BA02168C/66/EN/03.23
70207205

Operating Instructions

Rxn-30 Raman spectroscopic probe

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1 About this document

1.1 Warnings

Structure of Information	Meaning
⚠ WARNING **Causes (/consequences)** Consequences of noncompliance (if applicable) ▸ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation can result in a fatal or serious injury.
⚠ CAUTION **Causes (/consequences)** Consequences of noncompliance (if applicable) ▸ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
NOTICE **Cause/situation** Consequences of noncompliance (if applicable) ▸ Action/note	This symbol alerts you to situations which may result in damage to property.

1.2 Symbols on the device

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 Raman Rxn 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 CSA Certification Mark indicates that the product was tested against and met the applicable North American standards requirements.
	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.
	The CE Marking indicates conformity with health, safety, and environmental protection standards for products sold within the European Economic Area (EEA).
	The ATEX Marking indicates the product has been certified to the ATEX directive for use in Europe, as well as in other countries accepting ATEX-certified equipment.

1.3 U.S. export compliance

The policy of Endress+Hauser is in 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.

1.4 Glossary

Term	Description
ANSI	American National Standards Institute
ATEX	atmosphere explosible
˚C	Celsius
CDRH	Center for Devices and Radiological Health
CFR	Code of Federal Regulations
cm	centimeter
CSA	Canadian Standards Association
EO	electro-optical
EU	European Union
EXC	excitation
˚F	Fahrenheit
ft	feet
ft-lb	foot-pound force
IEC	International Electrotechnical Commission
IGCC	integrated gasification combined cycle
in	inches
IPA	isopropyl alcohol
IS	intrinsically safe
LED	light emitting diode
m	meter
mbar	millibar pressure unit
mm	millimeter
MPE	maximum permissible exposure
NeSSI	New Sampling/Sensor Initiative
Nm	newton meter
nm	nanometer
psi	pounds per square inch
RD	red
SNR	signal-to-noise ratio
WEEE	Waste Electrical and Electronic Equipment
YE	yellow

2 Basic safety instructions

2.1 Requirements for personnel

- Installation, commissioning, operation, and maintenance of the measuring system 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 properly authorized and 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-30 Raman spectroscopic probe is intended for gas-phase sample analysis.

Recommended applications include:

- **Chemical:** ammonia, methanol, HyCO
- **Gas-phase streams in refining:** hydrogen production and recycle fuel blending, fuel characterization
- **Power and energy:** integrated gasification combined cycle (IGCC) power plants, gas turbines
- **Life sciences/food and beverage:** fermentations, offgas, volatiles

Use of the device for any purpose other than that described 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

The product has been tested for electromagnetic compatibility in accordance with the applicable international standards for industrial applications.

The electromagnetic compatibility indicated applies only to a product that has been properly connected to the analyzer.

2.4 Operational safety

Before commissioning the entire measuring point:

- Verify that all connections are correct.
- Ensure that electro-optical cables are undamaged.
- Do not operate damaged products, and protect them against unintentional operation.
- Label damaged products as defective.

During operation:

- If faults cannot be rectified, products must be taken out of service and protected against unintentional operation.
- 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 Laser safety

The Raman Rxn analyzers use Class 3B lasers as defined in the following:

- American National Standards Institute (ANSI) Z136.1, American National Standard for Safe Use of Lasers
- International Electrotechnical Commission (IEC) 60825-1, Safety of Laser Products – Part 1

WARNING

Laser radiation

- ▶ Avoid exposure to beam
- ▶ Class 3B laser product

CAUTION

Laser beams can cause ignition of certain substances such as volatile organic compounds.

The two possible mechanisms for ignition are direct heating of the sample to a point causing ignition and the heating of a contaminant (such as dusts) to a critical point leading to ignition of the sample.

The laser configuration presents further safety concerns because the radiation is nearly invisible. Always be aware of the initial direction and possible scattering paths of the laser. The use of laser safety glasses with OD3 or greater is highly recommended for 532 nm and 785 nm excitation wavelengths and OD4 or greater for a 993 nm excitation wavelength.

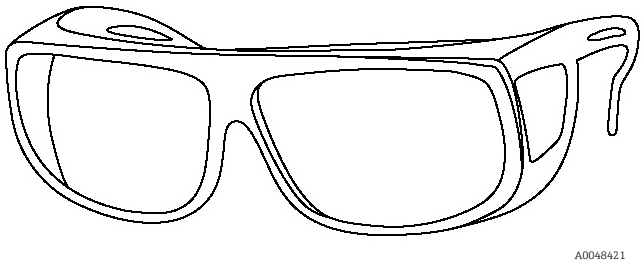


Figure 1. Laser safety glasses

For more assistance with taking appropriate precautions and setting the proper controls when dealing with lasers and their hazards, refer to the most current version of ANSI Z136.1 or IEC 60825-14. See *Technical data* → 🖹 for relevant parameters to calculate maximum permissible exposure (MPE) and nominal ocular hazard distance (NOHD).

2.6 Service safety

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

2.7 Important safeguards

- Do not use the Rxn-30 probe for anything other than its 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.
- Do not leave attached and unused probes uncapped or unblocked.
- Always use a laser beam block to avoid inadvertent scatter of laser radiation.

2.8 Product safety

This 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 also comply with the applicable analyzer safety standards.

Endress+Hauser Raman spectroscopy systems incorporate the following safety features to conform to the United States Government requirements 21 Code of Federal Regulations (CFR) Chapter 1, Subchapter J as administered by the Center for Devices and Radiological Health (CDRH) and IEC 60825-1 as administered by the International Electrotechnical Commission.

2.8.1 CDRH and IEC compliance

Endress+Hauser Raman analyzers are certified by Endress+Hauser to meet CDRH and IEC 60825-1 design and manufacturing requirements.

Endress+Hauser Raman analyzers have been registered with the CDRH. Any unauthorized modifications to an existing Raman Rxn analyzer or accessory may result in hazardous radiation exposure. Such modifications may result in the system being no longer in conformance with federal requirements as certified by Endress+Hauser.

2.8.2 Laser safety interlock

The Rxn-30 probe, as installed, forms part of the interlock circuit. If the fiber cable is severed, the laser will turn off as a result of the breakage, in compliance with IEC 60079-28 and IEC 60825-2.

NOTICE

Permanent damage may result if cables are not routed appropriately.

