

Brief Operating Instructions

Accessory optics for the Rxn-10 probe

KIO1, KNCO1, KLBI01, KRSU1



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1 About this document

1.1 Disclaimer

These instructions are Brief Operating Instructions; they do not replace the Operating Instructions included in the scope of supply.

1.2 Warnings

Structure of Information	Meaning
<p> WARNING</p> <p>Causes (/consequences) If necessary, consequences of non-compliance (if applicable)</p> <p>► Corrective action</p>	<p>This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation can result in a fatal or serious injury.</p>
<p> CAUTION</p> <p>Causes (/consequences) If necessary, consequences of non-compliance (if applicable)</p> <p>► Corrective action</p>	<p>This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.</p>
<p>NOTICE</p> <p>Cause/situation If necessary, consequences of non-compliance (if applicable)</p> <p>► Action/note</p>	<p>This symbol alerts you to situations which may result in damage to property.</p>

Table 1. Warnings

1.3 Symbols

Symbol	Description
	The Laser Radiation symbol is used to alert the user to the danger of exposure to hazardous visible laser radiation when using the system.
	The High Voltage symbol that alerts people to the presence of electric potential large enough to cause injury or damage. In certain industries, high voltage refers to voltage above a certain threshold. Equipment and conductors that carry high voltage warrant special safety requirements and procedures.
	The WEEE symbol indicates that the product should not be discarded as unsorted waste but must be sent to separate collection facilities for recovery and recycling.

Table 2. Symbols

1.4 U.S. export compliance

The policy of Endress+Hauser is strict compliance with U.S. export control laws as detailed in the website of the [Bureau of Industry and Security](#) at the U.S. Department of Commerce.

2 Basic safety instructions

The safety information in this section is specific to the optics that are compatible with the Rxn-10 Raman spectroscopic probe. Refer to the *Rxn-10 Raman spectroscopic probe Operating Instructions* for additional information related to probe and laser safety.

2.1 Requirements for the personnel

- Installation, commissioning, operation, and maintenance of the probe/optics may be carried out only by specially trained technical personnel.
- The technical personnel must be authorized by the plant operator to carry out the specified activities.
- The technical personnel must have read and understood these Operating Instructions and must follow the instructions contained herein.
- The facility must designate a laser safety officer who ensures staff are trained on all Class 3B laser operating and safety procedures.
- Faults at the measuring point may only be rectified by authorized trained personnel. Repairs not described in this document must be carried out only directly at the manufacturer's site or by the service organization.

2.2 Designated use

The Rxn-10 Raman spectroscopic probe 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.

Recommended applications for the optics include:

Optic	Fields of application
Immersion optic (IO)	<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 (NCO)	<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

Optic	Fields of application
bIO-Optic	<ul style="list-style-type: none"> ▪ Cell culture: glucose, lactate, glutamine, amino acids, cell density, titer ▪ Fermentation: glycerol, methanol, ethanol, sorbitol, biomass ▪ Downstream: aggregation, protein crystallization, formula stability, product CQA, protein concentration, buffer excipients
Raman optic system for single use	<ul style="list-style-type: none"> ▪ Cell culture: glucose, lactate, amino acids, cell density, titer ▪ Fermentation: glycerol, methanol, ethanol, sorbitol, biomass

Table 3. Fields of application

The above table 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.

2.3 Workplace safety

As the user, you are responsible for complying with the following safety conditions:

- Installation guidelines
- Local standards and regulations for electromagnetic compatibility

2.4 Operational safety

Before commissioning the entire measuring point:

1. Verify that all connections are correct.
2. Ensure that electro-optical cables are undamaged.
3. Ensure fluid level is sufficient for probe/optics immersion (if applicable).
4. Do not operate damaged products, and protect them against unintentional operation.
5. Label damaged products as defective.

During operation:

1. If faults cannot be rectified, products must be taken out of service and protected against unintentional operation.
2. When working with laser devices, always follow all local laser safety protocols which may include the use of personal protective equipment and limiting device access to authorized users.

2.5 Service safety

Follow your company's safety instructions when removing a process probe/optic from the process interface for service. Always wear proper protective equipment when servicing the equipment.

