TI01631C/66/EN/03.23
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Technical Information

Rxn-20 Raman spectroscopic probe

The no-touch, focus-free solution for Raman lab or process solids measurement

Application

The Rxn-20 Raman spectroscopic probe is intended for the measurement of solids and semi-solids in a laboratory or process development or manufacturing setting.

Recommended applications include:

- **Polymers:** extruded pellet quality, crystallinity, density, raw materials
- **Pharmaceutical:** crystallinity, polymorphism, granulation, blend uniformity, content uniformity, coating, tableting
- **Chemicals:** final product quality, blend impurities, crystallinity, raw materials
- **Food and beverage:** quality of dairy solids, meat and fish composition

Device properties

- 316L stainless steel
- optical-grade materials
- PVC jacketed, proprietary construction

Your benefits

- Non-contact measurement of heterogeneous solids for better representation
- Improved process control and efficiency through faster measurements
- Non-destructive measurements from a distance
- Reproducible sampling
- Sampling flexibility with a variety of focus-free and immersion Rxn-20 accessory optics
- No need to align probe for surface roughness
- Surface and deep layer (volumetric) analysis

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Function and system design

Application

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.

Laser safety interlock

The Rxn-20 probe, as installed, forms part of the interlock circuit. If the fiber cable is severed, the laser will turn off within milliseconds of the breakage.

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 probe contains an intrinsically safe level of electrical potential. If the probe is installed in an enclosure, an optional interlock switch may be fitted to the enclosure lid such that opening the enclosure will operate the laser interlock and shut the laser down within milliseconds of the enclosure being opened.

Rxn-20 probe

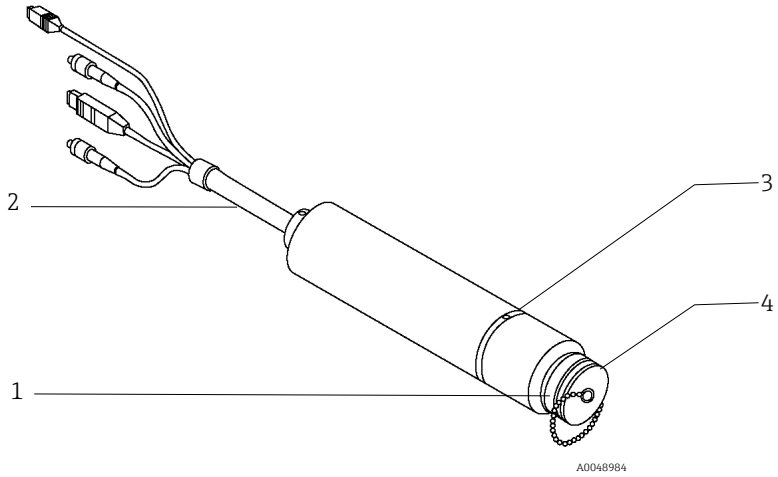


Figure 1. Rxn-20 probe

#	Name	Description
1	Removable non-contact optic	Lens adapters used to modify spot size to one of the following: 1, 1.5, 3, 4.7 and 6 mm (0.04, 0.06, 0.12, 0.19 and 0.24 in).
2	Fiber-optic cable	Connects the probe to the Raman Rxn analyzer. Standard fiber cable lengths are 3, 10 or 15 m (9.84, 32.81, or 49.21 ft). See Figure 2 for fiber optic bundle details.
3	Laser emission indicator	When there is potential for the laser to be energized, the indicator light is illuminated.
4	Beam block	Threaded cap attached to the Rxn-20 probe to prevent inadvertent laser scatter. Attached and unused probes should be capped.