- Handle probes and cables with care, ensuring they are not kinked.
- Install fiber cables with a minimum bend radius according to the *Raman fiber-optic cable Technical Information (TI01641C)*.

The interlock circuit is a low-current electrical loop. If the Rxn-30 probe is used in a hazardous classified area, the interlock circuit must pass through an intrinsically safe (IS) barrier.

When there is potential for the laser to be energized, the LED laser indicator light is illuminated in accordance with 21 CFR Chapter 1, Subchapter J.

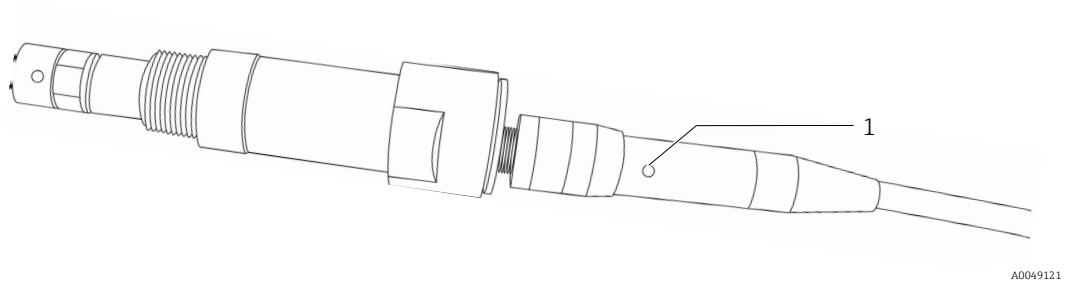


Figure 2. LED laser indicator location (1)

2.8.3 Hazardous area approvals

The Rxn-30 probe has been third-party approved for use in hazardous areas in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council dated 26 February 2014.

Only the Rxn-30 probe with the ATEX badge has been certified to the ATEX Directive for use in Europe, as well as in other countries accepting ATEX-certified equipment.

Figure 3. ATEX label for use in hazardous areas

The Rxn-30 probe has also been approved for use in hazardous areas in the United States (US) and Canada by the Canadian Standards Association when installed in accordance with the Hazardous Area Installation Drawing (4002396).

The products are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Figure 4. CSA label for use in hazardous areas in the US and Canada

The Rxn-30 probe can also be marked for International Electrotechnical Commission Certification Systems for Explosive Atmospheres (IECEx) when installed in accordance with the Hazardous Area Installation Drawing (4002396).

Only the Rxn-30 with the JPEx badge has been certified to meet Japan explosion proof requirements.

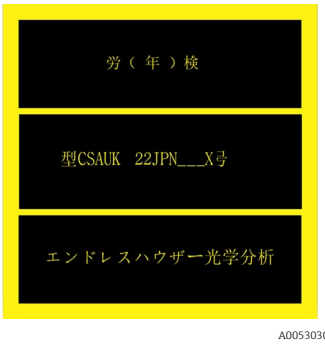


Figure 5. JPEx product certification label

The Rxn-30 has been assessed against Regulation 42 of the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016, UKSI 2016:1107 and been found to comply when installed in accordance with the Hazardous Area Installation Drawing (4002396).

Figure 6. UK product certification label

Refer to the *Rxn-30 Raman spectroscopic probe Safety Instructions (XA02748C)* for more information on condition of use and appropriate markings required for your application.

3 Product description

3.1 Rxn-30 probe

The Rxn-30 Raman spectroscopic probe, powered by Kaiser Raman technology, is intended for robust gas-phase measurements in a laboratory or process plant setting. The probe is designed to be compatible with Endress+Hauser Raman Rxn anlyzers operating at 532 nm.

The Rxn-30 probe is available with a variety of mounting options for maximum installation and sampling flexibility. These options allow for direct insertion, side insertion, and in sample loops. The probe is NeSSI compatible and slip-stream compatible. In addition, the Rxn-30 probe is compatible with installations in hazardous areas/classified environments.

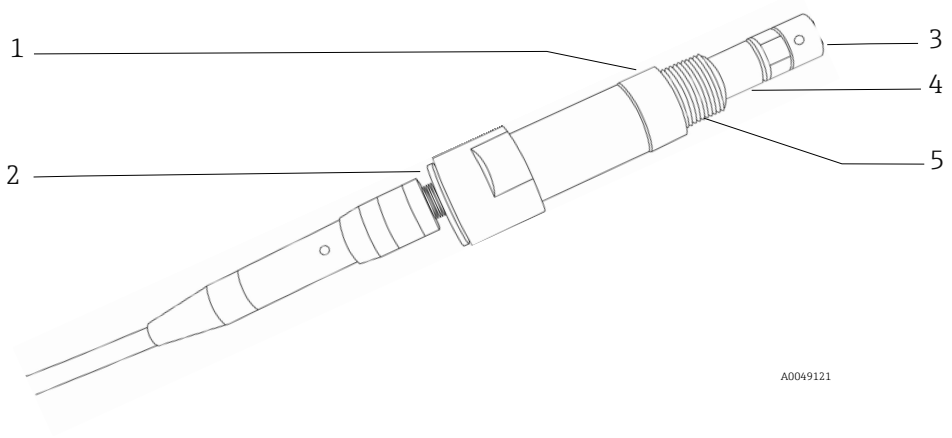


Figure 7. Rxn-30 probe

#	Description
1	1″ diameter compression fitting compatible
2	Connector/cable interface (leave attached)
3	Retro assembly
4	Sample gas ports located under a sintered metal filter
5	½″ NPT interface thread

3.2 Hardware

3.2.1 Standard hardware

Standard Rxn-30 hardware includes the following:

- Rxn-30 gas-phase probe
- Sample tube removal and replacement wrench to facilitate cleaning of internal sample and window surfaces
- Contamination gas filter for use in “dirty” sample environments and some classified/hazardous environments (20 micron pore sintered)

3.2.2 Additional accessories

The Rxn-30 probe connects to the Raman Rxn analyzer via a fiber-optic cable. Cables are available in 5 m (16.4 ft) increments with the length configured to suit and limited by the application. See *Probe and fiber optic connection* → 🖹 for additional information about fiber-optic cable options.

The Rxn-30 is designed to accommodate installation to a sample stream or vessel using one of these industry standard optional accessories:

- ½″ NPT cross fitting
- 1″ compression cross fitting

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

Probe may be damaged during transport if packaged inadequately.