2.6 Important safeguards

- Do not use the optics for anything other than their intended use.
- Do not look directly into the laser beam.
- Do not point the laser at a mirrored/shiny surface or a surface that may cause diffuse reflections. The reflected beam is as harmful as the direct beam.
- When not in use, close the shutter on the Rxn-10 probe. If an optic cap is available, place it on the unused optic.
- Always use a laser beam block to avoid inadvertent scatter of laser radiation.

2.7 Product safety

The product is designed to meet all current safety requirements, has been tested, and shipped from the factory in a safe operating condition. The relevant regulations and international standards have been observed. Devices connected to an analyzer must comply with the applicable analyzer safety standards.

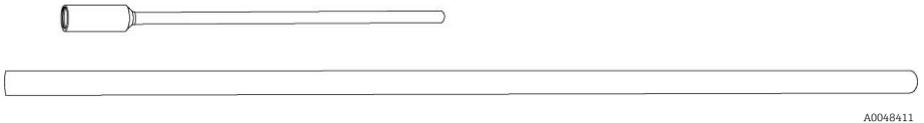
3 Product description

The variety of optics available for the Rxn-10 Raman spectroscopic probe, powered by Kaiser Raman technology, enables flexible sampling options in the laboratory, process development, or single use manufacturing environment. Endress+Hauser offers immersion, bioprocess, and non-contact optics for the analysis of liquids, slurries and solids. Optics are available in multiple lengths and sizes to meet the requirements of different applications. Refer to the sections below for descriptions of the optics types and their use.

- 3.1: Immersion optic
- 3.2: Non-contact optic
- 3.3: bIO-Optic
- 3.4: Raman optic system for single use

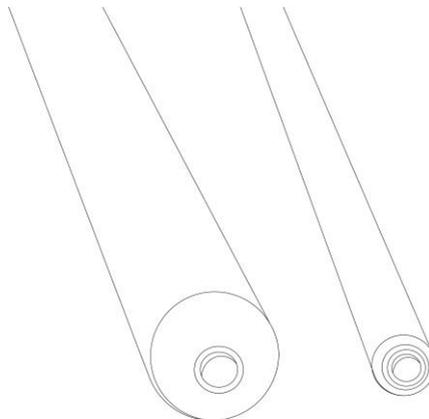
3.1 Immersion optic (KIO1)

The Endress+Hauser immersion optic is suited for use with the Rxn-10 probe in reaction vessels, laboratory reactors, or process streams. It has a fixed focus design and no movable parts, providing long-term measurement stability and superior signal performance. The sealed design is the standard for use with embedded Raman Rxn analyzers.



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Figure 1. Immersion optics with varying shaft length and diameter



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Figure 2. Tips of immersion optics with varying diameters

3.2 Non-contact optic (KNCO1)

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.

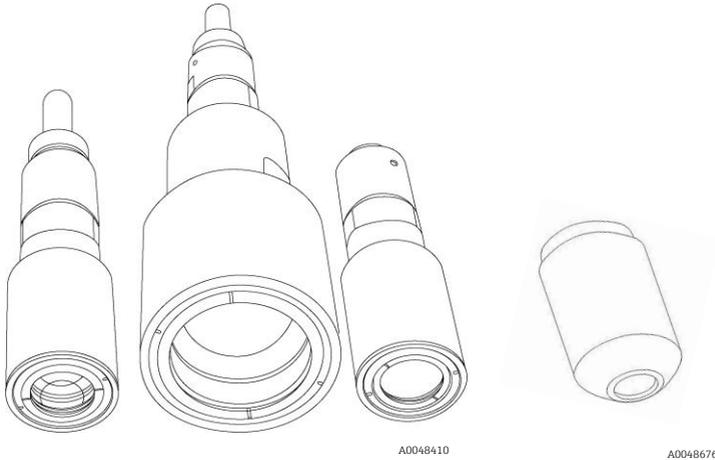


Figure 3. Non-contact optics in varying sizes

3.3 bIO-Optic (KLBI01)

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.