Fiber optic bundle

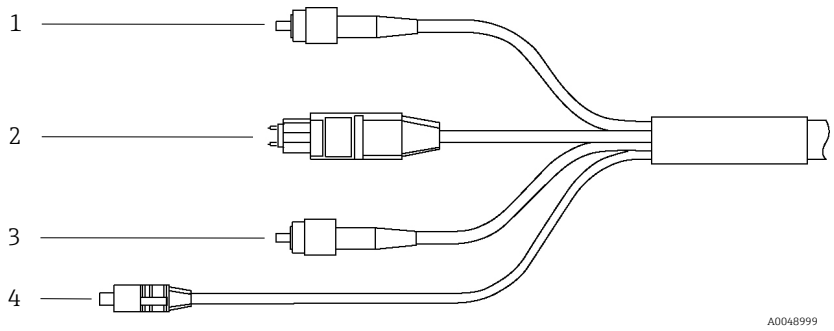
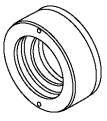
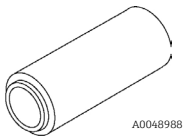
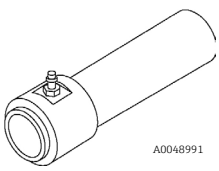
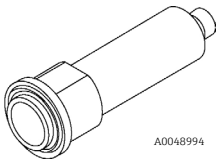


Figure 2. Rxn-20 probe fiber-optic bundle

#	Name	Description
1	Excitation fiber	Fiber channel (FC) type fiber that provides fiber optic laser radiation output
2	Collection fiber	Mechanical transfer (MT) type fiber for Raman scatter collection
3	Calibration fiber	FC type fiber that provides fiber optic auto-calibration source output
4	Laser interlock connector	Electrical interlock loop connector; in case of fiber breakage, laser will turn OFF

Rxn-20 probe accessories

The probe is compatible with the following accessories to meet the requirements of different applications.

Accessories		Materials of Construction	Diameter	Available Spot Sizes
Lens adapters	 A0048985	316 stainless steel, PTFE adhesive: ISO 10993 compliant fused silica glass	38.1 mm (1.50 in)	1 mm (0.04 in)* 1.5 mm (0.06 in)* 3 mm (0.12 in) 4.7 mm (0.19 in) 6 mm (0.24 in)
Lens tubes: non-purged	 A0048988	Aluminum alloy 6061-T651, anodized black	31.8 mm (1.25 in)	3 mm (0.12 in) 4.7 mm (0.19 in) 6 mm (0.24 in)
Lens tubes: purgeable	 A0048991	316 stainless steel with 303 stainless barbed nipple	25.4 mm (1.00 in)	3 mm (0.12 in) 4.7 mm (0.19 in) 6 mm (0.24 in)
Immersion optics	 A0048994	316 stainless steel, Kalrez, PTFE, sapphire	25.4 mm (1.00 in)	3 mm (0.12 in) 6 mm (0.24 in)

*Compatible with small sample chamber using 3 mm (0.12 in) lens tube mounted between the probe body and lens adapter

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.

The probe should be installed using sealing techniques (e.g., flanges, compression fittings) appropriate and typical for the vessel or piping.

WARNING

If the probe head will be installed in a high temperature or pressure process, additional safety precautions must be taken to avoid equipment damage or safety hazards.

A blow-out protection device is highly recommended in accordance with local safety standards.

- ▶ It is the responsibility of the user to determine if any blow-out protection devices are required and ensure they are attached to the probe during installation.

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 as described below.

For safe and compliant installation, please refer to ASME PCC-1, ASME BPE, and/or the prevailing local standards.

WARNING	**Standard precautions for laser products should be observed.** ▶ Probes should always be capped and/or pointed away from people toward a diffuse target if not installed in a sample chamber.
CAUTION	**If stray light is allowed to enter an unused probe, it will interfere with data collected from a used probe and may cause calibration failure or measurement errors.** ▶ Unused probes should ALWAYS be capped to prevent stray light from entering the probe.
NOTICE	**Take care to install the probe such that it is positioned to measure the sample or region of interest.**

Specifications

General specifications

General specifications for the Rxn-20 probe are listed below.

Item		Description
Maximum laser power into probe		< 499 mW
Compatible wavelength		785 nm
Sample interface	temperature	10 to 40 °C (50 to 104 °F)
	pressure	ambient
	relative humidity	20 to 80 %, non-condensing
Materials of construction	probe body	316L stainless steel
	window	optical-grade materials
	fiber-optic cable	design: PVC jacketed, proprietary construction connections: FC, MT, and electrical
Probe weight		approximately 0.9 kg (2 lb), with cable
Probe length, including fiber cable bend radius		312 mm (12.29 in)
Fiber-optic cable specifications	length	3, 10, or 15 m standard (9.84, 32.81, or 49.21 ft) Custom lengths are available
	minimum bend radius	75 mm (2.96 in)
	temperature	−40 to 70 °C (−40 to 158 °F)
Nominal beam diameter at focal position	standard	6 mm (0.24 in)
	optional	4.7, 3, or 1 mm (0.19, 0.12, or 0.04 in)

Dimensions

The dimensions for the Rxn-20 probe and lens adapter are shown below.