4.2 Product identification

4.2.1 Label

The probe is labeled with the following information:

- Endress+Hauser branding
- Product identification (e.g., Rxn-30)
- Serial number

Tags are permanently affixed and also include:

- Extended order code
- Manufacturer information
- Key functional aspects of the probe (e.g., material, wavelength, focal depth)
- Safety warnings and certification information, as applicable

Compare the information on the probe and 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:

- Rxn-30 probe
- *Rxn-30 Raman spectroscopic probe Operating Instructions* manual
- Rxn-30 Certificate of Product Performance
- Local declarations of conformity, if applicable
- Certificates for hazardous zone use, if applicable
- Rxn-30 probe optional accessories, if applicable
- Material certificates, if applicable

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

4.4 Certificates and approvals

Refer to the *Rxn-30 Raman spectroscopic probe Safety Instructions (XA02748C)* manual for detailed certification and approval information.

5 Probe and fiber optic connection

The Rxn-30 probe connects to the Raman Rxn analyzer via one of the following:

- Fiber channel (FC) cable assembly
- Electro-optical (EO) fiber cable

An optional EO extension fiber cable is also available.

Fiber-optic cables are available in 5 m (16.4 ft) increments with the length configured to suit and limited by the application. Refer to the applicable Raman Rxn analyzer Operating Instructions for analyzer connection details. When connecting, ensure the following, as applicable:

- The laser interlock is connected to the safety indicator light and to any other safety systems (such as purges) appropriate to the installation.
- Remote interlock connectors are in place on each channel.

NOTICE

Connection of the probe to the FC cable assembly or the EO fiber cable must be conducted by a qualified Endress+Hauser engineer or specially trained technical personnel.

- ▶ Unless trained by qualified personnel, customer attempts to connect the probe to the fiber-optic cable can result in damage and may void the warranty.
- ▶ Contact your local Endress+Hauser service representative for additional support regarding the probe and fiber cable connection.

5.1 FC cable assembly

The FC cable assembly connects the Rxn-30 probe to the analyzer via the following:

- Electrical interlock connector
- Yellow (YE) excitation fiber for laser output
- Red (RD) collection fiber for spectrograph input

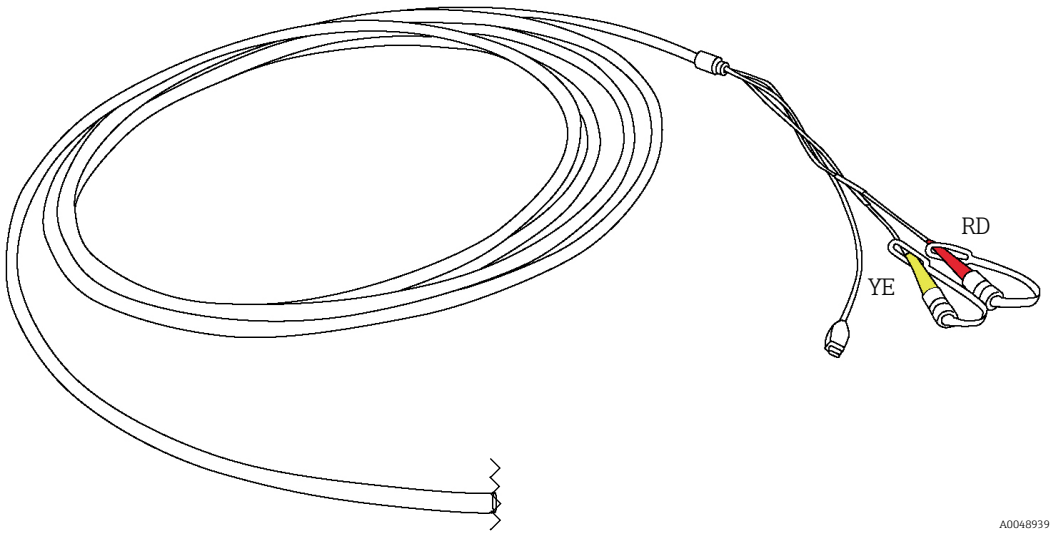


Figure 8. FC cable assembly showing connector for analyzer

5.2 EO fiber cable

The EO fiber cable connects the Rxn-30 probe to the analyzer with a single, robust connector that contains the excitation and collection fiber-optics as well as an electrical laser interlock.

An EO extension cable is available for longer cable runs or installation in conduit.

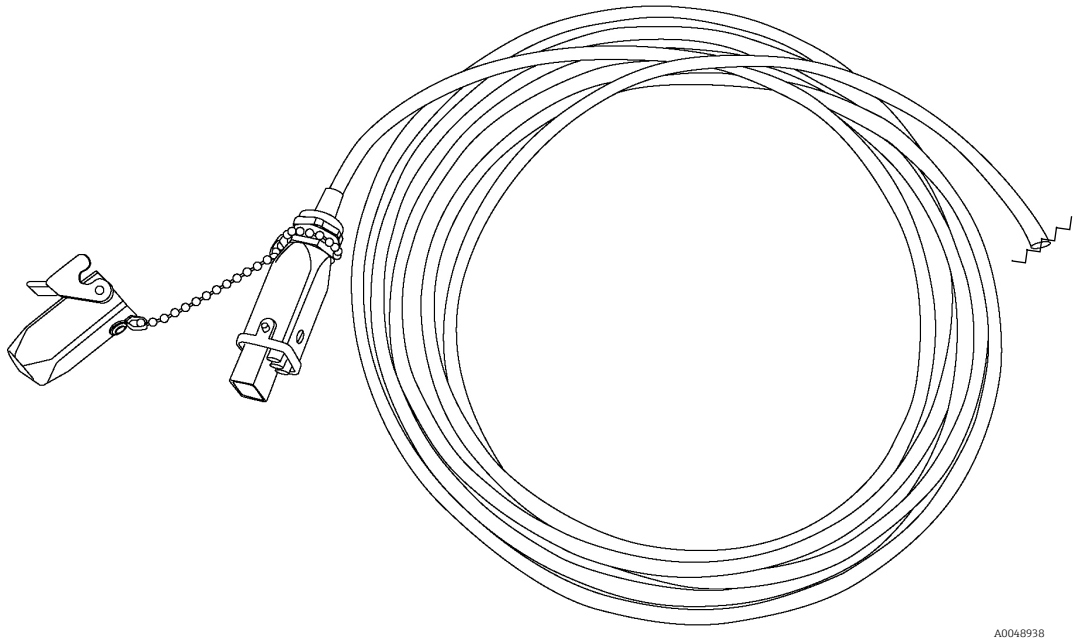


Figure 9. EO fiber cable showing connector for analyzer

6 Installation

Prior to installation in the process, verify that the amount of laser power out of each probe is no more than the amount specified in the Hazardous Area Equipment Assessment (4002266) or equivalent.