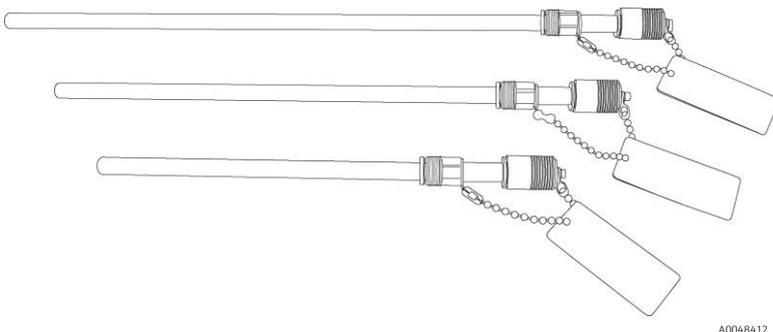


Figure 4. bIO-Optics in varying lengths

NOTICE

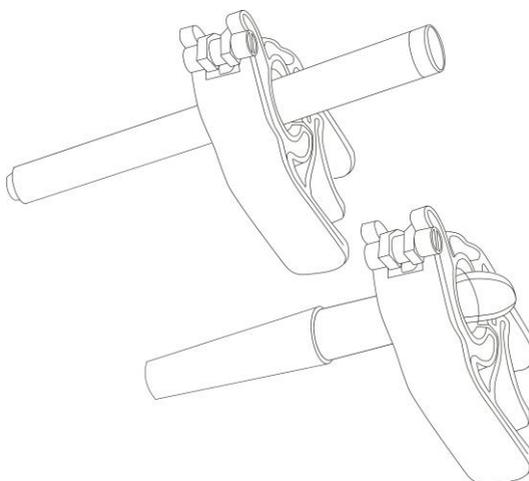
The **bio-Optic** should **NOT** be used with hydrocarbon solvents (including ketones and aromatics).

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

3.4 Raman optic system for single use (KRSU1)

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 bioprocess applications. The system is used in conjunction with the Rxn-10 probe and is comprised of the following parts:

- The reusable optic, which is never in contact with the end product, and
- A disposable fitting, which is installed, tested, and supplied ready to use from the single use vessel vendor.



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Figure 5. Reusable optic (top) and disposable fitting (bottom)

NOTICE

The **Raman optic system for single use** should **NOT** be used with hydrocarbon solvents (including ketones and aromatics).

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

4 Incoming product acceptance and product identification

4.1 Incoming acceptance

1. Verify that the packaging is undamaged. Notify the supplier of any damage to the packaging. Keep the damaged packaging until the issue has been resolved.
2. Verify that the contents are undamaged. Notify the supplier of any damage to the delivery contents. Keep the damaged goods until the issue has been resolved.
3. Check that the delivery is complete and nothing is missing. Compare the shipping documents with your order.
4. Pack the product for storage and transportation in such a way that it is protected against impact and moisture. The original packaging offers the best protection. Make sure to comply with the permitted ambient conditions.

If you have any questions, please contact your supplier or your local sales center.

NOTICE

Incorrect transportation can damage the optics.

4.2 Product identification

4.2.1 Label

At a minimum, the optics are labeled with the following information:

- Manufacturer information
- Serial number

Compare the information on the label/tag with the order.

4.2.2 Manufacturer address

Endress+Hauser
371 Parkland Plaza
Ann Arbor, MI 48103 USA

4.3 Scope of delivery

The scope of delivery comprises:

- Selected optic(s)
- *Accessory optics for the Rxn-10 probe Operating Instructions* manual

If you have any queries, please contact your supplier or local sales center.

5 Installation

The installation information in this section is specific to the optics that are compatible with the Rxn-10 Raman spectroscopic probe. Refer to the *Rxn-10 Raman spectroscopic probe Operating Instructions* for additional information related to probe installation.

The Rxn-10 probe is compatible with both immersion optics and non-contact optics. The probe has a torque limiting clamp that secures the immersion optics. The clamp also holds the adapter for non-contact optics.

When replacing an optic on a probe, use the Raman Calibration Accessory (or HCA) to perform an intensity calibration for that probe with the new optic.

