

Technical Information

Accessory optics for the Rxn-10 probe

KIO1, KNCO1, KL BIO1, KRSU1, KR BMO, KRBSL



Table of Contents

Function and system design 3
 Fields of application 3
 Immersion optics: options 4
 Immersion optics: data collection zone 5
 Non-contact optics 5
 Non-contact-optics: options 6
 bIO-Optics 6
 bIO-Optics: options 6
 Bio multi optic and bio sleeve 7

Bio multi optic and bio sleeve: options 7
 Raman optic system for single use 8
Specifications 9
 Rxn-10 probe with accessory optics 9
 Immersion optic 9
 Non-contact optic 10
 bIO-Optic 10
 Bio multi optic and bio sleeve 11
 Raman optic system for single use 11

Function and system design

Fields of application

The Rxn-10 Raman spectroscopic 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, commercially available optics (immersion and non-contact) to meet the requirements of different applications.

Table 1 lists common applications for the Rxn-10 probe and optics. There are other possible fields of application; however, use of the device for any purpose well outside of the fields of application described here poses a threat to the safety of people and of the entire measuring system and invalidates any warranty.

Recommended applications for the optics include:

Optic	Fields of application
Immersion optic (KIO1)	<ul style="list-style-type: none"> ▪ 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)	<ul style="list-style-type: none"> ▪ Polymer solids (pellets, films, or powders) ▪ Pharmaceutical drug product manufacturing ▪ Raw material identification ▪ Meat or fish quality ▪ Formulation optimization
bio-Optic (KLBO1)	<ul style="list-style-type: none"> ▪ 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)	<ul style="list-style-type: none"> ▪ 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)	<ul style="list-style-type: none"> ▪ 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 optics: 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)

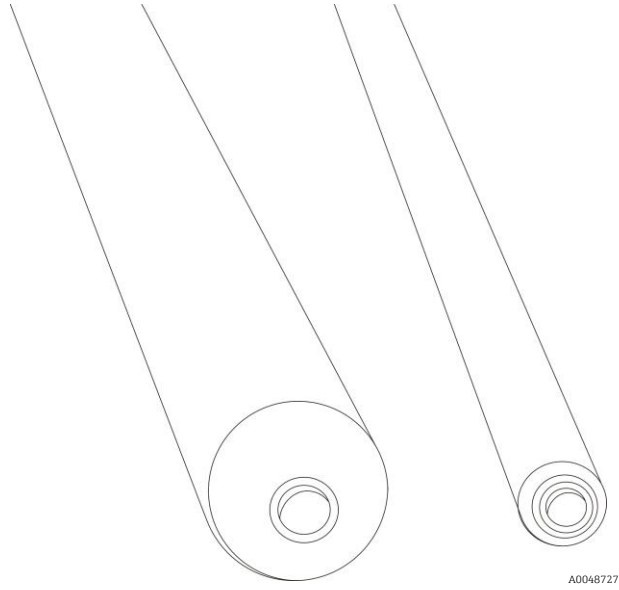


Figure 1. Tips of immersion optics with varying diameters

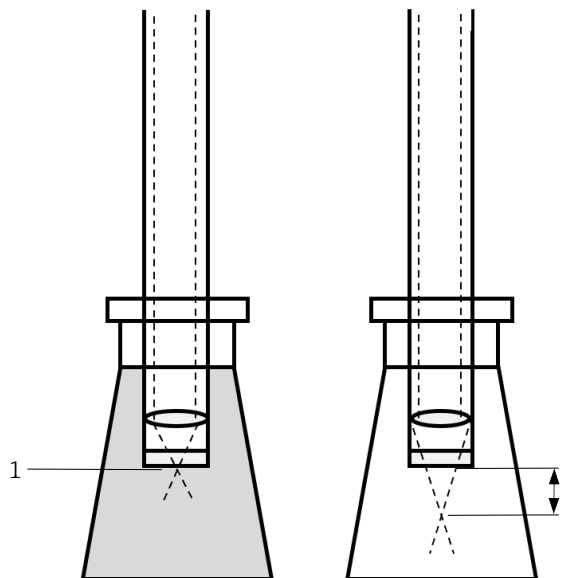
Immersion optics: data collection zone

The immersion optic can have either a short (at the window) or long (3 mm or 0.12 in. from the window) data collection zone. The data collection zone selected is also indicated on the immersion optic.

Short or long data collection zones are used for different kinds of samples. Spectral data is collected most efficiently at the focal plane.