Standard eye and skin safety precautions for Class 3B laser products (as per EN-60825/IEC 60825-14) should be observed.

The Rxn-30 probe is designed to accommodate installation to a sample stream or vessel using one of these industry standards:

- ½″ NPT cross fitting
- 1″ compression cross fitting

With either installation, ensure that the sample gas ports will be in the stream flow or region of interest.

6.1 Rxn-30 probe with NPT cross fitting

Endress+Hauser offers an optional, custom ½″ NPT cross fitting with standard NPT adapters for ¼″ stainless tubing (P/N 70187793, not included). It provides four ½″ NPT ports. The fourth port may be used for temperature or pressure sensors, condensate drainage, or it may be plugged.

Apply Teflon tape to the NPT threads of the Rxn-30 probe when connecting the probe to the cross fitting.

NOTICE

Excessive twisting of the cable within the connector may break a fiber connection, rendering the Rxn-30 inoperable.

▶ Using a compression fitting installation instead of NPT may alleviate this issue.

Take care not to twist the cable within the connector while tightening the Rxn-30 into this or any other NPT fitting. Thread the fitting onto the stationary Rxn-30 if circumstances allow. Otherwise, rotate the entire cable with the probe as the Rxn-30 is threaded into the fitting.

NOTICE

NPT interconnects are not the preferred probe interface if the probe will be removed and reinstalled.

▶ For these types of installations, a compression fitting is recommended. See *Rxn-30 probe with compression cross fitting* → 🖹.

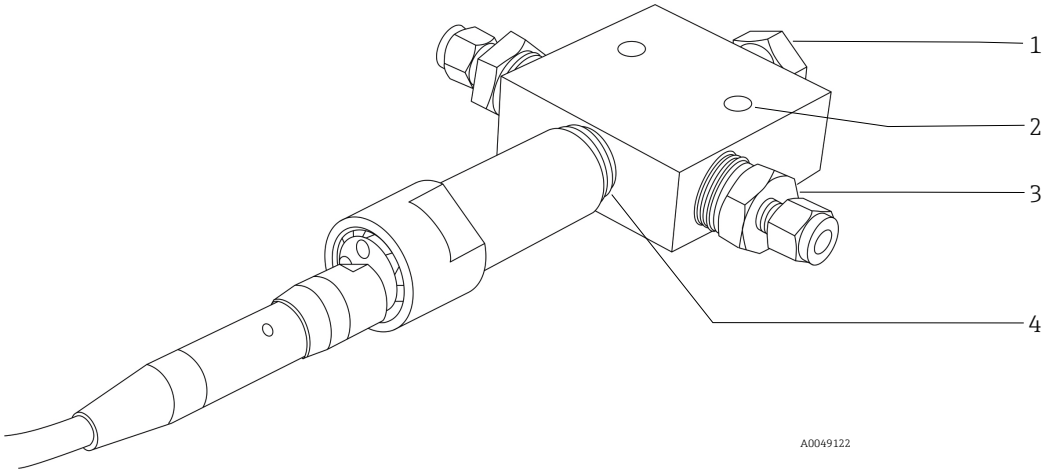


Figure 10. Rxn-30 probe integrated to ½ inch NPT cross fitting

#	Description
1	½″ NPT plug for port not in use
2	(2) ¼″ mounting holes
3	(2) ½″ NPT to ¼ inch stainless tubing compression adapters
4	½″ NPT Rxn-30 port

6.2 Rxn-30 probe with compression cross fitting

The Rxn-30 probe may also be installed using a standard 1˝ compression cross fitting, commercially available or from Endress+Hauser (P/N 71675522).

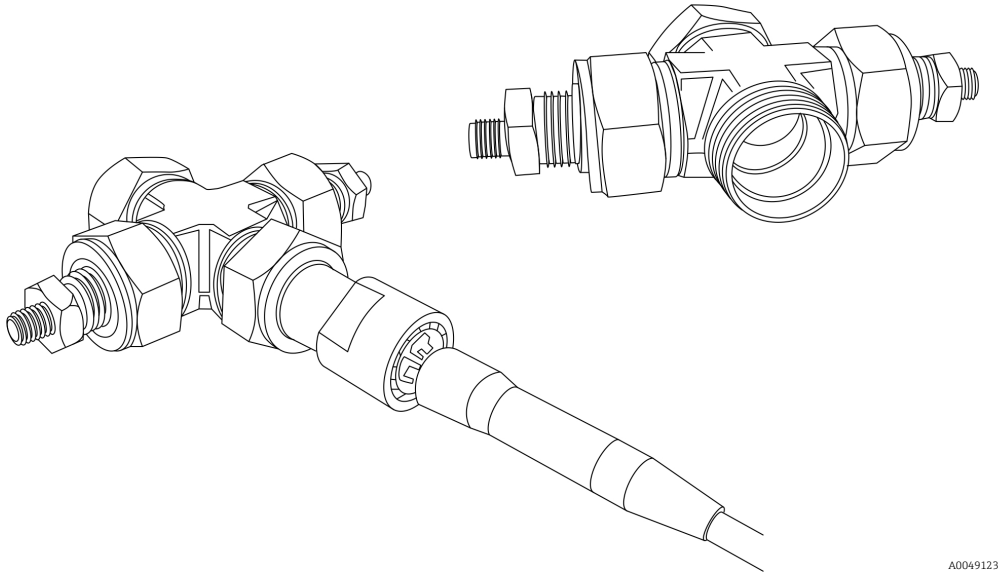


Figure 11. Rxn-30 probe integrated to 1 inch standard compression cross fitting

6.3 Process and probe compatibility

Prior to installation, the user must check that the probe pressure and temperature ratings, as well as the materials from which the probe is made, are compatible with the process into which it is being inserted.