5.1 Installing immersion optics and bIO-Optics

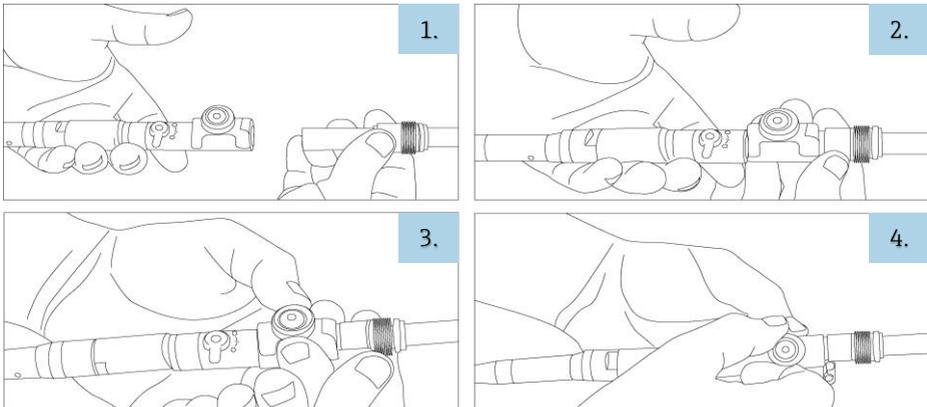
Endress+Hauser immersion optics and bIO-Optics are not threaded. They slip into the Rxn-10 probe and are secured by a thumb screw-based clamp.

⚠ WARNING

When installing or removing immersion optics, ensure the laser and emission shutter are in the closed position.

To install an immersion optic:

1. Loosen the metal thumb screw on the Rxn-10 probe by turning the screw approximately one turn (do not remove). Then find the probe end of the optic, which is the end that includes the product markings.
2. Insert the probe end of the optic through the end optic clamp.
3. Push the optic back until it stops.
4. Tighten the thumb screw until you hear a clicking sound to ensure the optic is held in place. Failure to tighten the screw will result in the optic coming loose, potentially damaging the optic.
5. After installing an optic on a probe, use the Raman Calibration Accessory to perform an intensity calibration for the probe with the new optic.



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Figure 6. Installing an immersion optic (IO) on an Rxn-10 probe

To remove an immersion optic:

1. Loosen the torque limiting thumb screw by turning it approximately one turn so that the immersion optic is released from its clamp. Do not remove the screw.
2. Slide the immersion optic out.

5.2 Installing non-contact optics

The non-contact optics offered with the Rxn-10 probe are threaded, so a threaded adapter is required to attach the optic to the Rxn-10 probe.

⚠ WARNING

When installing or removing non-contact optics, ensure the laser and emission shutter are in the closed position.

To install a non-contact optic:

1. Loosen the torque limiting thumb screw on the Rxn-10 probe by turning the screw approximately one turn (do not remove). Then find the narrow, non-threaded end of the adapter.
2. Insert the narrow end of the adapter through the clamp. Push the adapter back until it stops.
3. Tighten the torque limiting thumb screw to hold the adapter in place.
4. Find the male threaded end of the non-contact optic.
5. Screw a non-contact optic onto the threaded end of the adapter.
6. After installing an optic on a probe, use the Raman Calibration Accessory to perform an intensity calibration for the probe with the new optic.

