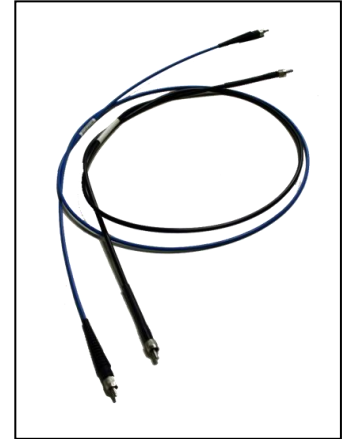


## Proper Care and Handling of Fiber-optic Cables

Fiber-optic cables are marvels of innovation for modern spectroscopic instrumentation. The advantages offered by fiber optical cable-based sampling include great flexibility for enabling measurements at various sample sites, ease of use, and flexibility for easy transportation. Fiber-optic sampling is widely used in applications of broadband UV-Vis, NIR spectroscopy, laser excitation delivery and signal collection for Raman, fluorescence spectrometers and on-line process analyzers using these spectroscopic technologies. The fiber-optic technology has taken analysis out of the lab and from fixed bench-top equipment to anywhere one can imagine. With this freedom however comes increased responsibility for care and maintenance of the associated fiber accessories to ensure the measurement quality and fiber durability.



Fiber-optic accessories are typically terminated with connectors or receptacles so they can be interfaced to an instrument. B&W Tek instruments such as lasers that use fiber delivery systems and Raman spectrometers using fiber-optic probes are typically equipped with FC, SMA905 or other types of matching fiber couplers at the output ports or entrances. The tips on these fibers and probes are optically polished and inspected using a high magnification microscope at the factory to ensure optical integrity and optimal signal throughput when coupled to lasers and spectrometers. Protective dust caps are provided for these fiber terminations as well as for the matching ports at the instrument side. It is vital to keep track of the caps and put them in place to protect all exposed terminations whether these are the fiber tips, probe ends, spectrometer fiber input receptacles, or laser output fiber couplers. Always keep the dust caps attached to the laser output couplers (if applicable) and protect the open fiber tips at all times from dirt, dust, scratches, and debris by using the supplied caps. Keep the spectrometer entrance caps on whenever possible to prevent foreign objects from falling into the spectrometer entrance.

Special attention must be given to the cleaning of fiber ends that are going to be connected to a laser port. Before connecting any fiber to a laser port (output coupler), the operator must follow cleaning instructions for tips of fibers. One practical cleaning procedure for SMA905 type of connector can be the use of a degreased cotton swab which has been soaked with pure AP grade alcohol or acetone to wipe the fiber tips to be connected straight across the fiber tip three times. Wipe off all residual cleaning agents with dry fiber cleaner before connecting the tips. Most commercial cotton swabs cannot be used because they have not been degreased for this purpose. In order to ensure that the laser output fiber coupling works properly, the fiber tips of the delivery fiber need to be cleaned every time before connecting to the laser output ports.

Any micron size foreign materials such as dust particles, debris and tissue materials left on the tips can cause the fiber to be burned under the high laser power density. Burned spots on the fibers can generate heat when further exposed to laser power radiation, thus leading to further energy loss at the coupling interface. This can quickly result in significant power drop exiting the connected fiber. It is

recommended to keep the fiber attached once the cleaning and connection to the laser port are made. This is the best way to keep one side of the fiber tips clean. Great attention should be paid to the handling of an instrument which has fibers attached. Avoid damaging fibers by excessive bending (See table 1 for minimum recommended bend radius). Protect the fibers and connections during transportation.

Ensure the bend radius is larger than the specified minimum value to protect fiber from damage:

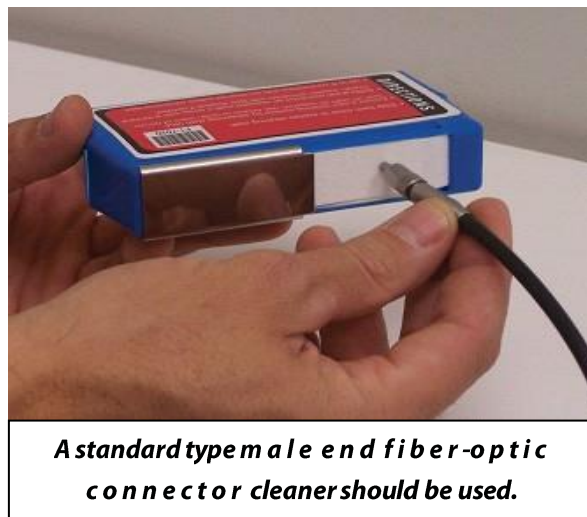
NA	Fiber Core Size	Minimum Bend Radius
0.22	50 $\mu\text{m}$	1.5 cm
0.22	100 $\mu\text{m}$	3.0 cm
0.22	200 $\mu\text{m}$	6.0 cm
0.22	400 $\mu\text{m}$	12.0 cm
0.22	600 $\mu\text{m}$	25.0 cm
0.22	1000 $\mu\text{m}$	30.0 cm

Table 1: Fiber bend radius

The following checklist serves as a handy guideline for fiber accessory handling and maintenance.

**Proper Usage Considerations**

1. Grasp only the connector housing when plugging or unplugging connectors;
2. Install dust caps on all non-connected terminations;
3. Keep dust caps clean by storing in a resealable container;
4. Do not re-use swabs or cleaning tissues. Dispose of them properly;
5. For safety, never look into a fiber when it is connected to a laser port with radiation on;
6. For safety, never attempt observations of fiber tip using a fiberscope while the laser is on;
7. If using alcohol or other high purity wet cleaner, wipe dry before connecting the fiber;
8. Avoid contamination to the end face of the fibers by touching or exposure to other contamination source;
9. Follow manufacturer’s recommended handling procedure when using isopropyl alcohol or other cleaning agents;



### **Fiber Inspection and Cleaning Procedure**

If tools are available it is a great idea to perform frequent inspections and cleaning of the fiber ends, especially after repeated connection and disconnection. The following are general steps that should be performed for cleaning the fiber ends.

