

Technical Information

Accessory optics for the Rxn-10 probe

KIO1, KNCO1, KLBI01, KRSU1, KRBM0, KRBSL



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Function and system design

Fields of application

The Rxn-10 Raman probe, powered by Kaiser Raman technology, is designed for product and process development as well as manufacturing (when used with the Raman optic system for single use). The probe is compatible with a wide range of interchangeable optics (immersion and non-contact) to meet the requirements of different applications.

Table 1 lists common applications for the Rxn-10 probe and optics. Different applications are possible; however, use of the device outside of the specified fields of application may compromise the safety of personnel and the measuring system and invalidates any warranty.

Recommended applications for the optics include:

Optic	Fields of application
Immersion optic (KIO1)	- Development laboratory - Pharmaceutical: drug substance unit operations, reaction analysis, crystallization, end-point detection, solvent swaps - Chemical: material identification, reaction analysis, polymerization, cross-linking, blending - Food and beverage: blending, purification, natural and synthetic components
Non-contact optic (KNCO1)	- Polymer solids (pellets, films, or powders) - Pharmaceutical drug product manufacturing - Raw material identification - Meat or fish quality - Formulation optimization
bIO-Optic (KL BIO1)	- Benchtop bioreactors to measure glucose, lactate, amino acids, cell density, titer, and more - Benchtop fermenters to measure glycerol, methanol, ethanol, sorbitol, biomass, and more - Use with Flow assembly CYA680 for select downstream bioprocessing applications
Bio multi optic (KRBMO) and bio sleeve (KRBSL)	- Benchtop bioreactors to measure glucose, lactate, amino acids, cell density, titer, and more - Benchtop fermenters to measure glycerol, methanol, ethanol, sorbitol, biomass, and more - Use with Flow assembly CYA680 for select downstream bioprocessing applications
Raman optic system for single use (KRSU1)	- Single-use bioreactors to measure glucose, lactate, amino acids, cell density, titer, and more - Single-use fermenters to measure glycerol, methanol, ethanol, sorbitol, biomass, and more

Table 1. Fields of application

Immersion optic: options

The immersion optic is available in 12.7 mm (0.5 in.) and 6.35 mm (0.25 in.) diameter configurations with two optical coating options:

- VIS: optimized for use in the visible (VIS) region (532 nm)
- NIR: optimized for use in the near infrared (NIR) region (785 nm and 993 nm)

