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QFT1, QFT2

Fiber Optic Holder for Glass Fiber Filters (89575, 89385)

INSTRUCTION MANUAL

Serial No._____

041709

World Precision Instruments

WARRANTY

WPI (World Precision Instruments, Inc.) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of one year* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

• Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within 10 days after receipt of shipment. Claims for lost shipments must be made within 30 days of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim settles. In some instances, photographic documentation may be required. Some items are time sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container.

• WPI cannot be held responsible for items damaged in shipment en route to us. Please enclose merchandise in its original shipping container to avoid damage from handling. We recommend that you insure merchandise when shipping. The customer is responsible for paying shipping expenses including adequate insurance on all items returned.

• Do not return any goods to WPI without obtaining prior approval and instructions (RMA#) from our returns department. Goods returned unauthorized or by collect freight may be refused. The RMA# must be clearly displayed on the outside of the box, or the package will not be accepted. Please contact the RMA department for a request form.

• Goods returned for repair must be reasonably clean and free of hazardous materials.

• A handling fee is charged for goods returned for exchange or credit. This fee may add up to 25% of the sale price depending on the condition of the item. Goods ordered in error are also subject to the handling fee.

• Equipment which was built as a special order cannot be returned.

• Always refer to the RMA# when contacting WPI to obtain a status of your returned item.

• For any other issues regarding a claim or return, please contact the RMA department.

Warning: This equipment is not designed or intended for use on humans.

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

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APPEDIX A: ADJUSTING THE COLLIMATOR

Fiber Optic Collimator **300051** connects to SMA-terminated optical fiber. The collimator is factory-set to collimate light from a 600µm diameter quartz fiber optic cable. Other assorted quartz and plastic fiber optic cables with various core sizes are available from WPI. If a fiber optic cable other than the 600µm quartz fiber optic cable is used, the collimator may require adjustments to optimize its performance. The set screws on the collimator body are used to adjust the collimated output beam. When handling the collimators, be careful not to contaminate the lens surface.

When using the QFT2, the collimator needs to be adjusted properly for the GF/F filter or the cuvette to maximize the signal and balance the UV and visible spectra.

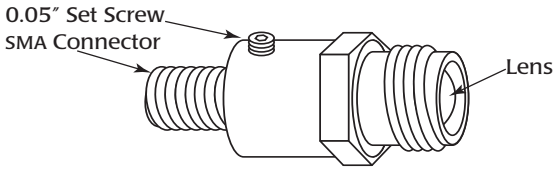

Fig. 3–*300051 collimator with SMA connection*

1. Remove the collimator from the QFT with the included 0.5" deep socket driver.
2. Attach the collimator to your fiber optic light source (WPI #**FO-6000** or **D2H**) with a fiber optic cable. Shine the light from the collimator onto a flat white surface (about 10cm from the collimator) and watch the beam. If the light beam appears collimated (a high contrast beam) then it may not require any adjustment. If the beam appears diffused, then some focusing adjustments may be required.
3. With the supplied 0.05" hex wrench, loosen the set screws on the collimator.
4. Hold the collimator body (with fiber optic cable attached), and slide the cable slowly in and out to obtain the best collimated beam.
5. Tighten the set screw.
6. Remove the fiber optic cable, carefully reinsert the collimator in the QFT and tighten with the 0.5" deep socket set.

CAUTION: The QFT is easily cross-threaded. Use caution when installing collimators.

NOTE: Collimation adjustments can also be made for other distances (if required) by following this procedure and using the desired focal length.

ABOUT THIS MANUAL

The following symbols are used in this guide:

This symbol indicates a CAUTION. Cautions warn against actions that can cause damage to equipment. Please read these carefully.

This symbol indicates a WARNING. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.

NOTES and TIPS contain helpful information.

Fig. 1–*QFT2, closed and open*

INTRODUCTION

WPI's filter holders for particulate absorption measurements are specially designed for field use, rugged and portable. They perform as well as laboratory based spectrophotometer arrangements. They can be directly connected with WPI's line of fiber optic spectrometers and light sources using SMA connectors. Instead of collecting samples and transporting them to a laboratory, samples can be measured on-site.