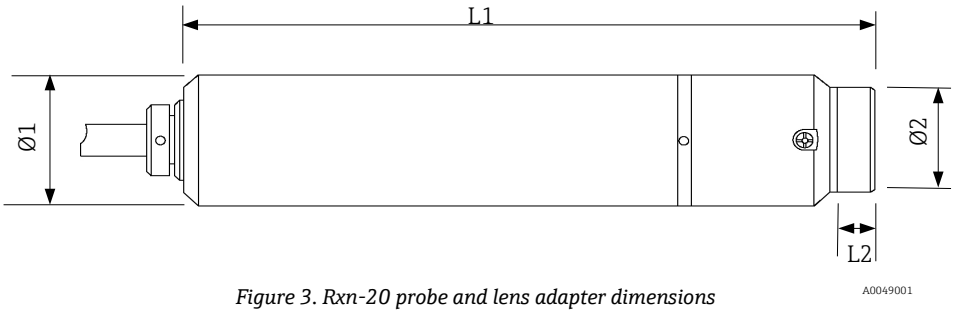


Figure 3. Rxn-20 probe and lens adapter dimensions

Dimension	Measurement	Description
L1	224.33 mm (8.83 in)	Length of probe body with lens adapter
L2	14.6 mm (0.58 in)	Length of 6 mm (0.24 in) spot size lens adapter
Ø1	48 mm (1.89 in)	Diameter of probe
Ø2	38.1 mm (1.50 in)	Diameter of lens adapters

MPE: ocular exposure

The ANSI Z136.1 standard provides means to perform maximum permissible exposure (MPE) for ocular exposure. Please refer to the standard to calculate the relevant MPE levels for the case of laser exposure from the Rxn-20 probe and from the unlikely occurance of laser exposure from a broken optical fiber.

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

MPE for point source ocular 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)***	
785	10^{-13} to 10^{-11}	1.5 $C_A \times 10^{-8}$	-	2.2×10^{-8} ($J \cdot cm^{-2}$)
	10^{-11} to 10^{-9}	2.7 $C_A\, t^{0.75}$	-	Insert time (t) and calculate
	10^{-9} to 18×10^{-6}	5.0 $C_A \times 10^{-7}$	-	7.40×10^{-7} ($J \cdot cm^{-2}$)
	18 x 10^{-6} to 10	1.8 $C_A\, t^{0.75} \times 10^{-3}$	-	Insert time (t) and calculate
	10 to 3×10^{4}	-	$C_A \times 10^{-3}$	1.4971×10^{-3} ($W \cdot cm^{-2}$)

MPE: 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-20 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)***	
785	10^{-9} to 10^{-7}	2 $C_A \times 10^{-2}$	-	2.9582×10^{-2} ($J \cdot cm^{-2}$)
	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} ($W \cdot cm^{-2}$)

Nominal hazard zone

The focusing optic configurations below are available for the Rxn-20 probe. Use the dimensions to calculate the nominal hazard zone.

Refer to the applicable Raman Rxn2 or Raman Rxn4 analyzer operating instructions for analyzer-specific information regarding nominal hazard zone calculations.

Laser spot size (diameter) (b_0)	**Optic focal length (f_0)**	**Nominal ocular hazard distance (NOHD) equation**
1 mm (0.04 in)	35 mm (1.38 in)	$r_{NOHD} = (f_0/b_0)(4\Phi/\pi MPE)^{1/2}$ Φ = Laser power output in watts
1.5 mm (0.06 in)	50 mm (1.97 in)	
3 mm (0.12 in)	125 mm (4.93 in)	
4.7 mm (0.19 in)	200 mm (7.88 in)	
6 mm (0.24 in)	250 mm (9.84 in)	

Certificates and approvals

Hazardous area approvals

Refer to the *Rxn-20 Raman spectroscopic probe Safety Instructions (XA02747C)* manual for detailed certification and approval information.