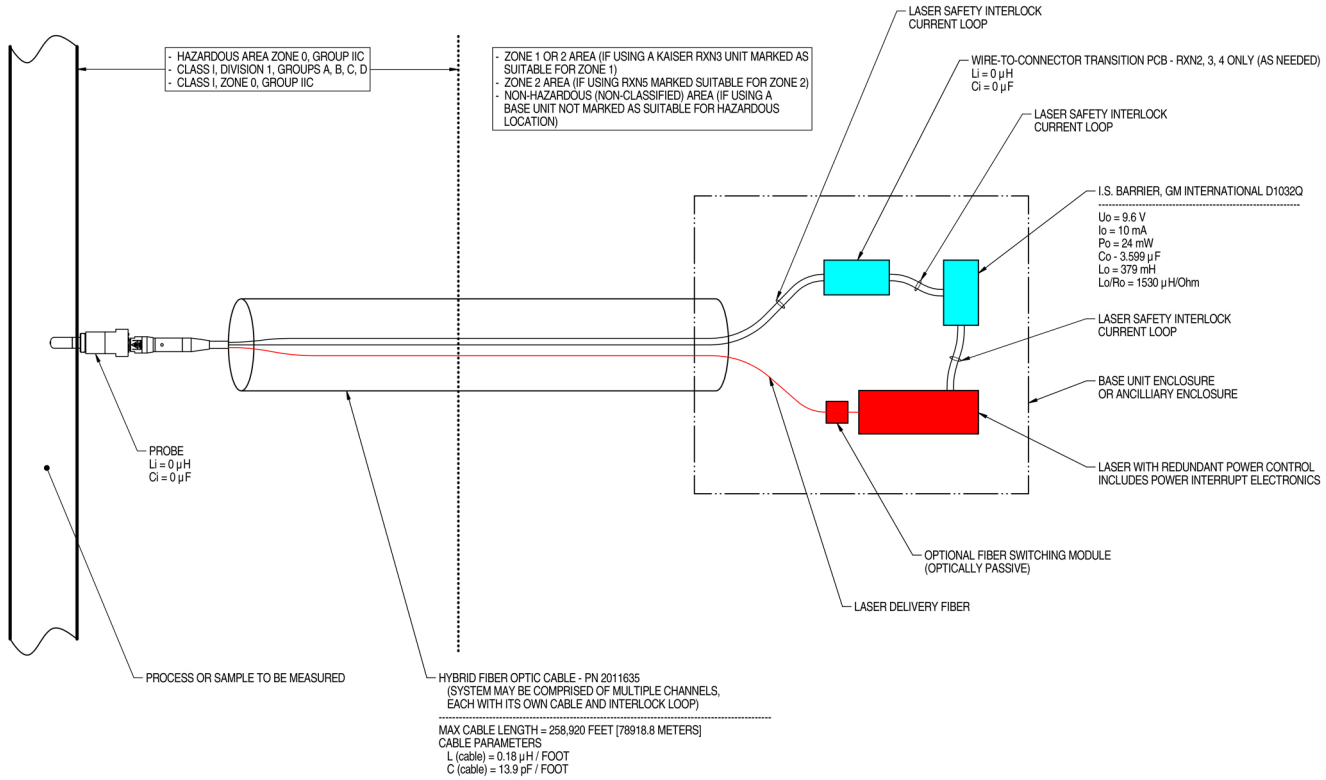
6.4 Hazardous area installation

The Rxn-30 probe is certified for use in hazardous area environments and has been designed to be installed directly into process streams or reactor vessels. The probe must be installed according to the Hazardous Area Installation Drawing (4002396).

Before installation, verify that the probe hazardous area markings are appropriate for the gas group, T-class, Zone, or Division it is being installed in. Please refer to IEC 60079-14 for more information on user responsibilities regarding use or installation of products in potentially explosive atmospheres.

NOTICE

When installing the probe *in situ*, the user must ensure that there is strain relief at the installation location which complies with fiber bend radius specifications.



NOTES:

1. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 VRMS OR VDC.
2. INSTALLATION IN THE U.S. SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" AND THE NATIONAL ELECTRICAL CODE® (ANSI/NFPA 70) SECTIONS 504 AND 505.
3. INSTALLATION IN CANADA SHOULD BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, CSA C22.1, PART 18, APPENDIX J18.
4. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
5. FOR U.S. INSTALLATIONS, THE PROBE MODELS RXN-30 (AIRHEAD), RXN-40 (WETHEAD) AND RXN-41 (PILOT) ARE APPROVED FOR CLASS I, ZONE 0 APPLICATIONS.
6. NO REVISION TO DRAWING WITHOUT PRIOR CSA APPROVAL.
7. WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

A0049010

Figure 12. Hazardous Area Installation Drawing (4002396 version X6)

7 Commissioning

The Rxn-30 probe is delivered ready to connect to the Raman Rxn analyzer. No additional alignment or adjustment to the probe itself is required. Follow the instructions below to commission the probe for use.

NOTICE

The probe installation and usage parameters may have specific requirements governed by the associated application.

- ▶ Please refer to the appropriate certificate for ATEX, CSA, IECEx, JPEx, or UKCA for those specific requirements.

7.1 Receipt of probe

Perform the steps for incoming product acceptance described in *Incoming acceptance* → 🖹.

Additionally, upon receipt, remove the shipping container cover and inspect the sapphire window for any damage prior to installing into the process. If the window shows any visible cracks, please contact the supplier.

7.2 Probe calibration and verification

The probe and the analyzer must be calibrated before use. Refer to the applicable Raman Rxn5 analyzer operating instructions for further information on internal instrument calibration.

An intensity calibration must be performed before collecting measurements, upon first installation, at intervals defined by your company's SOP, and after any service on the probe. Use the appropriate calibration gas composition related to your application. Follow the calibration instructions in the *RunTime Operating Instructions (BA02180C)*.

The Raman Runtime software will not allow spectra to be collected without passing internal system calibrations.

After calibration, perform Raman RunTime channel verification using a Raman spectrum of the calibration gas is highly recommended to verify the calibration results is recommended, but is not required. Instructions on verification can also be found in the *RunTime Operating Instructions (BA02180C)*.

The recommended calibration and qualification sequence follows this order:

1. Internal analyzer calibration for spectrograph and laser wavelength.
2. System intensity calibration using appropriate calibration accessory.
3. System function verification using appropriate standard material.

Contact your sales associate for specific questions related to your probe, optic, and sampling system.

8 Operation

Refer to the applicable Raman Rxn analyzer Operating Instructions for additional information not covered below.

