### 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. All data are securely saved in the NIRWare database.

NIRFlex N-500 – the validated solution for pharmaceutical industry.

### 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 entrance 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 transmittance 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 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 transmittance 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 receipt
- For applications in rough industrial environments



### 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 enables the use of 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.

### NIRFlex Liquids

NIRFlex Liquids is the ideal configuration for the 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 Petri dish add-on

- ideal for the food and feed industries
- can be expanded to accommodate liquid samples using transreflectance devices
- for measurements using standard glass Petri dishes or the high performance sample cup

#### NIRFlex Solids with vial add-on

- ideal especially for the pharmaceutical and chemical industries
- Autosampler with six positions
- glass vials with diameters of 10 to 15 mm can be applied

#### NIRFlex Solids with tablet add-on

- for measurements 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 measurements in any required type of container
- powders, for example, can be analyzed directly in their sample bags
- special adapters for transreflectance accessory, viscous cup and closed cup

## ...for PAT and product release

### **NIRFlex Solids Transmittance**

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.



# 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).



### Transflection

With special accessories, reflection options can be used in transflection 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**



**Liquids**



**Granulate**

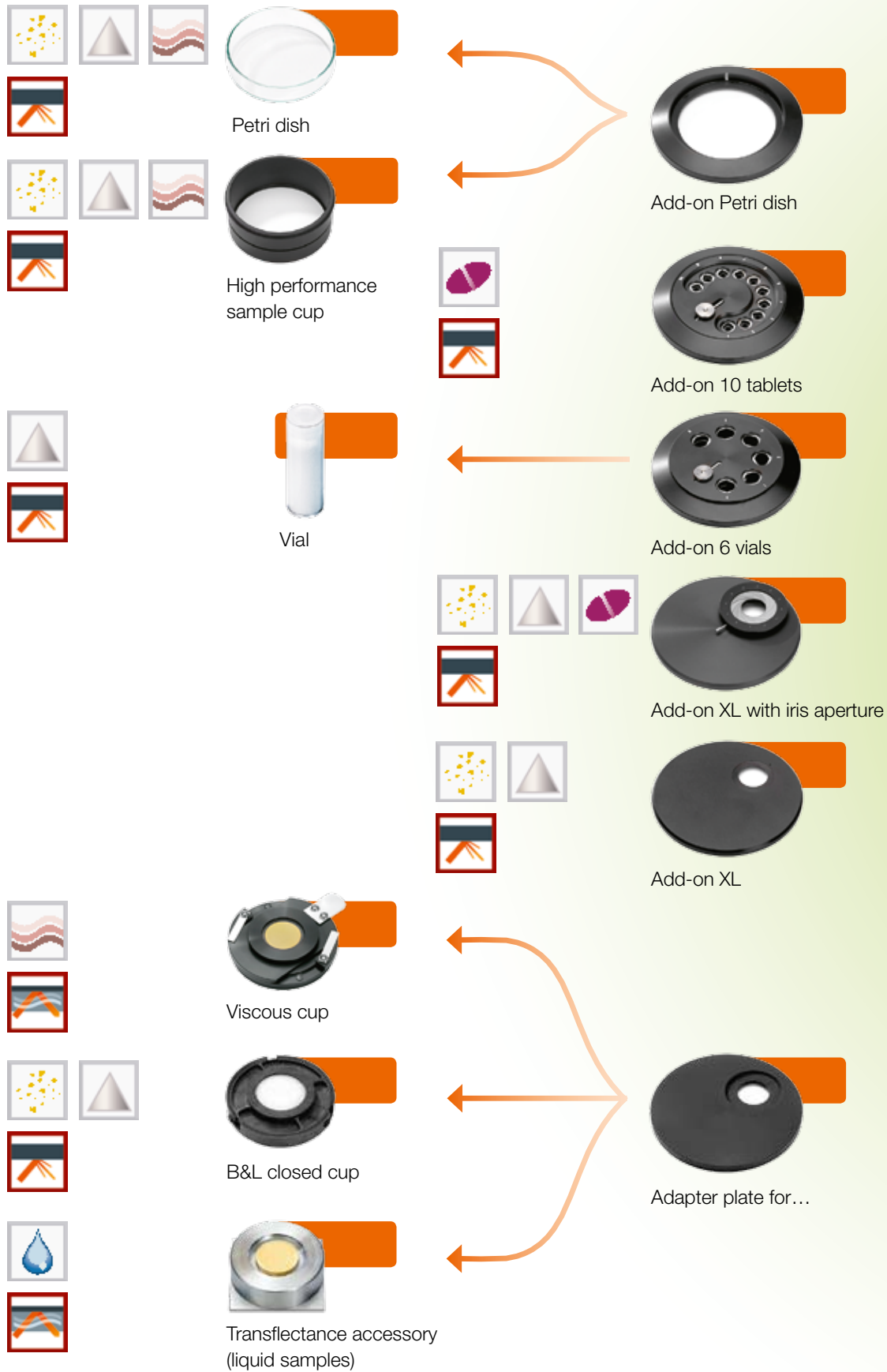


**Gels**



**Tablets, capsules**

# NIRFlex N-500 – modularity at a glance





NIRFlex Fiber Optic Module



Fiber Optic Liquids



Fiber Optic Solids



Transflectance adapter



NIRFlex N-500 Polarization Interferometer



NIRFlex Liquids



Transmission cuvette



Vial adapter



NIRFlex Solids Transmittance



Sample plate 30 tablets



Sample plate 10 tablets



Sample plate with 10 iris apertures



Sample plate 30 capsules



# 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 solved 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 completed 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 operation.

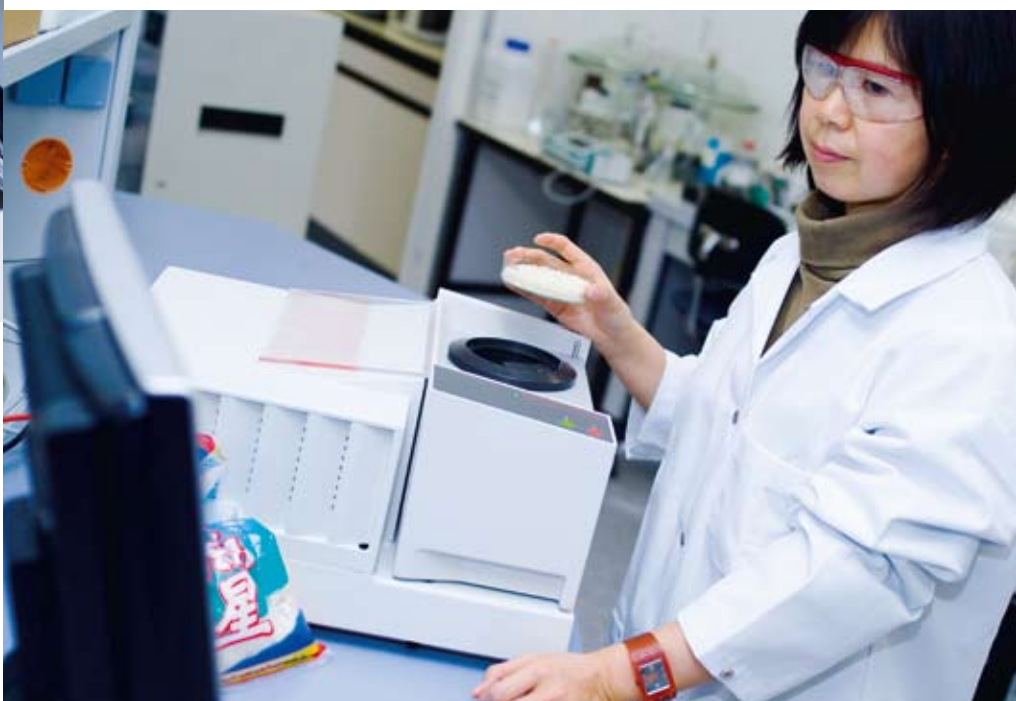
Method development is an important aspect to consider when planning your near-infrared project. Buchi offers a range of tools to enable you to apply NIR in routine use immediately.