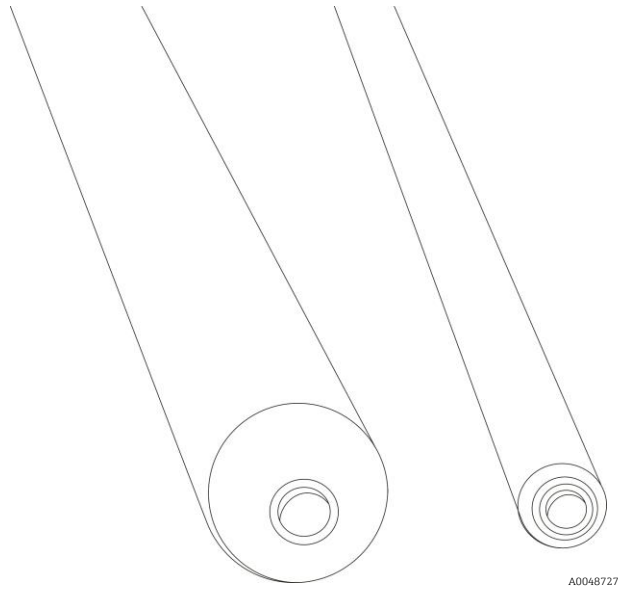


Figure 1. Tips of immersion optics with different diameters

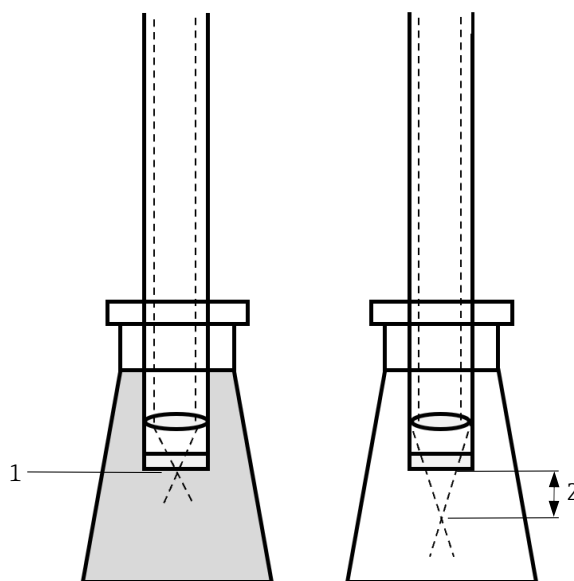
Immersion optic: working distance

The immersion optic is available with either a short (at the window) or long (3 mm or 0.12 in. from the window) working distance. The selected working distance, which defines the zone in which spectral data are collected, is identified on the immersion optic.

Short or long working distances are used for different sample types. Spectral data are collected most efficiently at the focal plane.

A short working distance is typically used for opaque or turbid media samples. When a long working distance is used for these materials, incident radiation may be lost due to specular and diffuse reflection by material above the focal plane.

A long working distance is preferred for transparent samples because it maximizes the signal intensity by using the entire effective focal cylinder.

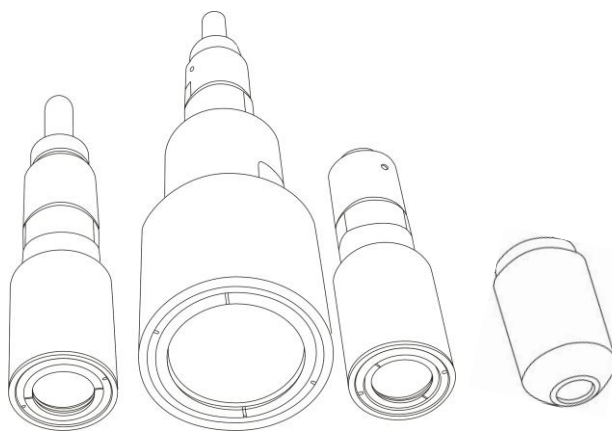


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Figure 2. Short (1) vs. long (2) working distance (data collection zone)

Non-contact optic

Paired with the Rxn-10 probe, the Endress+Hauser non-contact optic enables contactless Raman sample measurements taken directly, through sight glass, or through translucent sample packaging. These optics are ideal for applications involving solids, or turbid media or when avoiding sample contamination or damage to optical components is critical.



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Figure 3. Non-contact optics in varying sizes

Non-contact optic: options

Non-contact optics are available in a range of sizes, with working distances from 10 to 75 mm (0.40 to 3 in.) depending on the option selected. The internal lens comes with one of two types of anti-reflective coatings:

- VIS: optimized for use in the visible (VIS) region
- NIR: optimized for use in the near infrared (NIR) region

Refer to the table below for available options.

Non-contact optic size	Anti-reflective coating	Working distance (mm)	Working distance (in.)
NCO-0.4	NIR	10	0.40
NCO-0.5	VIS	12.5	0.50
NCO-1.3	VIS	33	1.30
NCO-2.5	VIS	64	2.52
NCO-3.0	NIR	75	2.96