A short data collection zone is generally used for opaque or turbid media samples. If an immersion optic with a long data collection zone were used to analyze these materials, most or all of the incident radiation would be lost to specular and diffuse reflection by material above the focal plane.

A long data collection zone is better for transparent samples because it maximizes the signal intensity by using the entire effective focal cylinder.

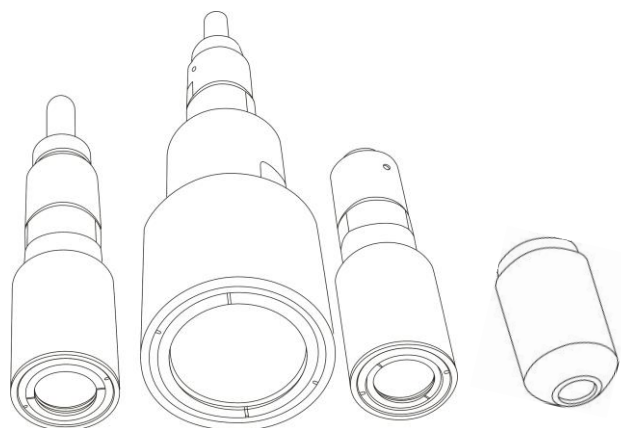


A0048742

Figure 2. Short (left) vs. long (right) data collection zone (1)

Non-contact optics

Paired with the Rxn-10 probe, the Endress+Hauser non-contact optic provides contact-free Raman measurements of samples either directly or through sight glass or translucent packaging. These optics are ideal for use with solids or turbid media or when sample contamination or damage to optical components is a concern.



A0048410

A0048676

Figure 3. Non-contact optics in varying sizes

Non-contact-optics: options

Non-contact optics are available in a variety of sizes with a working distance range of 10 to 140 mm (0.40 to 5.52 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

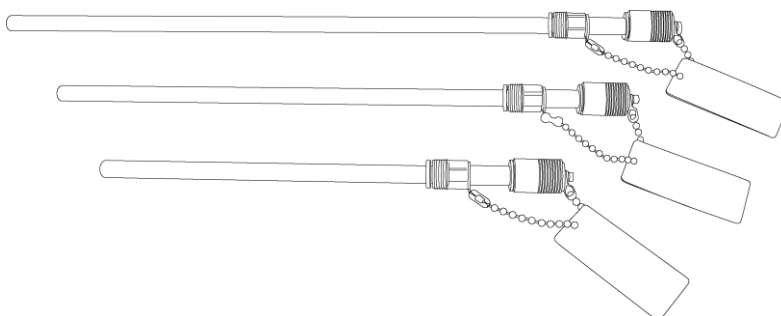
Refer to the table below for available options.

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
NCO-5.5	VIS	140	5.52
NCO-5.5	NIR	140	5.52

Table 2. Non-contact optics

bIO-Optics

The Endress+Hauser bIO-Optic is a versatile immersion optic used in conjunction with the Rxn-10 probe. It measures multiple, specific bioprocessing components in real-time and is compatible with standard PG13.5 bioreactor ports. The fixed focus design of the bIO-Optic provides long-term measurement stability along with superior signal performance, essential for transferable, high performance Raman-based bioprocess analysis. Available in various industry standard lengths, the bIO-Optic is ideally suited for benchtop bioreactor/fermentor applications requiring headplate entry.



A0048412

Figure 4. bIO-Optics in varying lengths

NOTICE

The bIO-Optic should NOT be used with hydrocarbon solvents (including ketones and aromatics).

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

bIO-Optics: 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 PG13.5 threaded connector is ideally suited for headplate entry into the bioreactor/fermentor. The 120 mm version is compatible with Endress+Hauser Flow assembly [CYA680](#).

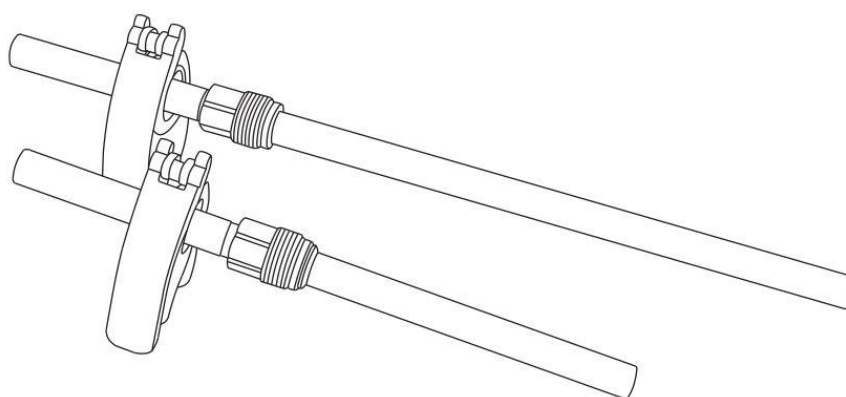
Bio multi optic and bio sleeve

The Endress+Hauser bio multi optic and bio sleeve make up a versatile, two part immersion optic system used in conjunction with the Rxn-10 probe. This system measures multiple, specific bioprocessing components in real-time and is compatible with standard PG13.5 bioreactor ports.