## **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 many 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.



# 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.

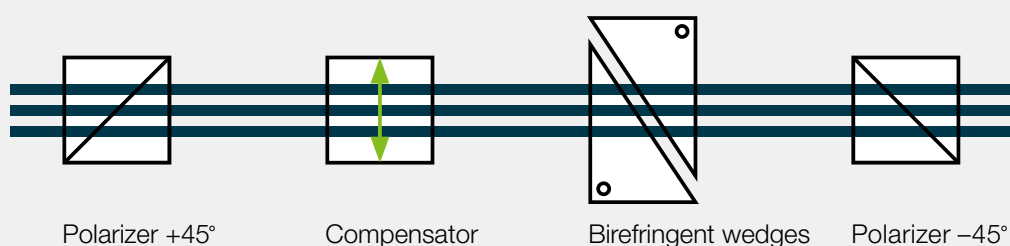
The reason for the superior performance of this interferometer even in rough environments is the fact that there is only one light beam travelling through the optical path. Thus, the risk of misalignment is eliminated. Whereas in a Michelson interferometer mechanical distortions directly affect the interference, such effects are reduced by a factor of 10 to 40 in a crystal interferometer.

## Optimum resolution

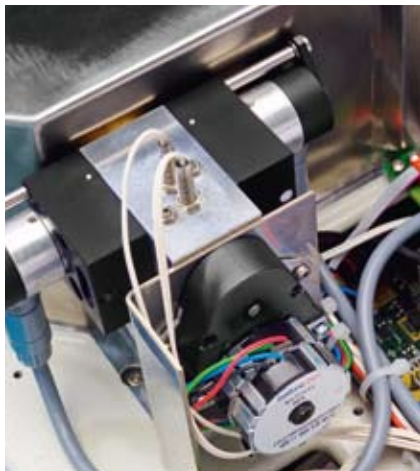
Because NIR absorption bands are relatively broad for liquids as well as for solid samples, resolutions higher than  $8\text{ cm}^{-1}$  do not improve the performance of NIR applications. On the contrary: Data collection with a higher resolution than the natural linewidth leads to a poorer signal-to-noise 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  $45^\circ$  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.

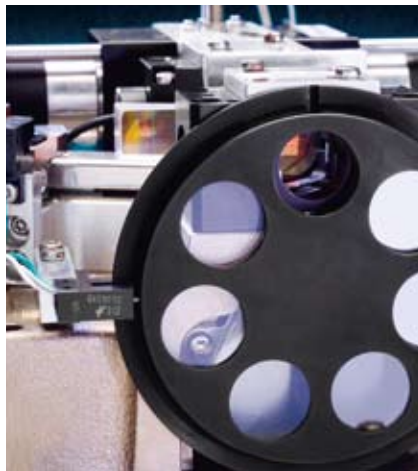


# Buchi extras for safe and uninterrupted performance – and for reduced service costs



## The twin lamp module

With the NIRFlex N-500, Buchi has set a new standard in terms of the availability of an NIR spectrometer. 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. Users can exchange the light source themselves; no servicing costs are generated.



## Checking the spectrometer against the integrated standards

Each NIRFlex N-500 is equipped with various NIR gray filters and a wavelength standard. These enable wavelength accuracy, signal-to-noise ratio, and linearity to be checked using specially designed software modules. This System Suitability Test (SST) is indispensable in the pharmaceutical industry in order to meet regulations.

The NIRWare Automatic Diagnose (NADIA) enables a complete, extended overview of the general NIRFlex N-500 condition. NADIA can be recorded very easily by users with just one mouse click. 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.



