TI01629C/66/EN/04.24
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Technical Information
Rxn-10 Raman spectroscopic probe

A versatile probe for your Raman spectroscopy needs

Application

Designed for product and process development, the Rxn-10 probe is the workhorse of the Raman probe portfolio. It is trusted to deliver high performance Raman measurements across a wide spectral range. It is also compact, lightweight, and flexible, offering multi-purpose convenience for solids and liquids analysis in the laboratory environment. The Rxn-10 probe accepts a variety of interchangeable optics, making it a highly versatile and easily adaptable instrument in your laboratory toolbox.

- **Chemical:** reaction monitoring, blending, catalyst monitoring, hydrocarbon speciation, process unit optimization
- **Polymer:** polymerization reaction monitoring, extrusion monitoring, polymer blending
- **Pharmaceutical:** active pharmaceutical ingredient (API) reaction monitoring, crystallization
- **Biopharmaceutical:** cell culture and fermentation monitoring, optimization, control
- **Food and beverage:** zonal heterogeneity mapping of meats and fish

Device properties

- 6061 aluminum, 316L stainless steel, and 303 stainless steel
- PVC jacketed, proprietary construction
- proprietary electro-optic (EO), or FC to EO fiber converter(s) for non-embedded systems

Your benefits

- Multipurpose use for both solids and liquids measurement
- Lightweight and compact
- Integrated laser safety interlock, including “laser on” indication and probe shutter
- Flexible output compatible with a range of sampling options
- Easy switching of non-contact, immersion, and bioprocessing optics to suit a variety of applications
- Wide spectral range, including access to the critical low-wavenumber region

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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-10 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)*.

Rxn-10 probe

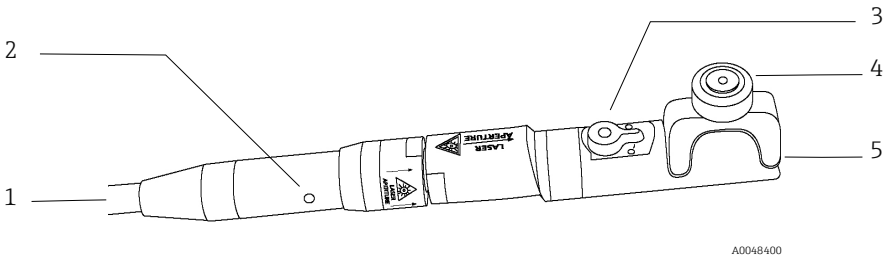
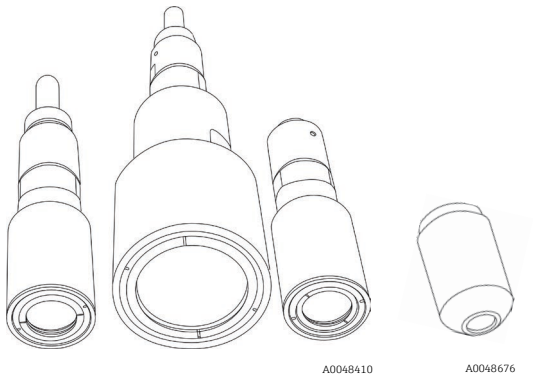
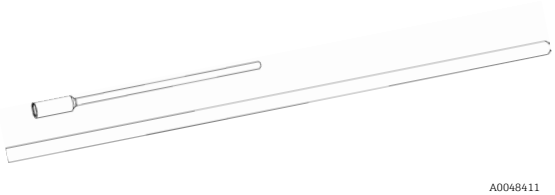
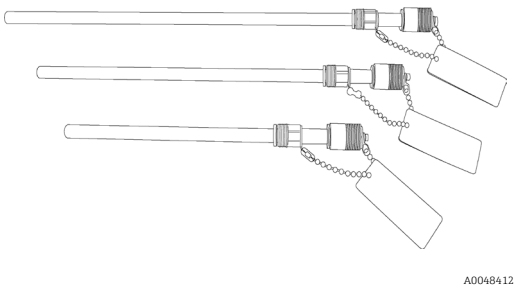
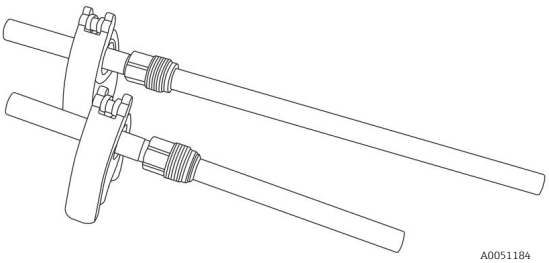
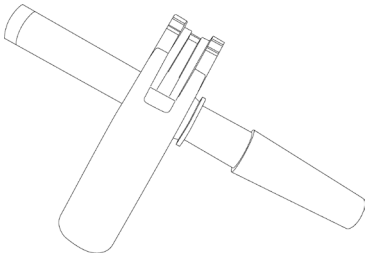