QFT1, an optical holder for glass fiber filters, allows you to measure absorbance of particulate matter concentrated on a glass fiber filter pad. The QFT2 is a QFT1 with an integrated 1cm cuvette holder, which allows for on-site liquid sample measurements, as well.

Particulate absorption of fresh water and seawater can be determined by filtering a known amount of sample through a Glass Fiber Filter (GF/F) and measuring the particulate absorption coefficient $a_p(\lambda)$ concentrated on the filter. This technique is called **quantitative filter technique** (QFT) and corrects for the pathlength amplification, an effect of scattering. The correction of the pathlength amplification and the correction of the non-linear relationship between the optical density of samples on a Whatman GF/F filter and in suspension are discussed in Mitchell (1990). (See "References" on page 9.) Mitchell's report results in an equation to calculate the corrected particulate absorption coefficient $a_p(\lambda)$ as follows:

$$a_p(\lambda) = 2.3 * \frac{a * a_p^*(\lambda) + b * (a_p^*(\lambda))^2}{\frac{V_f}{A_c}}$$

$a_p^*(\lambda)$ = uncorrected optical density of the filter-collected sample

V_f = filtered volume

A_c = clearance area of the filter

Coefficients *a* and *b* are filter-type dependent (Whatman GF/F filters: a = 0.392, b = 0.665).

SPECIFICATIONS

QFT1/2

Fiber input and output	200-1000µm, SMA terminated, 600µm fiber recommended
Glass Fiber Filter (GF/F) diameter	25mm
Light Beam Diameter	5mm
Light performance with GF/F*	>50% intensity at 3000ms integration time
Material in contact with Filter Pad	Delrin
Weight	0.5kg (1lb)

* measured with a TIDA*S I, 2 FO-600-SMA1M, D2H (color compensated)*

Collimator (300051, 300052)

Lens diameter	5mm
Lens focal distance	10mm
Lens material	Ultraviolet grade synthetic fused silica (KU-1)
Wavelength range	170nm-2µm
Mounting threads	3/8-24 UNF
Divergence	<0.1 rad for 1mm core fiber
Fiber connector interface	SMA(#300051) or ST(#300052)

TROUBLESHOOTING

Diminished Transmission Intensity

1. Compare the transmission intensity to the standard listed on the Certificate of Compliance.
2. If the intensity has diminished, clean the collimators. See "Cleaning the Collimators" on page 7.
3. Clean the QFT. See "Cleaning the QFT" on page 7.

Low GF/F Measurements

1. Verify that the reference signal with a GF/F filter has enough light.
2. If not, verify that the filter is wet.

INSTRUMENT DESCRIPTION

Parts List

After unpacking, verify that there is no visible damage to the instrument. Verify that all items are included:

(1) QFT1 Fiber optic holder for glass fiber filters (WPI #**89575**) or QFT2 Cuvette Holder/ Fiber optic holder for glass fiber filters (WPI #**89385**)

(1) 0.05" Hex wrench

(1) 0.5" Deep socket driver

(1) Certificate of Compliance

(1) Instruction Manual

Unpacking

Upon receipt of this instrument, make a thorough inspection of the contents and check for possible damage. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed damage should be reported at once to the carrier and an inspection requested. Please read the section entitled "Claims and Returns" on page 15 of this manual. Please contact WPI Customer Service if any parts are missing at 941.371.1003 or customerservice@wpiinc.com.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from WPI's Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container, if possible. If the original container is not available, use a suitable substitute that is rigid and of adequate size. Wrap the instrument in paper or plastic surrounded with at least 100mm (4") of shock absorbing material. For further details, please read the section entitled "Claims and Returns" on page 15 of this manual.

Setup

A typical setup for QFT Glass Fiber Filter Holder (WPI #**89575/89385**) consists of a light source (WPI's **FO-6000** or **D2H**), a spectrometer (WPI's **TIDAS-I**) and two 600µm fiber optic fibers (**FO-600-SMA1M**) (**Fig. 2**).