Certifications and markings	Endress+Hauser offers certifications for the Rxn-20 probe to the standards. Upon purchase, ensure the desired certification(s) are selected to obtain appropriately marked probe tags. Select the desired certification(s) and the probe or probe tag is marked accordingly. Refer to the *Rxn-20 Raman spectroscopic probe Safety Instructions (XA02747C)* for more information on condition of use and appropriate markings required for your application.

Hazardous area drawing

The Rxn-20 Hazardous Area Installation Diagram is shown below.

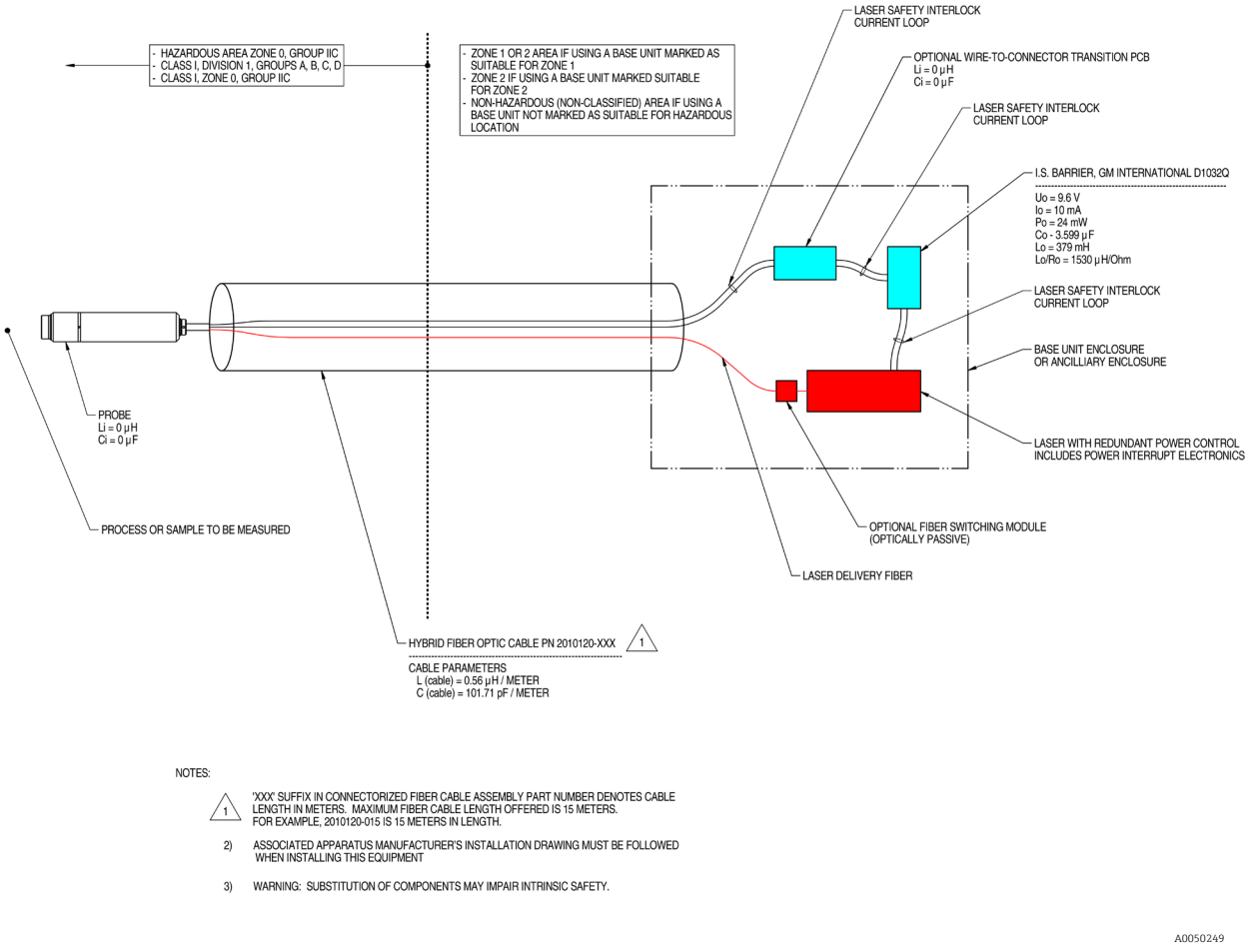


Figure 4. Rxn-20 Hazardous Area Installation Diagram (3000272 version X2)

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