

RFP-400 SERIES RAMAN PROBES AND FLOW CELLS

- **Modular, high performance probes for research, QC, and process development applications.**
- **NeSSI compatible cells for on-line applications.**



RFP-400 Series Raman probes have been designed to provide the same high optical performance as Axiom's RFP-500 Series process Raman probes but in a highly flexible package intended for laboratory and process development applications. The key to the design is a standardized optical head combined with interchangeable filter modules and objective lens/immersion assemblies

RFH-400 Probe Optical Head: This unit includes the fiber-optic terminations, collimating optics, interference filters, and beam combining optics. Its optical design is essentially the same as that of the RFP-500 Series process probes. As a result, calibrations performed with the laboratory probes can often be carried over directly for use in process installations. As in the case of the process probes, the two optical filters are mounted in a single plug-in filter module. This makes it a simple task to switch a given probe for operation with different laser excitation frequencies.

RFP-410 Sight Glass Probe: This probe consists of the RFH-400 Optical Head combined with the RFT-10 Non-contact Objective Lens Assembly. The standard design provides an optical focus approximately 15 mm from the front of the lens assembly, allowing the probe to view the sample through a sight glass, the side of a cuvette, or a beaker wall. Other focal distances are available on special order.

RFP-420 Small Diameter Probe: The RFP-420 employs the RFT-20 Small Diameter Immersion Tip. It is intended for use with small reaction vessels operating at moderate pressures and can tolerate a wide range of chemical conditions¹.

RFP-430 Intermediate Diameter, Extended Temperature/Pressure Probe:

This probe is designed for operation at temperatures as high as 200 C and pressures to 100 bar. The RFT-30 Immersion Tip features 316 stainless steel construction, a sapphire window, and Axiom's proprietary metal window seal design incorporating a PTFE coated high Nickel alloy C-ring in a fully welded structure².

RFP-440 High Performance, Extended Length Probe:

By using a 9.5 mm ID gold lightguide, this probe provides an optical signal level comparable to the RFP-410 Sight Glass Probe but with an immersion length of 30 cm. As an option, the length can be extended even more with minimal decrease in signal.

RFP-450 Compound Lens Probe for Highly Scattering Samples:

The RFT-50 objective lens assembly employed in the RFP-450 probe provides a large collection solid angle and small illuminated spot size comparable to those obtained with a ball lens. However, its compound lens design provides the additional advantage of allowing the focus offset to be varied by the user so as to optimize the performance for the particular scattering conditions encountered.

RFP-460 Multipass Raman Probe: This probe employs Axiom's patented multipass design (3), which provides up to an order of magnitude signal enhancement for clear liquids and solids.

NeSSI Compatible Process Raman Flow Cells:

Models RFF-440Ne and RFF-460Ne are surface mount Raman flow cells based on the RFP-440 and 460 Raman probes. Each of these cells consists of the corresponding probe modified to include an appropriate interface fitting (Option RFN) plus an appropriate surface mount fixture (Model RFA-40 or RFA-60). These mount

directly on an industry standard NeSSI substrate. Although based on Axiom's laboratory Raman probes, these flow cells are intended for use in at-line process applications in conjunction with NeSSI-based sample conditioning systems. (For further information about Axiom's NeSSI compatible sampling equipment, please see data sheet PS-NeSSI-01.)

Process Raman Probes

In addition to the RFP-400 Series laboratory probes and the RFF NeSSI compatible process flow cells, Axiom Analytical manufactures the highly robust RFP-500 Series Process Raman probes (See data sheet PS-RFP50-03). These probes feature Hastelloy C-276 construction including Axiom's proprietary welded Hastelloy to sapphire window seal. They include a sealed conduit termination housing. Optional features include full secondary confinement and provision for pneumatically controlled retraction from the process line.