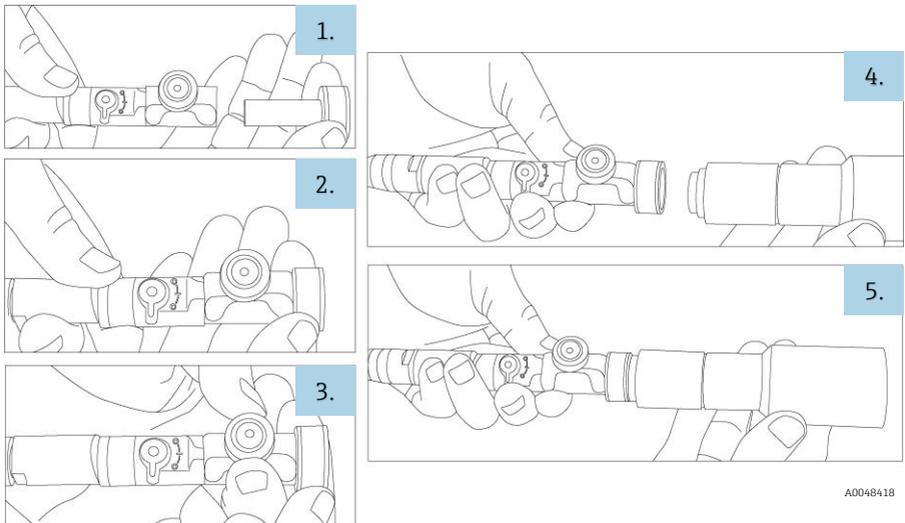


Figure 7. Installing an adapter and non-contact optic on a Rxn-10 probe

To remove a non-contact optic:

1. Unscrew the non-contact optic from the adapter.
2. If an immersion optic will be used, remove the adapter by turning the torque limiting thumb screw approximately one turn until the adapter is released from the clamp. Slide the adapter out.

5.3 Installing the Raman optic system for single use

NOTICE

Prior to insertion in the disposable fitting, the Rxn-10 probe with the reusable optic should be calibrated and verified.

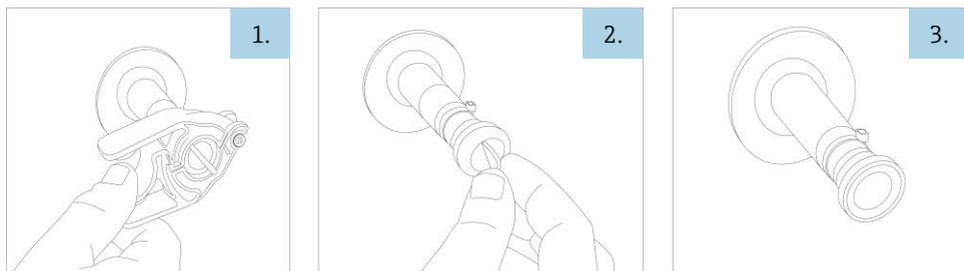
- ▶ See Section 6.2 →  for calibration and verification instructions.

5.3.1 Preparing the disposable fitting

The port shown below is specific to one type of single use bioreactor. The port, fitting, and cap/clamp (if present) may vary depending on the type of single use bioreactor. However, the optic insertion instructions are the same for all types of single use bioreactors.

To prepare the disposable fitting for optic insertion:

1. Depress the release lever on the sanitary clamp and remove the clamp.
2. Remove the sanitary cap from the fitting.
3. Ensure the sanitary o-ring seal is in place on the fitting.



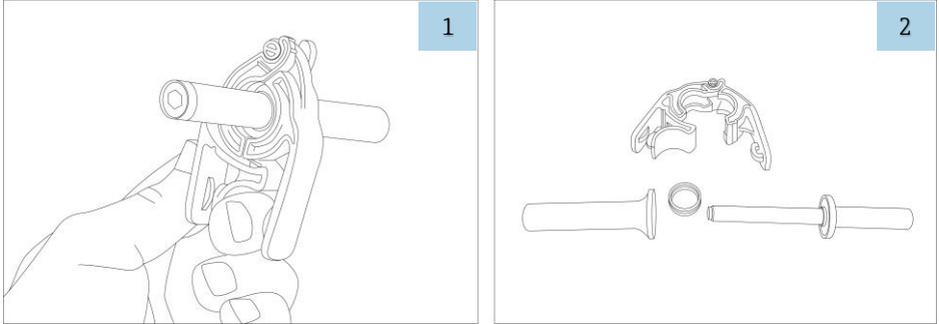
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Figure 8. Preparing the disposable fitting

5.3.2 Preparing the reusable optic for insertion into the fitting

To prepare the optic for insertion into the fitting:

1. Depress the release lever on the sanitary clamp and remove the clamp.
2. Remove the cap and seal. Store these components in a secure location.