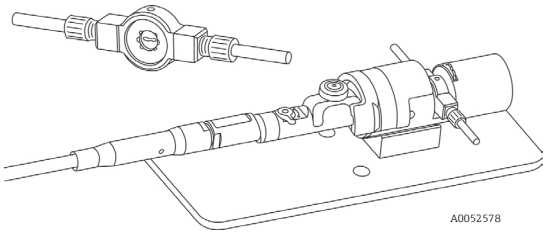
Figure 1: Rxn-10 probe

#	Name	Description
1	Fiber cable	Connects the probe to the Raman Rxn analyzer via one of the following: • Fiber channel (FC) cable assembly • Electro-optical (EO) fiber cable
2	Laser emission indicator	When there is potential for the laser to be energized, the indicator light is illuminated.
3	Laser beam shutter	Can be closed to prevent laser emission. Position “I” indicates emission potential. Moving the lever passed position “O” indicates emission is shuttered.
4	Thumb screw	Tighten to secure optics onto the probe when there is not a threaded interface.
5	Optics interface	Insert optics or threaded adapter.

Rxn-10 probe optics

The probe is compatible with the following optics to meet the requirements of different applications:

Optics		Applications
Non-contact optics	 A0048410 A0048676	For use with solids or turbid media. Also well-suited for delicate or corrosive liquids when sample contamination or damage to optical components is a concern.
Immersion optics (IO)	 A0048411	For use in reaction vessels, laboratory reactors, or process streams.
bIO-Optic	 A0048412	For use with continuous inline measurement in benchtop bioreactor/ fermenter applications requiring headplate entry.
Bio multi optic and bio sleeve	 A0051184	For use with continuous inline measurement in benchtop bioreactor/ fermentor applications requiring headplate entry.
Raman optic system for single use	 A0048413	For use with disposable fittings for single-use applications.

Optics		Applications
Raman flow assembly (includes micro flow bench and micro flow cell)		For use with lower flow rate liquids, where monitoring a dynamic process stream provides valuable information, and speed or limit of detection are particularly important.

Installation

During installation, standard eye and skin safety precautions for Class 3B laser products (as per EN-60825/IEC 60825-14 or ANSI Z136.1) should be observed as described below.

WARNING	**Standard precautions for laser products should be observed.** ▶ Probes should always be shuttered or pointed away from people toward a diffuse target if not installed in a sample chamber.
CAUTION	**The laser input into the Rxn-10 probe must not exceed 499 mW.** **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 shuttered to prevent stray light from entering the probe. If an optic cap is available, place it on the unused optic.
NOTICE	**When installing the probe head *in situ*, the user must ensure that there is strain relief at the installation location which complies with fiber bend radius specifications.**

Specifications

Probe specifications

Specifications for the Rxn-10 probe are listed below.