8.1 Routine operation

The Endress+Hauser Raman Rxn-30 probe is designed for *in situ* Raman spectroscopy of gas-phase samples in a laboratory or process plant setting. The Rxn-30 line of probes is designed to be compatible with Endress+Hauser Raman Rxn analyzers operating at 532 nm.

8.2 Start-up procedure

Illuminate the Rxn-30 probe with the excitation laser for as long as is practical before acquiring operational Raman spectra. This has the effect of quenching background that originates from the internal optical surfaces of the probe. Guidelines for start-up:

- A minimum of 1 hour is recommended if the probe has been “dark” for several hours.
- A period of 1 to 3 days is recommended if the probe has been “dark” for an extended period (days or weeks).

The quenching reduction in background/baseline and corresponding increase in signal-to-noise ratio (SNR) will be significant in applications involving low concentration or low pressure sample gases.

8.3 Recommendations for optimal performance

The Rxn-30 probe is a sensitive optical instrument that must be handled and operated with appropriate care for optimal performance. The following recommendations and precautions should be observed:

- Keep the sample end of the Rxn-30 probe clean. If dust or other condensates collect on the internal optics of the sample tip, the Raman signature of those contaminants will be added to, or even dominate, the weaker gas sample signatures being measured.
- If the probe becomes contaminated to the point where cleaning is absolutely necessary, refer to the relevant disassembly and cleaning instructions in *Maintenance* → 🖹. Alternately, you may return the Rxn-30 to Endress+Hauser for cleaning.
- A sintered metal contamination filter is normally mounted over the probe’s gas sample ports for operation in a dirty or hazardous environment. It may be removed, if desired, for a somewhat faster response to changes in gas sample concentrations. Refer to the filter kit installation instructions in *Installing the particulate filter* → 🖹.
- Mount the Rxn-30 in a horizontal orientation. This will minimize the likelihood of any contaminants or condensates collecting on the optical surfaces, thereby minimizing their impact on performance.
- Leave the cable attached to the Rxn-30. The fibers are coupled to the head with index matching gel inside the connector. If the connector is removed, the exposed gel becomes a magnet for contamination that can reduce throughput and risk damage due to laser burn.

  If the connector is removed, it is recommended that all traces of the original coupling gel be cleaned from both the cable and Rxn-30 fiber interfaces. Partial disassembly of the input end of the Rxn-30 is necessary in order to accomplish this. Fresh coupling gel must then be reapplied immediately prior to reconnection. These operations should only be performed by factory trained service personnel.
- Do not twist the cable at its connection to the Rxn-30 probe. If the probe is interfaced to an NPT fitting, follow the NPT cross fitting installation instructions in *Rxn-30 probe with NPT cross fitting* → 🖹 to ensure the internal fiber optical connection is not damaged.

9 Diagnostics and troubleshooting

Refer to the table below when troubleshooting issues with the Rxn-30 probe. If the probe is damaged, isolate the probe from the process stream and turn off the laser prior to evaluation. Contact your service representative as needed for assistance.

Symptom		Possible cause	Action
1	Substantial reduction in signal or signal-to-noise ratio	Window fouling	1. Carefully remove probe from the process, decontaminate, and inspect optical window at tip of probe. 2. If necessary, clean the window as described in *Cleaning the window and mirror*→ 🖹 before returning it to service.
		Cracked but intact fiber	Verify condition of fiber and contact your service representative for replacement.
2	Complete loss of signal while laser is powered and LED laser indicator is lit	Broken fiber without interlock wire breakage	Ensure all fiber connections are secure.
3	Rising baseline when compared to result at installation	Probe window or retro fouling	1. Turn off the laser for the contaminated probe. 2. Clean the window and mirror as described in *Cleaning the window and mirror*→ 🖹 before returning to service. 3. If increased baseline persists, contact your service representative.
4	High signal level	Detector saturation is too high. Possible increase in sample pressure	Check that the sample pressure is in range with the original installation conditions.
5	LED laser indicator on probe is not lit	Damaged fiber assembly	Look for signs of breakage in fiber. Contact your service representative for replacement.
		Fiber cable EO connector not secured/latched	Ensure EO connector is properly connected and latched at the probe (if applicable) and at the analyzer.
		Remote interlock connector disconnected	Ensure the twist-lock remote interlock connector at the rear of analyzer (next to fiber EO connector) is connected.
6	Unstable signal and contamination visible behind window	Window seal failure	1. Examine the area inside the window for moisture or condensation. 2. Examine the probe for fluid penetration or signs of sample fluid in the probe body (e.g., corrosion, residue). 3. Look for any sign of spectral deviation. 4. If any of the above are noted, contact your service representative to return the probe to the manufacturer.
7	Decreased laser power or collection efficiency	Contaminated fiber connection	Carefully clean the fiber ends at the probe. Refer to the applicable Raman Rxn analyzer Operating Instructions for cleaning instructions and steps for starting up a new probe.
8	Laser interlock on analyzer causes laser to shut down	Laser interlock activated	Check for fiber breakage on all connected fiber-optic cable channels and ensure remote interlock connectors are in place on each channel.
9	Unrecognized bands or patterns in the spectra	Cracked but intact fiber	Verify possible causes and contact your service representative to return the damaged product.
		Contaminated probe tip	
		Contaminated internal optics of probe due to leakage	
10	Other unexplained negative performance of the probe	Physical damage to probe	Contact your service representative to return the damaged product.

10 Maintenance

10.1 Partial disassembly and reassembly

The gas port and mirror tube assembly can be removed for the following activities:

- Cleaning a contaminated window or mirror
- Installing the optional particulate filter for operation in contaminated sample environments

WARNING

The laser must be OFF when removing the assembly.

If the laser is ON, unsafe laser radiation levels may escape the disassembled Rxn-30 probe.

CAUTION

Disassembly and reassembly as described below may generate a slight misalignment of the optical system, resulting in a partial reduction of sensitivity (normally not more than 10 percent).

- ▶ It is recommended that cleaning and filter installation be performed at the manufacturer's site, where alignment can be adjusted as necessary after reassembly.
- ▶ These maintenance tasks must be conducted by a qualified Endress+Hauser service representative or specially trained technical personnel.
- ▶ Unless trained by qualified personnel, customer attempts to perform these tasks can result in permanent damage and may void the warranty.
- ▶ Contact your local Endress+Hauser service representative for additional support.