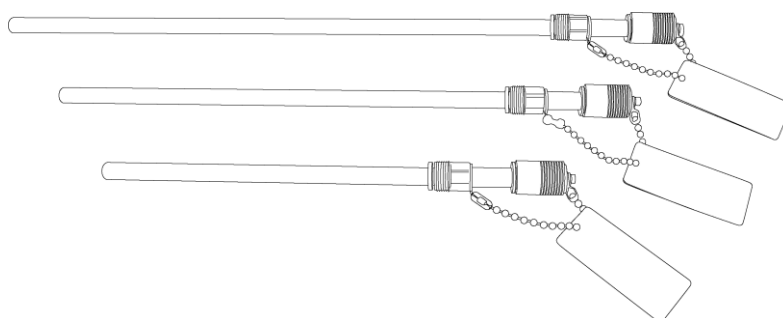
Table 2. Non-contact optics

bIO-Optic

The Endress+Hauser bIO-Optic is a versatile immersion optic designed for use with the Rxn-10 probe. It enables real-time measurement of key bioprocessing components and is compatible with standard PG13.5 bioreactor ports.

The fixed focus design of the bIO-Optic provides long-term measurement stability and superior signal performance, supporting reliable and transferable Raman-based bioprocess analysis.

Available in a range of industry standard lengths, the bIO-Optic is suitable for benchtop bioreactor or fermenter applications requiring headplate entry.



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Figure 4. bIO-Optics in varying lengths

NOTICE

Do not use the bIO-Optic with hydrocarbon solvents (including ketones and aromatics).

- These solvents can degrade probe performance and invalidate the warranty.

bIO-Optic: options

The bIO-Optic is available in 120, 220, 320, or 420 mm (4.73, 8.67, 12.60, or 16.54 in.) lengths.

The 12 mm (0.48 in.) diameter with the PG13.5 threaded connector is suitable for headplate entry into the bioreactor or fermenter.

The 120 mm version is compatible with Endress+Hauser Flow assembly [CYA680](#).

Bio multi optic and bio sleeve

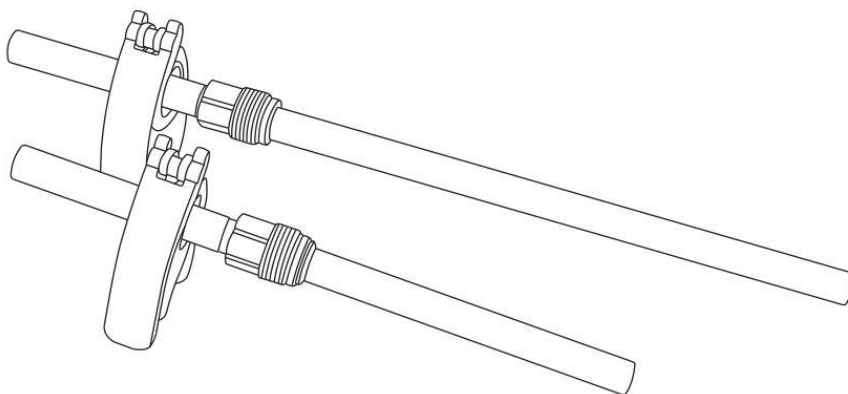
The Endress+Hauser bio multi optic and bio sleeve make up a versatile, two-part immersion optic system for use with the Rxn-10 probe. This system enables real-time measurement of multiple key bioprocessing components and is compatible with standard PG13.5 bioreactor ports.

The system consists of the following parts:

- Reusable bioprocessing multi optic with no product contact
- Bioprocessing sleeve with product contact that interfaces with the bio multi optic. The sleeve supports up to 50 autoclave cycles when used with the bio sleeve desiccator.

The modular design allows calibration of the optic without removing the bio sleeve from the bioreactor or wetted area. This design simplifies the wetted and sterilized portion, reducing service effort and minimizing process disruption.

The fixed focus design provides long-term measurement stability and robust signal performance, supporting reliable and transferable Raman-based bioprocess analysis.



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Figure 5. Bio multi optic and bio sleeve in varying lengths

NOTICE

Do not use this system with hydrocarbon solvents (including ketones and aromatics).

- These solvents can degrade probe performance and invalidate the warranty.

NOTICE

Do not submerge the optic in any liquid unless it is attached to a bio sleeve.

Bio multi optic and bio sleeve: options

The bio multi optic and bio sleeve are available in 120 mm and 220 mm (4.73 in. and 8.67 in.) standard lengths.