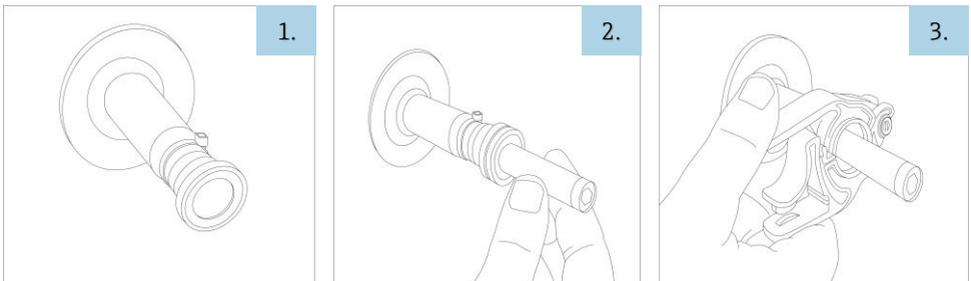
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Figure 9. Preparing the reusable optic

5.3.3 Inserting the optic in the fitting

To insert the optic in the disposable fitting:

1. Verify the sanitary o-ring seal on the fitting is still in place.
If not present, place a sanitary o-ring seal over the optic such that it is located in the sealing gland area.
2. Insert the optic into the disposable fitting.
3. Install the sanitary clamp, making sure it is clamped tightly.
There should be two distinct clicks indicating it is clamped correctly.



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Figure 10. Inserting the optic in the fitting

5.3.4 Installing the optic on the Rxn-10 probe

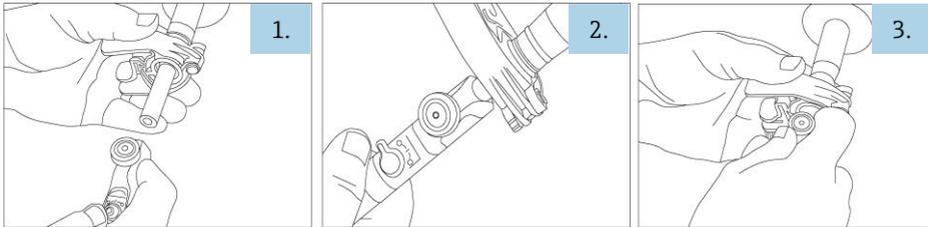
The Endress+Hauser reusable optic is not threaded. It slips into the Rxn-10 probe and is secured by a torque limiting thumb screw-based clamp.

⚠ WARNING

When installing or removing optics, ensure the laser and emission shutter are in the closed position.

To install the optic onto the probe:

1. Loosen the torque limiting thumb screw on the Rxn-10 probe by turning the screw approximately one turn (do not remove). Then insert the optic through the end optic clamp.
2. Push the optic back until it stops.
3. Tighten the torque limiting thumb screw to hold the optic in place. Failure to tighten the screw will result in the optic coming loose, potentially damaging the optic.
4. After installing an optic on a probe, and before it is connected to the fitting, use the Raman Calibration Accessory to perform an intensity calibration for the probe with the new optic and single use calibration adapter.



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Figure 11. Installing the reusable optic on the Rxn-10 probe

To remove the optic:

1. Loosen the torque limiting thumb screw by turning it approximately one turn so that the optic is released from its clamp. Do not remove the screw.
2. Slide the optic out.

6 Commissioning

The optics for the Rxn-10 probe are delivered ready to connect to the probe. No additional alignment or adjustment to the probehead is required. Follow the instructions below to commission the optics for use in conjunction with the probe.

6.1 Receipt of optics

Perform the steps for incoming product acceptance described in Section 4.1 → .

6.2 Calibration and verification

The probe and the analyzer must be calibrated before use.

6.2.1 Raman Calibration Accessory

After installing an optic on the probehead, use the Raman Calibration Accessory (HCA) to perform an intensity calibration for the probehead with the new optic.

For the Raman optic system for single use, an additional single use calibration adapter is installed onto the optic following the same process as connecting the optic to the fitting (see Section 5.3 → ). The optic/calibration adapter combination is then inserted into an HCA adapter attached to the HCA head.