The system is comprised of the following parts:

- A reusable bioprocessing multi optic, which has no product contact, and
- The bioprocessing sleeve that interfaces with the bio multi optic and has product contact. The bio sleeve has a lifespan of 10 autoclave cycles when used in conjunction with the bio sleeve desiccator.

The modular design of this sample system allows for calibration of the optic without removing the bio sleeve from the bioreactor/wetted area. Another benefit realized from the modular design is reduced service and maintenance because of the simplification of the wetted/sterilized portion. The fixed focus design provides long-term measurement stability and superior signal performance, essential for transferable, high performance Raman-based bioprocess analysis.



A0051184

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

NOTICE

This system should NOT be used with hydrocarbon solvents (including ketones and aromatics).

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

NOTICE

The optic is NOT intended to be submerged into any liquid without being attached to a bio sleeve.

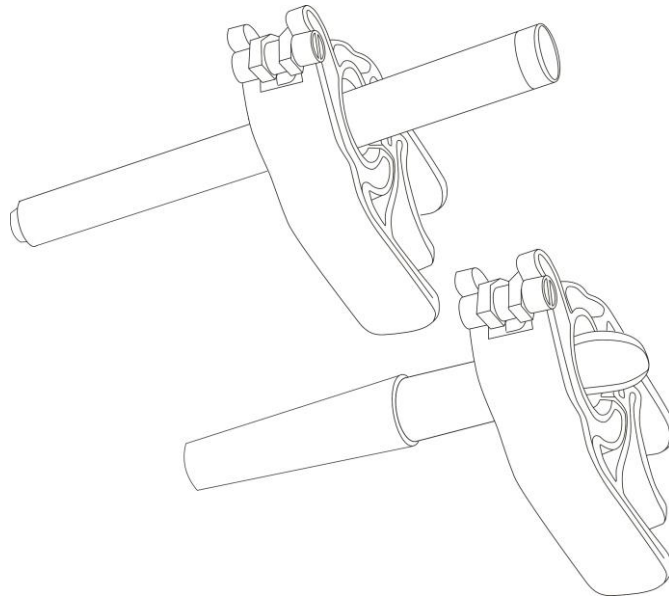
Bio multi optic and bio sleeve: options

The bio multi optic and bio sleeve are available in 120 mm and 220 mm (4.73 in. and 8.67 in.) industry standard lengths. The 120 mm version is compatible with Endress+Hauser Flow assembly [CYA680](#). The sample system is ideally suited for benchtop bioreactor/fermentor applications requiring headplate entry.

Raman optic system for single use

The Endress+Hauser Raman optic system for single use was developed according to 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:

- The reusable optic, which has no product contact, and
- A disposable fitting, which is installed, tested, and supplied ready to use from the single use vessel vendor.



A0048734

Figure 6. Reusable optic (top) and disposable fitting (bottom)

NOTICE

This system should NOT be used with hydrocarbon solvents (including ketones and aromatics).

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

NOTICE

The optic is NOT intended to be submerged into any liquid without being attached to the disposable fitting.

Specifications

Rxn-10 probe with accessory optics

The specifications for the Rxn-10 probe in conjunction with each of the optics are listed in the tables below. Additionally:

- Maximum pressure for the immersion optic and bIO-Optic is calculated per ASME B31.3 2020 Edition for material and probe geometry at temperatures not to exceed the maximum listed.
- Minimum pressure rating: All probes have a minimum pressure rating of 0 bara (full vacuum). However, unless specified, they are not rated for low outgassing at high vacuum service.

Immersion optic

Item		Description	
Laser wavelength		532 nm, 785 nm, 993 nm	
Spectral coverage		limited by the coverage of the analyzer being 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.)
	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 coverage of the analyzer being 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 140 mm (0.40 to 5.52 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 coverage of the analyzer being 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) with electropolish
	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 coverage of the analyzer being 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 (with the use of the bio sleeve desiccator) rated for 10 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 coverage of the analyzer being 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. Raman optic system for single use specifications

www.addresses.endress.com