The 120 mm version is compatible with Endress+Hauser Flow assembly [CYA680](#).

The sample system is suitable for benchtop bioreactor or fermenter applications requiring headplate entry.

Raman optic system for single use

The Endress+Hauser Raman optic system for single use was developed in accordance with industry standards for single-use sensors and is designed for single-use applications. The system is used in conjunction with the Rxn-10 probe and is comprised of the following parts:

- Reusable optic with no product contact
- Disposable fitting supplied, installed, and tested by the single-use vessel vendor.

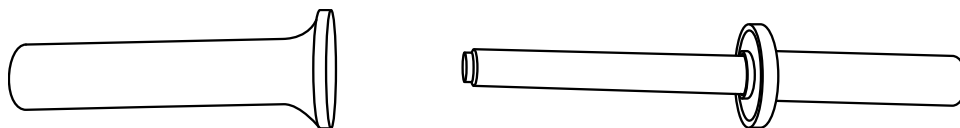


Figure 6. Disposable fitting (right) and reusable optic (left)

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NOTICE

Do not use this system with hydrocarbon solvents (including ketones and aromatics).

- These solvents can degrade probe performance and invalidate the warranty.

NOTICE

Do not submerge the optic in any liquid unless it is attached to the disposable fitting.

Specifications

Rxn-10 probe with accessory optics

The specifications for the Rxn-10 probe are listed in the tables below for each optic. The following conditions apply:

- Maximum pressure for the immersion optic and bIO-Optic is calculated in accordance with ASME B31.3 2020 Edition for material and probe geometry. Temperatures must not exceed the maximum listed.
- Minimum pressure rating: 0 bara (full vacuum). Unless otherwise specified, the probes are not rated for low outgassing in high-vacuum service.

Immersion optic

Item		Description
Laser wavelength		532 nm, 785 nm, 993 nm
Spectral coverage		Limited by the analyzer used
Maximum laser power into probe head		< 499 mW
Relative humidity		Sealed: Up to 95 %, non-condensing Non-sealed: 20 to 60 %, non-condensing
Sample interface	Temperature	316L stainless steel: -30 to 120 °C (-22 to 248 °F) C276 alloy: -30 to 280 °C (-22 to 536 °F) Grade 2 titanium: -30 to 315 °C (-22 to 599 °F)
	Maximum pressure ¹ , 12.7 mm (0.5 in.) diameter IO	316L stainless steel: 142.4 barg (2066 psig) C276 alloy: 158.1 barg (2293 psig) Grade 2 titanium: 65.2 barg (946 psig)
	Maximum pressure ¹ , 6.35 mm (0.25 in.) diameter IO	316L stainless steel: 168.5 barg (2444 psig) C276 alloy: 186.2 barg (2701 psig) Grade 2 titanium: 76.3 barg (1107 psig)
Wetted materials	Metal	C276 alloy standard 316L stainless steel or Grade 2 titanium upon request
	Window	High-purity sapphire, proprietary compression fit non-brazed design
Shaft length	12.7 mm (0.5 in.) diameter IO	152 mm (6 in.) 305 mm (12 in.) 457 mm (18 in.)
	6.35 mm (0.25 in.) diameter IO	152 mm (6 in.) 203 mm (8 in.)
Working distance	Short (S)	0 mm (0 in.)
	Long (L)	3 mm (0.12 in.)
Calibration method	532 nm	HCA-532
	785 nm	HCA-785
	993 nm	HCA-1000
Verification method	532 nm	Immerse in cyclohexane
	785 nm, 993 nm	Immerse in cyclohexane or 70 % IPA

Table 3. Immersion optic specifications

¹ Maximum service pressure ratings do not include the ratings of any fittings or flanges used to mount the probe into the process system. These items need to be independently evaluated and may lower the maximum service pressure of the probe.