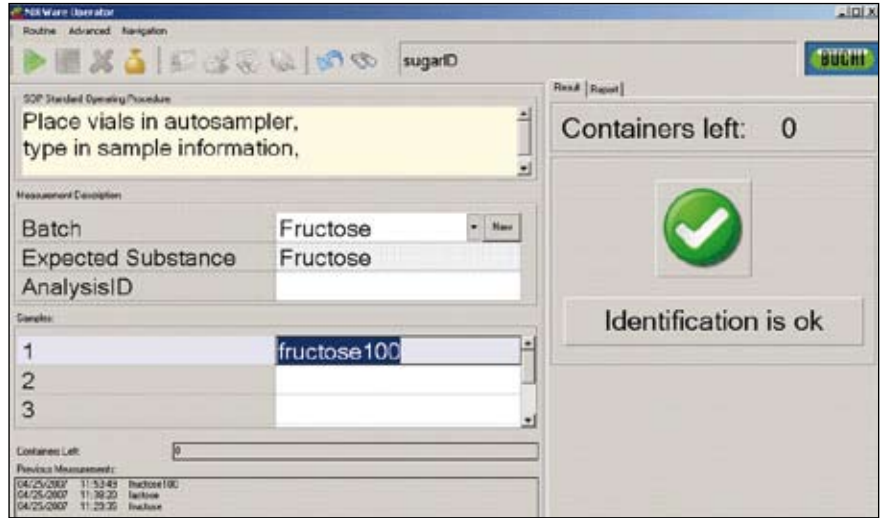
## The replaceable laser unit

It is a matter of minutes to replace the HeNe laser module. The user has just to loosen four screws in order to exchange the prealigned laser module.

## NIRWare Software

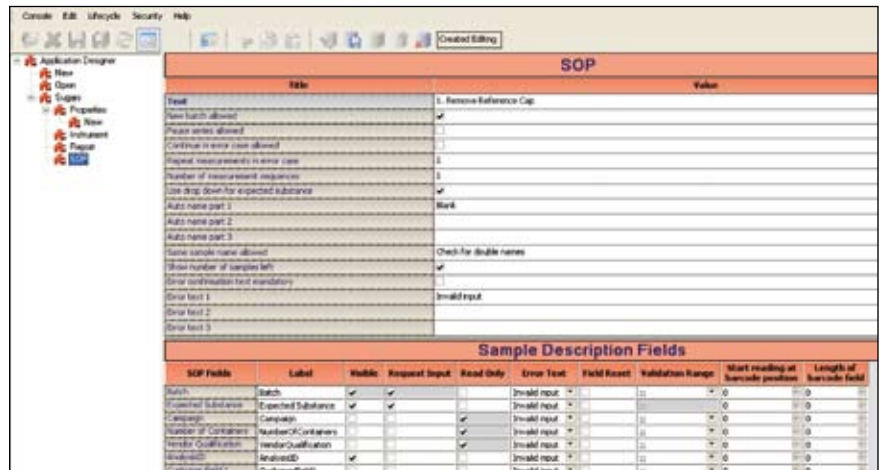
The system uses the latest version of the NIRWare Software Suite **NIRWare 1.2**. Our customers are used to the ergonomic and intuitive use of Buchi products. That is one of the core features of the new NIRWare version 1.2.

The **Operator** of NIRWare 1.2 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 are displayed directly in report format on the computer screen.



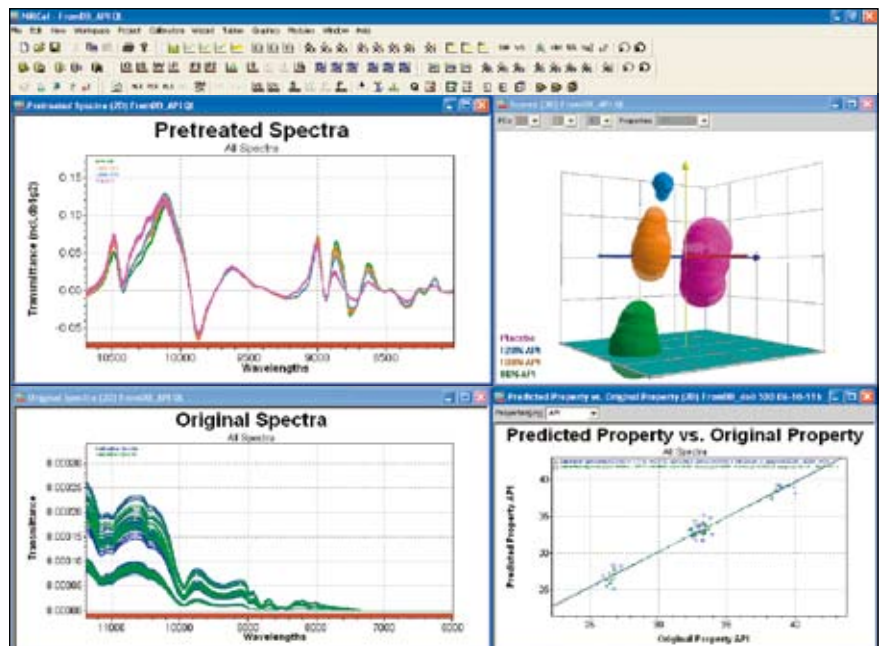
The **Application Designer** of NIRWare 1.2 allows the development of all possible NIR applications with NIRFlex N-500 in an easy and convenient way – all within seconds. A wide range of settings ensures that the application can be specifically tailored to all of your needs.