FEATURES:

- Interchangeable objective/immersion assemblies
- Interchangeable filter sets
- 15 mm standard sample offset (RFP-410)
- 6.35 mm diameter probe tip (RFP-420)
- Compatible with high temperatures and pressures (RFP-430, 440, and 450)
- Compatible with highly aggressive chemistries (RFP-420 through 450)
- Multipass design for enhanced sensitivity (RFP-460)



RFP- 400 Series Options and Accessories

Interchangeable Objective Lens/Immersion Assemblies: A given RFP-400 Series probe can be converted between any of the five basic models by simply installing the appropriate RFT Series Objective Lens Assembly listed in the table below. In some cases, modified objective assemblies are also available which provide a selection of focus offsets.

Interchangeable Filter Modules: Any RFP-400 probe can be switched to operate with a selection of laser excitation frequencies by interchanging RFF-W Series filter Modules, where “W” specifies the excitation frequency in nanometers.

NeSSI Compatible Flow Fixtures: Models RFA-40 and RFA-60 are surface mount fixtures which adapt RFP-440 and 460 probes to the industry standard NeSSI platform (ANSI/ISA SP76.00.02-2002).

Option RFL, Custom Probe lengths: RFP-400 Series probes can be provide in a wide range of lengths. Inquire with Axiom for price and delivery.

Option RFO, Custom Focus Offset: The offset of the optical focus from the probe window can be varied to meet particular requirements. Inquire with Axiom for price and availability.

Option RFN, NeSSI Flow Fixture Interface: Provides an O-ring sealed, threaded male fitting to interface the RFP-440 or 460 probe to the appropriate NeSSI surface mount flow fixture. This option also reduces the length of the probe to minimize the overall space requirement within the NeSSI system.

Vessel Attachment: RFP-400 Series Probes can be provided with a variety of means for attachment to a reaction vessel. Inquire with Axiom for price and availability.

Fiber –Optic Cables:

RFP-400 Series probes can be connected to a laser source and to a Raman spectrometer by means of a variety of different fiber-optic cables. For optimum performance, the core diameter of the collection fiber should be at least three times that of the excitation fiber (e.g. 100 μm excitation and 300 μm collection). When the probes are used with a dispersive spectrometer, it is often advantageous to use a bundle to make the transition from the circular pattern characteristic of the probe output to a slit pattern at the spectrometer input slit. (Inquire with Axiom for available configurations.)

References:

- (1) US Patent No. _6,876,801 B2
- (2) US Patent No. _6,587,195 B1
- (3) US Patent No. _6,795,177 B2

FDR-400 SERIES LABORATORY RAMAN PROBE SPECIFICATIONS

	RFP-410-W	RFP-420-W	RFP-430-W	RFP-440-W	RFP-450-W	RFP-460
Standard Objective Assembly Included	RFT-10-15	RFT-20-3	RFT-30-3	RFT-40-8	RFT-50	RFT-60
Immersion Length:	NA (sight glass)	16 cm	18 cm	30 cm	30 cm	20 cm
Immersion Shaft Diam.:	NA (sight glass)	6.35 mm	9.5 mm	16 mm	16 mm	19 mm
Standard Optical Focus Offset:	15 mm	3 mm	3 mm	8 mm	0.2 – 1.0 mm User settable	6 mm
Max. Sample Temp.:	NA	150° C	200° C	200° C	200° C	200° C
Maximum Pressure:	NA	20 bar	100 bar	100 bar	100 bar	100 bar
Window Material:	Glass lens	Sapphire	Sapphire	Sapphire	Sapphire	BK-7 glass
Window Seal:	UV adhesive	PTFE	PTFE Coated Inconel-718	PTFE Coated Inconel-718	PTFE Coated Inconel-718	Kalrez O-ring

Raman Shift Range (all models): 200 – 4000 cm⁻¹

Standard Excitation Wavelengths (all models): W = 532, 632, or 785 nm

Wetted Metal (all but RFP-410): 316 stainless steel

Fiber Connectors (all models): SMA-905 standard, FC optional

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