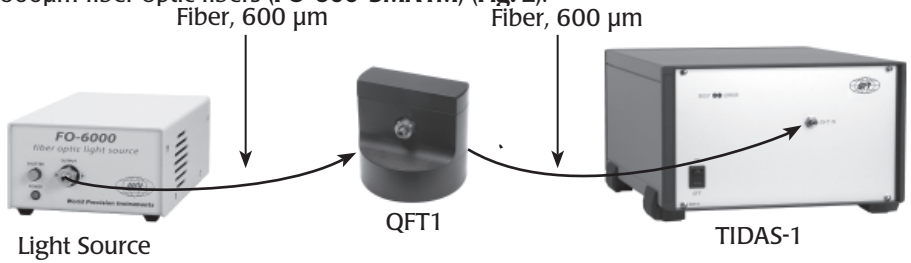

Fig. 2–Typical experimental setup

Optical Fibers

The QFT1 connects to SMA-terminated optical fibers of 200-1,000µm core diameter. The optimal diameter is 600µm (WPI #**FO-600-SMA1M**).

Detector & Light Source Requirements

The optical throughput of QFT1 or QFT2 Glass Fiber Filter Holder equipped with a classical GF/F filter is very low and requires a matched light source/spectrometer system. WPI's **TIDAS I** in combination with WPI's **FO-6000** tungsten light source or **D2H** deuterium/halogen light source can be used in the 380–730nm and 280–730nm wavelength ranges, respectively. Further, the QFT1 can be interfaced with WPI's **SpectraUSB** CCD spectrometer line. The QFT1 can also be interfaced with any other CCD, PDA or scanning type spectrometer with fiber optic capabilities.

Collimators

WPI's Fiber Optic Collimator can be used for both collimating a light beam emitted by an optical fiber or coupling light from a collimated light beam into an optical fiber. The numerical aperture of the collimator is optimized for maximum coupling efficiency into typical fused silica fibers. The collimator can, for example, be used to guide a parallel light beam through a sample cuvette or an optical filter with very little optical losses. In this application, one collimator collimates the light into a parallel beam 5mm in diameter, enabling it to pass a long distance without losing the energy. After the light passes the sample media, a second collimator can be used to collect the beam into the receiving fiber. A unique design feature of the WPI collimator is that the distance between the lens and the optical fiber can be easily adjusted. This permits it to be used as a focusing device or for fine-tuning the color balance when coupling light from a light source into a fiber.

REFERENCES

Mitchell, B. G., "Algorithms for Determining the Absorption Coefficient of Aquatic Particles Using the Quantitative Filter Technique (QFT)", SPIE Vol. 1302 Ocean Optics X (1990), 137-148.

Sosik, H. M., "Storage of marine particulate samples for light-absorption measurements", Limnol. Oceanogr., 44(4), 1999, 1139-1141

Belz, M., Larsen, K., Klein, F. "Fiber optic sample cells for polychromatic detection of dissolved and particulate matter in natural waters", Proc. SPIE, Vol. 6377, Oct 2006, 63770X

ACCESSORIES

Table 1: Accessory Parts

WPI Part No.	Item
300051	Fiber Optic Collimator for connecting to an SMA-terminated optical fiber
D_2H	Deuterium Halogen Light Source
LEDspec	BioPhotometric Detection System
TIDAS-I	High Performance Fiber Optic Spectrometer system
FO-6000	Fiber Optic Light Source
FO-400-SMA1M	Fiber Optic cable, 1m, SMA, 400µm core, UV-enhanced
FO-600-SMA1M	Fiber Optic cable, 1m, SMA, 600µm core, UV-enhanced
FO-1000-SMA1M	Fiber Optic cable, 1m, SMA, 1000µm core, UV-enhanced

See www.wpiinc.com or email info@wpiinc.com for specifications on the complete line of cuvettes, including synthetic quartz and optical glass, self-masking, continuous flow-through cells, micro cell, flouresence, long path and standard cuvettes.