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**.



## NIRCal 5.2 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.



# Technical data of NIRFlex N-500

## NIRFlex N-500

Dimensions housing (W x H x D)	350 x 250 x 450 mm
Spectral range	800–2500 nm (recommended 1000–2500 nm) 12500–4000 cm <sup>-1</sup> (recommended 10000–4000 cm <sup>-1</sup> ) (if not specified differently for measuring cell)
Resolution	8 cm <sup>-1</sup> (with boxcar apodization)
Type of interferometer	Polarisation interferometer with TeO <sub>2</sub> wedges
Wavenumber accuracy	± 0.2 cm <sup>-1</sup> (measured with HF gascell at an ambient temperature of 25 °C ± 5 °C)
Signal-to-noise ratio	10000 (peak-to-peak noise)
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 / 12000 h (2x 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

Detector	Extended range InGaAs (temperature controlled)
Electric power supply	100–230 VAC ± 10 %, 50/60 Hz, 20 W

	Petri dish add-on	Vial add-on	Tablet add-on	XL add-on
Max. number of samples per sequence	1	6	10	1
Measurement based on diffuse reflection	x	x	x	x
Measurement based on transmittance	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
Internal reference	x	–	–	–
External reference	x	x	x	x
Sample dimensions	Petri dish 100 mm	Glass vials 10–15 mm	Tablets 5–10 mm	

**NIRFlex Solids Transmittance**

Detector	InGaAs (temperature controlled)
Spectral range	12500–6000 cm <sup>-1</sup> (recommended range 11 520–6000 cm <sup>-1</sup> ) 800–1660 nm (recommended range 870–1660 nm)
Photometric dynamic range	0–6 AU
Photometric linearity	The “addition of filter technique” has been used. A 2% transmission filter and a wavelength standard (Rare Earth Oxide mixture) were used 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 $< 2 \times 10^{-7}$ T at 7876 cm <sup>-1</sup>
Typical signal-to-noise ratio	Rms for spectral segments of 300 cm <sup>-1</sup> in the range of 11 000–6500 cm <sup>-1</sup>
– open beam	Mean $2 \times 10^{-5}$ AU (16 scans; Blackman apodization)
– 5 mm Spectralon®	Mean $10 \times 10^{-5}$ AU (64 scans; Blackman apodization)
Electric power supply	100–230 VAC +/- 10%, 50/60 Hz, 20 W

**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 reach a stable control of the set temperature	Ambient temperature to 65 °C: 15 min
Electric power supply provided from NIRFlex N-500	100–230 VAC ± 10%, 50/60 Hz, 250 W

**NIRFlex Fiber Optic Solids**

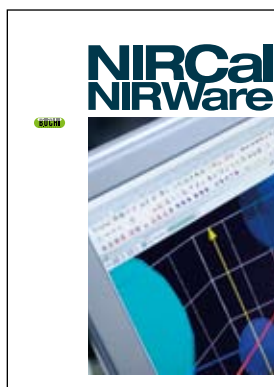
Temperature range at probe tip	0 °C–80 °C
Electric power supply	100–230 VAC ± 10%, 50/60 Hz, 20 W
Detector	Extended range InGaAs (temperature controlled)
Standard lengths of fiber optic probes	2 m, 3 m, 5 m

## 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

## NIRFlex Fiber Optic Liquids

Temperature range of the probe head at the probe tip	0 °C–150 °C
Max. pressure at the probe tip	6 bar
Electric power supply	100–230 VAC ± 10%, 50/60 Hz, 20 W
Detector	Extended range InGaAs (temperature controlled)
Standard length of fiber optic probe	2 m (available up to 7 m)
Pathlength	2 mm (other pathlengths available on request)



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Quality in your hands