Refer to the *Raman Calibration Accessory Operating Instructions* for additional information about the HCA and adapters.

6.2.2 Performing calibration and verification

Refer to the applicable Raman Rxn analyzer operating instructions for steps to:

- Perform internal analyzer calibration; may include alignment calibration, full wavelength calibration and/or full laser wavelength calibration depending on status of analyzer
- Perform probe calibration; requires HCA with an appropriate optic adapter
- Perform probe verification; verifies the calibration results using a standard reference sample
- View calibration and verification reports

The Raman RunTime software will not allow spectra to be collected without passing internal and probe calibrations. Passing the probe verification step is not required but highly recommended.

Raman Rxn analyzer operating instructions are available by searching the Downloads area of the Endress+Hauser web site: <https://endress.com/downloads>

7 Operation

This manual provides information about the optics used with the Endress+Hauser Rxn-10 Raman spectroscopic probe. The Rxn-10 probe is a versatile probe designed for product and process development and is compatible with Endress+Hauser Raman Rxn analyzers operating at 532 nm, 785 nm, or 993 nm. The Rxn-10 probe accepts a variety of interchangeable optics including:

- Immersion optic
- Non-contact optic
- bIO-Optic
- Raman optic system for single use

The optics are installed on the probe following the instructions in Section 5 → .

Refer to the *Rxn-10 Raman spectroscopic probe Operating Instructions* for operation of the probe with the optics. Standard precautions for laser products should be observed.

Additional use and storage instructions for some optics are provided below.

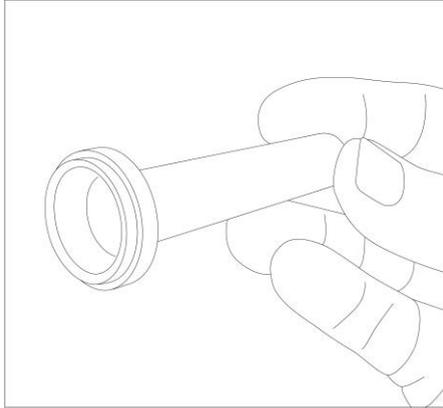
7.1 bIO-Optic and Raman optic system for single use

The bIO-Optic and Raman optic system for single use should NOT be used with hydrocarbon solvents (including ketones and aromatics). Doing so can degrade probe performance and invalidate the warranty.

The Raman optic system for single use is NOT intended to be submerged into any liquid without being attached to the disposable fitting.

7.2 Storing the reusable portion of the Raman optic system for single use

It is important to always keep the reusable optic protected via the fitting (when taking measurements) or with the cover provided during shipping (when storing). In either case, verify the o-ring seal is installed to ensure a clean and dry environment.



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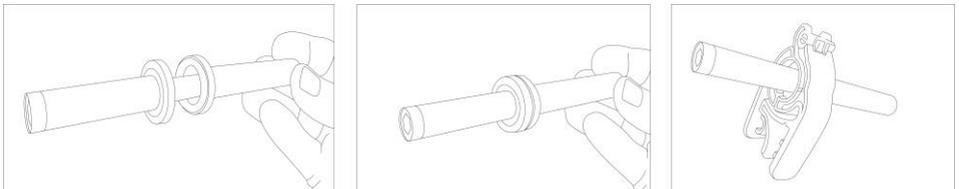
Figure 12. The cover for the reusable optic with o-ring present

⚠ WARNING

When installing or removing optics, ensure the laser and emission shutter are in the closed position.

To remove the optic and install the optic cover for storage:

1. Loosen (do not remove) the torque limiting thumb screw on the Rxn-10 probe.
2. Slide the Rxn-10 probehead off the reusable optic.
3. Locate the quick release clamp, the optic cover, and the sanitary seal (see Figure 12).
4. Slide the optic into the cover.
5. Install the quick release clamp over the optic/cover flange and squeeze the clamp until you hear two distinct clicks to tighten.



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Figure 13. Installing the optic cover and clamp

8 **Diagnostics and troubleshooting**

Refer to the *Rxn-10 Raman spectroscopic probe Operating Instructions* to troubleshoot issues with the Rxn-10 probe and accessory optics.

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