Item		Description
Laser wavelength	with non-contact or immersion optic	532 nm, 785 nm, or 993 nm
	with bIO-Optic or Raman optic system for single use	785 nm or 993 nm
	with bio multi optic and bio sleeve or micro flow bench and micro flow cell	785 nm
Maximum laser power into probe head		< 499 mW
Working distance		Based on the sampling optic selected
Sample interface		Based on the sampling optic selected
Polarization at sample		Unpolarized
Probe temperature		−10 to 70 °C (14 to 158 °F)
Temperature ramp		≤ 30 °C/min (≤ 54 °F/min)
Probe relative humidity		20 to 60 %, non-condensing
Probe spectral coverage		Probe spectral coverage is limited by the coverage of the analyzer being used
Laser power at sample	532 nm (with standard 120-mW laser)	> 45 mW
	785 nm (with standard 400-mW laser)	> 150 mW
	993 nm (with standard 400-mW laser)	> 150 mW
Materials of construction	probe body	6061 aluminum, 316L stainless steel, and 303 stainless steel
	fiber-optic cable	Design: PVC jacketed, proprietary construction Connections: proprietary electro-optic or FC to EO fiber converter(s) for non-embedded systems
Probe	length (not including fiber cable bend radius)	203 mm (8 in)
	length (including fiber cable bend radius)	356 mm (14.02 in)
	diameter (not including cable)	19 mm (0.75 in)
	weight (including cable)	0.5 kg (approximately 1 lb)
Fiber-optic cable	temperature*	−40 to 70 °C (−40 to 158 °F)
	length	5 to 25 m (16.4 to 82.0 ft) lengths standard in 5 m (16.4 ft) increments Extension fiber cables are also available in lengths from 5 to 200 m (16.4 to 656.2 ft) in 5 m (16.4 ft) increments, limited by application.
	minimum bend radius	152.4 mm (6 in)
	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

* While the fiber-optic cable can withstand temperatures up to 80 °C (17 °F), the interface of the cable to the probe head is limited to 70 °C (158 °F).

Probe dimensions

The dimensions for the Rxn-10 probe are shown below.

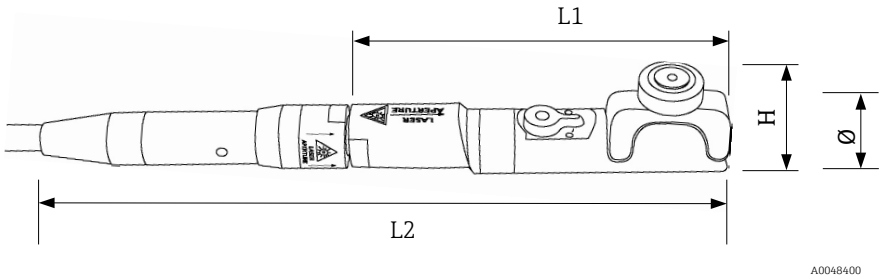


Figure 2. Rxn-10 probe dimensions

Dimension	Measurement	Description
L1	111 mm 4.37 in	Length of probe body without cable or optics
L2	203 mm 8 in	Length with fiber-optic cable connected Note: This does not include additional minimum bend radius of cable
H	33 mm 1.3 in	Height of probe including thumb screw
Ø	19 mm 0.75 in	Diameter of probe, not including cable

MPE: ocular exposure

Refer to the tables below from the ANSI Z136.1 standard to calculate the maximum permissible exposure (MPE) for point source ocular exposure to a laser beam.

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

Maximum permissible exposure (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}

Maximum permissible exposure (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 and 993	10^{-13} to 10^{-11}	$1.5\ C_A \times 10^{-8}$	-	2.2×10^{-8} (J·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·cm^{-2})
	18×10^{-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·cm^{-2})

MPE: skin exposure

Refer to the table below from the ANSI Z136.1 standard to calculate the MPE for skin exposure to a laser beam.

Maximum permissible exposure (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, 785 and 993	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})

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