OPERATING INSTRUCTIONS

Taking GF/F Filter Measurements

1. Prepare your sample GF/F filter pad by filtering a known amount of sample through the GF/F filter pad.
2. Moisten a new filter (blank) with the filtrate and insert it into the cover of the filter pad holder and place it into the QFT1 or QFT2 holder base.

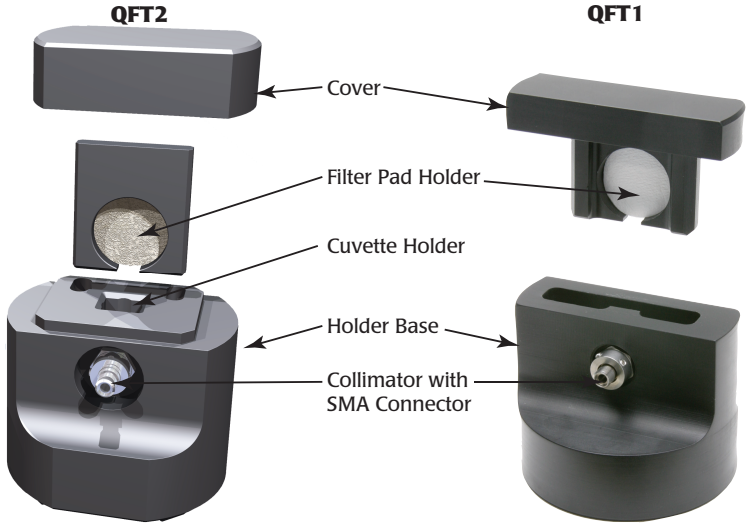

Fig. 3–*QFT2 and QFT1, labeled*

3. Follow instructions in the spectrometer manual to take a reference measurement with the moistened blank.
4. Remove the blank GF/F pad and insert the sample GF/F pad into the holder.
5. Follow instructions in the spectrometer manual to take a sample reading.

Taking Cuvette Measurements

Use the QFT2 for cuvette measurements, because the QFT1 cannot measure a liquid sample in a cuvette.

1. Prepare your reference and sample cuvettes.
2. Verify that the filter pad holder has NO GF/F filter installed.
3. Insert the reference cuvette into the QFT2 base holder and cover with the lid.

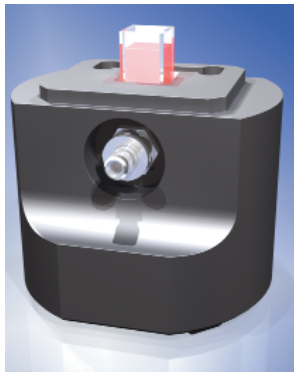

Fig. 4–*QFT2 with cuvette installed*

4. Follow instructions in the spectrometer manual to take a reference measurement with the reference cuvette.
5. Remove the reference cuvette and insert a sample cuvette into the holder. Cover with the lid.
6. Follow instructions in the spectrometer manual to take a sample reading.

INSTRUMENT MAINTENANCE

Cleaning the Collimators

1. Remove the collimator from the QFT with the included 0.5" deep socket driver.
2. Wet a cotton swab with isopropyl alcohol and gently clean the lens of the collimator.
3. If the lens is still not clear, use the 0.05" hex wrench to loosen the set screws and remove the SMA connector. Then, use the cotton swab to clean the inside of the lens. The inside of the lens rarely needs cleaned, because it is not exposed to liquid.
4. Reassemble the collimator and carefully reinsert it in the QFT. Tighten with the 0.5" deep socket driver.

CAUTION: The QFT is easily cross-threaded. Use caution when installing collimators.

Cleaning the QFT

1. Remove the collimators from the QFT with the included 0.5" deep socket driver.
2. Immerse the QFT in an ultrasonic cleaner with soapy water.

CAUTION: DO NOT CLEAN THE QFT WITH ACIDS.

CAUTION: DO NOT PUT THE COLLIMATORS IN THE ULTRASONIC BATH.

3. Rinse with tap water or deionized water to remove the soap.