1. Inspect the fiber end with a fiberscope if available; if the fiber tip is contaminated, clean using a dry cleaning method, see below.
2. Perform the cleaning by use of the appropriate fiber optic connector cleaner to clean the fiber tip;

#### **Dry Cleaning Method**

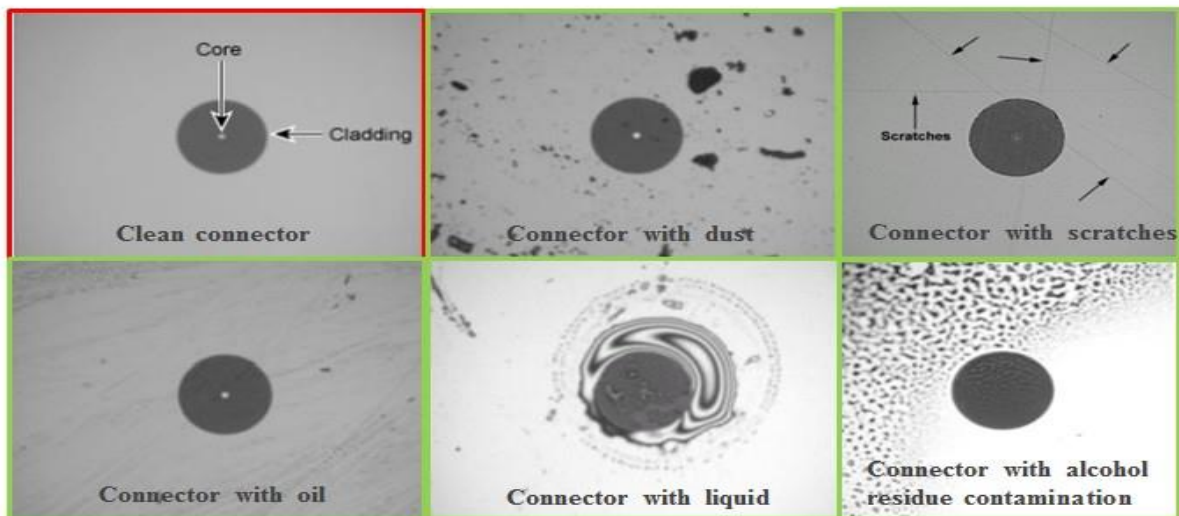
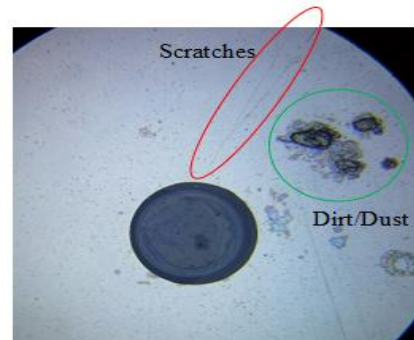
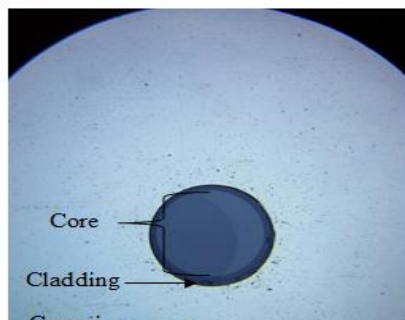
Before you apply any cleaning kit to a fiber tip make sure to review instructions provided on the specific kit. Apply the kit to ONLY specified matching fiber tips.

- Expose a fresh surface of the cleaning cloth
- Holding the fiber end perpendicular to the cleaning cloth, twist 90 degrees and then drag down across the exposed cloth applying a small amount of pressure.
- Do not re-use the same section of the cleaning cloth once it has been used to clean a fiber end.
- Inspect the connector again using the fiberscope if available.
- If the fiber end still has any particulate matter or residue, apply the cleaning method again.
- Inspect the connector again using the fiberscope.
- If the contaminants on connectors are still not removed, clean using a wet cleaning method (see below) immediately followed by a dry cleaning method to remove all residues.

#### **Wet Cleaning Method**

If the dry cleaning does not adequately clean the connector, isopropyl alcohol is frequently used as the cleaning fluid, but alcohol does not dry quickly and must be wiped from the surface so that it does not leave residues behind. Specially formulated fiber optic cleaning solutions are recommended.

- Dampen the cleaning cloth with the cleaning fluid. Do not saturate the cloth.
- Holding the fiber connector perpendicular to the cloth, twist and wipe the end face in the damp area of the cloth several times.
- Repeat the twist and clean on a clean, dry area of the cleaning cloth;
- Inspect the connector again using the fiberscope;
- Repeat this process until the end face is clean.



Repeated fiber-optic connector disconnection and reconnection often leaves debris on the fiber connector tip. Examples of common issues are depicted in the photos above. Aside from leaving residues at the surface of the tips, strong solvents can also degrade the quality of the tip after prolonged exposure. The top right photo shows an example of the possible damage incurred after exposing a dirty tip to a laser.

For further details of any specific fiber product please refer to the accompanying product manual, or contact the B&W Tek support team at [www.bwtek.com/support](http://www.bwtek.com/support)

Watch this [video](#) for guidance on cleaning fiber probes for your portable i-Raman series spectrometer.