To disassemble the gas port and mirror tube assembly:

1. Stabilize the body of the Rxn-30 probe using a 1⅛″ wrench or adjustable wrench on the stabilizing flats.
2. Use a $^{9}/_{16}$″ hex wrench or adjustable wrench on the hexagonal portion of the probe head to turn the tube assembly counter-clockwise.
3. Once the threads are loosened, unscrew the tube and fully remove it by hand.

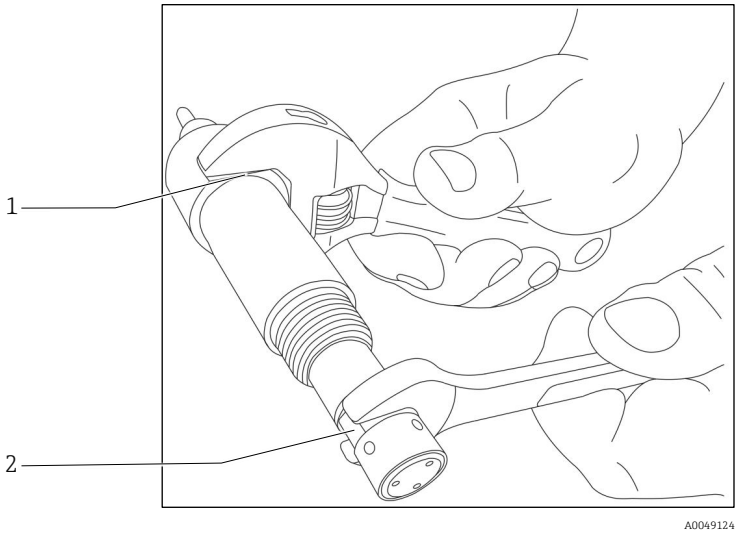


Figure 13. Disassembly and reassembly of the gas port and mirror tube assembly

#	Description
1	Stabilizing wrench flat
2	Hex wrench flats

CAUTION

Do NOT use any thread compound on the threads.

The threads are exposed to the sample region. Use of compound could cause a possible reaction or contamination of the optics.

To reassemble the gas port and mirror tube assembly:

1. Thread the tube back onto the Rxn-30 probe body by hand.
2. Stabilize the body of the Rxn-30 probe using a 1⅛ ″ wrench or adjustable wrench.
3. Use a $^{9}/_{16}$ ″ hex wrench or adjustable wrench on the hexagonal portion of the probe head to turn the tube assembly clockwise to tighten.
4. When the tube assembly reaches the hard stop for alignment, tighten the threads against this stop with 32.54 Nm (288 lb-in) of torque to avoid inadvertent loosening.

10.2 Cleaning the window and mirror

The window is located in the body of the Rxn-30 probe and the mirror is in the gas port and mirror tube assembly. Both optical surfaces are recessed.

Extra care must be taken to ensure that the window surface is not further contaminated during the cleaning process.

For all other maintenance, it is recommended that the Rxn-30 probe is serviced at the manufacturer's site.

To clean the Rxn-30 window or mirror

1. Follow the disassembly steps above to access the window or mirror for cleaning.
1. Blow off the surface with clean compressed air to remove any loose particles such as metal fragments from threads or the sintered metal filter.

   If particles are present and not removed, they may scratch the optical coatings during the rest of the cleaning process.
2. Wipe the surface using a swab **lightly** dampened with a solvent appropriate for the substance to be cleaned. Solvents may include reagent grade acetone, 100 % isopropyl alcohol (IPA), deionized water, or others.

   Do not allow the solvent to drip behind the retaining components.
3. Wipe the surface dry with a dry swab.
4. Repeat the cleaning with an additional solvent, if needed, and wipe the surface dry with a dry swab.
5. Blow with clean compressed air to remove any swab remnants.
6. Inspect the surface under a microscope to verify the effectiveness of the cleaning.

   Use of an inspection microscope in the cleaning process is highly recommended to look for smeared contaminants, swab remnants, etc., that may cause increased spectrum background.
7. Repeat the previous steps as necessary.

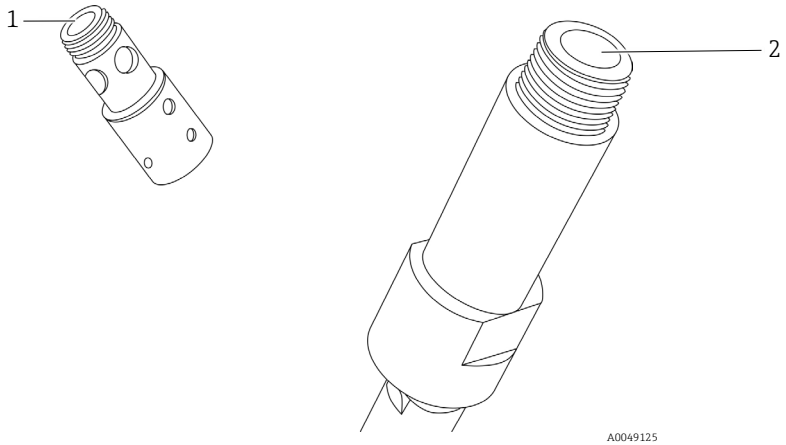


Figure 14. Separated sample tube and main body assemblies for cleaning access

#	Description
1	Mirror cleaning access
2	Window cleaning access

10.3 Installing the particulate filter

The optional particulate filter is supplied as a kit consisting of:

- 1 sintered metal filter sleeve (20 micron pore size)
- 2 Teflon sealing gaskets

With the sample tube assembly removed according to the directions provided above, these components slip over the sample region of the tube. The tube and body are then reassembled as described above.

When the tube is torqued against the hard metal stop on the Rxn-30 body, the gaskets compress and seal both ends of the filter to the Rxn-30 assembly.