Non-contact optic

Item		Description
Laser wavelength		532 nm, 785 nm, 993 nm
Spectral coverage		Limited by the analyzer used
Maximum laser power into probe head		< 499 mW
Sample interface	Temperature	Ambient
	Pressure	Ambient
	Relative humidity	Ambient
Wetted materials		Optic dependent
Length		Varies based on model
Diameter		varies based on model
Working distance		10 to 75 mm (0.40 to 3 in.), depending on optic see Table 2 → 
Calibration method	532 nm	HCA-532
	785 nm	HCA-785
	993 nm	HCA-1000
Verification method	532 nm	Cyclohexane cuvette
	785 nm, 993 nm	Cyclohexane or 70 % IPA cuvette

Table 4. Non-contact optic specifications

bIO-Optic

Item		Description
Laser wavelength		785 nm, 993 nm
Spectral coverage		Limited by the analyzer used
Maximum laser power into probe head		< 499 mW
Sample interface	Temperature	–30 to 150 °C (–22 to 302 °F)
	Maximum pressure	13.8 barg (200 psig)
Wetted materials	Body	316L stainless steel
	Window	Proprietary material, optimized for bioprocesses
	Process connection	PG13.5
	Surface finish	Ra 0.38 µm (Ra 15 µin), electropolished
	Adhesive	USP Class VI and ISO 10993 compatible
Immersible length		120 mm (4.73 in.) 220 mm (8.67 in.) 320 mm (12.60 in.) 420 mm (16.54 in.)
Immersible diameter		12 mm (0.48 in.)
Sterilization method		Autoclave Rated for 25 autoclave cycles at 131 °C (268 °F)
Calibration method	785 nm	HCA-785
	993 nm	HCA-1000
Verification method	785 nm, 993 nm	bIO Sample Chamber with 70 % IPA

Table 5. bIO-Optic specifications

Bio multi optic and bio sleeve

Item		Description
Laser wavelength		785 nm
Spectral coverage		Limited by the analyzer used
Maximum laser power into probe head		< 499 mW
Sample interface	Temperature	-30 to 150 °C (-22 to 302 °F)
	Maximum pressure	13.8 barg (200 psig)
Wetted materials (bio sleeve)	Body	316L stainless steel
	Window	Proprietary material, optimized for bioprocesses
	Process connection	PG13.5
	Surface finish	Ra 0.38 µm (Ra 15 µin) with electropolish
	Adhesive	USP Class VI and ISO 10993 compatible
Immersible length (bio sleeve)		120 mm (4.73 in.) 220 mm (8.67 in.)
Immersible diameter (bio sleeve)		12 mm (0.48 in.)
Sterilization method (bio sleeve)		Autoclave (use the bio sleeve desiccator) Rated for 50 autoclave cycles (30 minutes each) at 131 °C (268 °F)
Calibration method	785 nm	Multi optic calibration accessory (recommended) or HCA-785 with bio sleeve attached to bio multi optic
Verification method	785 nm	Multi optic verification accessory with 70 % IPA (recommended) or bIO Sample Chamber with 70 % IPA and bio sleeve attached to bio multi optic

Table 6. Bio multi optic and bio sleeve specifications

Raman optic system for single use

Item		Description
Laser wavelength		785 nm, 993 nm
Spectral coverage		Limited by the analyzer used
Maximum laser power into probe head		< 499 mW
Sample interface temperature		0 to 100 °C (32 to 212 °F)
Immersible length		Dimensions vary according to single-use bioreactor vendor port and fitting type
Immersible diameter		Dimensions vary according to single-use bioreactor vendor port and fitting type
Calibration method	785 nm	Multi optic calibration accessory (recommended) or HCA-785 with single-use calibration adapter
	993 nm	HCA-1000 with single-use calibration adapter
Verification method	785 nm	Multi optic verification accessory with 70 % IPA (recommended) or bIO Sample Chamber with 70 % IPA and single-use calibration adapter
	993 nm	bIO Sample Chamber with 70 % IPA and single-use calibration adapter

Table 7. Specifications for the Raman optic system for single use

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