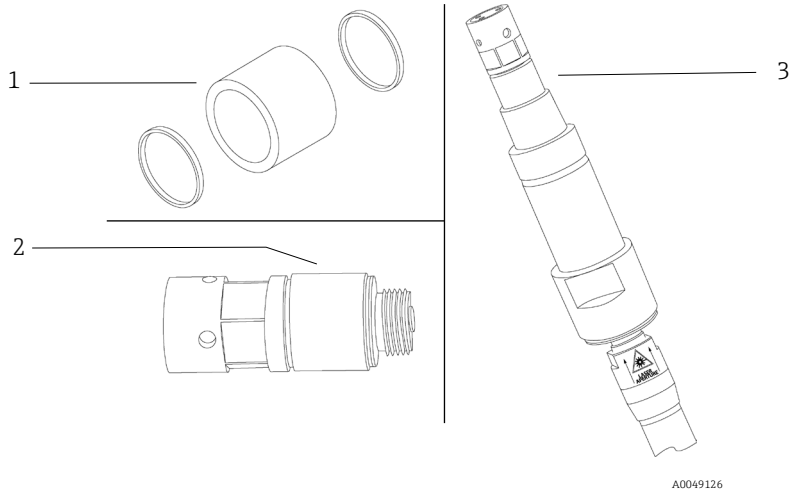


Figure 15. Particulate filter kit and installation

#	Description
1	Particulate filter kit with filter sleeve and 2 sealing gaskets
2	Particulate filter on sample tube
3	Final reassembly of the Rxn-30 probe with particulate filter

10.4 Inspecting and cleaning the optical fibers

The optical fiber connectors (FC or EO) must be clean and free of debris and oil to achieve optimal performance. If cleaning is required, refer to the applicable Raman Rxn analyzer Operating Instructions.

10.5 Probe interior volume maintenance

Probes that are located in hazardous areas should have the interior volumes re-purged and re-pressurized approximately every 5 years. This maintenance may be done in the field with a few special tools. Contact your local Endress+Hauser service provider for details.

11 Repair

Repairs not described in this document must be carried out only directly at the manufacturer's site or by the service organization. For Technical Service, refer to our website (https://endress.com/contact) for the list of local sales channels in your area.

If a product must be returned for repair or replacement, follow all decontamination procedures indicated by your service provider.

WARNING

Failure to properly decontaminate wetted parts before return can result in a fatal or serious injury.

To ensure swift, safe, and professional product returns, please contact your service organization.

For additional product return information, refer to the following site and select the applicable market/region: https://www.endress.com/en/instrumentation-services/instrumentation-repair

12 Technical data

12.1 Specifications

The following are specifications for the Rxn-30 probe.

Item		Description
Laser wavelength		532 nm
Spectral coverage		probe spectral coverage is limited by the coverage of the analyzer being used
Maximum laser power into probe		< 499 mW
Operating temperature (probe body/sample)		−20 to 150 °C (−4 to 302 °F)
Operating temperature (cable and connector)		−40 to 70 °C (−40 to 158 °F)
Temperature ramp		≤ 6 °C/min (≤ 10.8 °F/min)
Maximum operating pressure (sample space)		68.9 barg (1000 psig)
Operating humidity		0 to 95 % relative humidity, non-condensing
Probe body purge		helium
Probe body hermeticity		purge helium leak rate < 1×10^{-7} mbar·L/s
Chemical resistance		per sample contact with sapphire, fused silica, 316 stainless, dielectric coatings (SiO_2, TiO_2), thin dense chrome (TDC), and Teflon
Signal collection efficiency (system level, with nominal Raman Rxn base unit)		ambient air N_2 peak height Rxn-30-532: > 2.5 e^-/sec/mW
Background suppression, N_2 baseline		adjacent baseline < 0.15X N_2 ambient air peak at < 2331 cm^{-1}
Background suppression, full spectrum		max background < 1.0X N_2 air peak
Wetted materials		316/316L stainless steel PTFE sapphire fused silica glass
Fiber-optic cable (sold separately)	flame resistance	Certified: CSA-C/US AWM I/II, A/B, 80C, 30V, FT1, FT2, VW-1, FT4 Rated: AWM I/II A/B 80C 30V FT4
	length	available in 5 m (16.4 ft) increments with the length configured to suit and limited by the application

12.2 Maximum permissible exposure

The maximum permissible exposure (MPE) is the maximum level of laser radiation exposure that can occur before causing ocular or skin damage. The MPE is calculated using the laser wavelength (λ) in nanometers, the duration of the exposure in seconds (t), and the energy involved (J·cm^{-2} or W·cm^{-2}).

A correction factor (C_A) may also be required and can be determined below.

Wavelength λ (nm)	Correction factor C_A
400 to 700	1
700 to 1050	$10^{0.002(\lambda-700)}$
1050 to 1400	5

12.2.1 MPE for ocular exposure

The ANSI Z136.1 standard provides means to perform MPE for ocular exposure. Please refer to the standard to calculate the relevant MPE levels for the case of laser exposure from the Rxn-30 probe and from the unlikely occurance of laser exposure from a broken optical fiber.

MPE for point source ocular exposure to a laser beam			
Wavelength ***λ (nm)***	**Exposure duration** ***t (s)***	**MPE calculation**	
		(J·cm^{-2})	***(W·cm^{-2})***
532	10^{-13} to 10^{-11}	1.0×10^{-7}	-
	10^{-11} to 5×10^{-6}	2.0×10^{-7}	-
	5×10^{-6} to 10	$1.8\ t^{0.75} \times 10^{-3}$	-
	10 to 30,000	-	1×10^{-3}

12.2.2 MPE for skin exposure

The ANSI Z136.1 standard provides means to perform MPE for skin exposure. Please refer to the standard to calculate the relevant MPE levels for the case of laser exposure from the Rxn-30 probe and from the unlikely occurance of laser exposure from a broken optical fiber.

MPE for skin exposure to a laser beam				
Wavelength ***λ (nm)***	**Exposure duration** ***t (s)***	**MPE calculation**		**MPE where** C_A **= 1.4791**
		(J·cm^{-2})	***(W·cm^{-2})***	
532	10^{-9} to 10^{-7}	$2\ C_A \times 10^{-2}$	-	2.9582×10^{-2} (J·cm^{-2})
	10^{-7} to 10	$1.1\ C_A\ t^{0.25}$	-	Insert time (t) and calculate
	10 to 3×10^4	-	$0.2\ C_A$	2.9582×10^{-1} (W·cm^{-2})

13 Supplementary documentation

All documentation is available:

- On the Endress+Hauser mobile app: www.endress.com/supporting-tools
- In the Downloads area of the Endress+Hauser website: www.endress.com/downloads

This document is an integral part of the document package, which includes:

Part number	Document type	Document title
KA01548C	Brief Operating Instructions	Rxn-30 Raman spectroscopic probe Brief Operating Instructions
XA02748C	Safety Instructions	Rxn-30 Raman spectroscopic probe Safety Instructions
TI01632C	Technical Information	Rxn-30 Probe Raman spectroscopic probe Technical Information
BA02173C	Operating Instruction	Raman calibration accessory Operating Instructions

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