

# INSPECTING & CLEANING MULTI-FIBER OPTICAL CONNECTORS

*aka* Ribbon, MT, MPO & MTP® Connectors

## BEST PRACTICES



## PROCESS PROCEDURES

The fiber inspection, cleaning and testing procedures documented in this manual are recommendations made by JDSU. Please reference your company's process documents for standard tools and methods for your specific application.

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REV 2



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<b>PATENTS</b>	RibbonDrive Tips: US Patent No. 6,751,017 / 6,879,439 CleanBlast: US Patent No. 7,232.262
<b>TESTED EQUIPMENT</b>	All pre-qualification tests were performed internally at JDSU, while all final tests were performed externally at an independent, accredited laboratory. This external testing guarantees the unerring objectivity and authoritative compliance of all test results. JDSU's Commerce and Government Entities (CAGE) code under the North Atlantic Treaty Organization (NATO) is 0L8C3.
<b>FCC INFORMATION</b>	Electronic test equipment is exempt from Part 15 compliance (FCC) in the United States.
<b>EUROPEAN UNION</b>	Electronic test equipment is subject to the EMC Directive in the European Union. The EN61326 standard prescribes both emission and immunity requirements for laboratory, measurement, and control equipment. This unit has been tested and found to comply with the limits for a Class A digital device.
<b>INDEPENDENT LABORATORY TESTING</b>	This unit has undergone extensive testing according to the European Union Directive and Standards.

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# INTRODUCTION TO FIBER INSPECTION

## INSPECT BEFORE YOU CONNECT<sup>SM</sup>

**CONTAMINATION IS THE #1 SOURCE OF TROUBLESHOOTING** in optical networks. A single particle mated into the core of a fiber can cause significant back reflection, insertion loss, and equipment damage. Visual inspection is the only way to determine if fiber connectors are truly clean before mating them.

The JDSU video fiber inspection probe and handheld display system is used to quickly and easily inspect connector end faces, which ultimately minimizes loss and optimizes test conditions. WESTOVER FBP series video probes, available in digital or analog and single- or dual-magnification (200/400X) models are high-performance, handheld microscopes designed for inspecting both “female” (bulkhead) and “male” (patch cord) connectors, as well as other optical devices. The probe microscope can also be combined with a USB converter module to inspect connectors via compatible test platforms and PC/laptop. This versatile system offers a wide range of configurable solutions that can meet the demands of any application.



JDSU's precision, stainless-steel fiber inspection tips and adapters are carefully designed and engineered to produce consistent and accurate inspection. These inspection tips are interchangeable and designed with a unique optics architecture, which enables the probe to interface with every connector and application in your network.

## SIMPLE SOLUTION

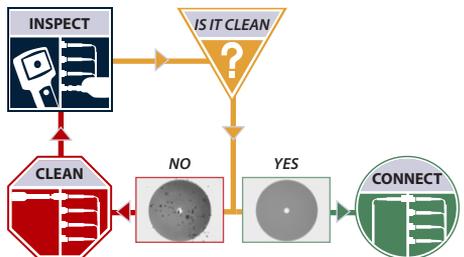
By implementing a **SIMPLE yet IMPORTANT** process of proactively inspecting and cleaning before mating, you can prevent poor signal performance and equipment damage.

## PROACTIVE INSPECTION

By **PROACTIVELY INSPECTING** your fiber optic connectors, you will...

- **Reduce Network Downtime**
- **Reduce Troubleshooting**
- **Optimize Signal Performance**
- **Prevent Network Damage**

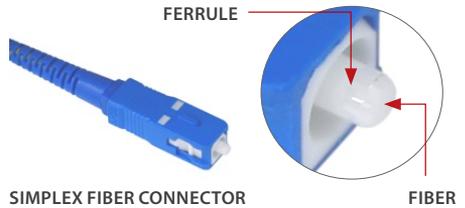
## INSPECT BEFORE YOU CONNECT<sup>SM</sup>



# SINGLE VS. MULTI-FIBER

## SINGLE FIBER CONNECTORS

Also called simplex connectors, these types contain a single fiber located in the center of a ceramic zirconia ferrule. The alignment of the mated connectors/fibers is achieved inside a ceramic or bronze mating sleeve within the bulkhead adapter.

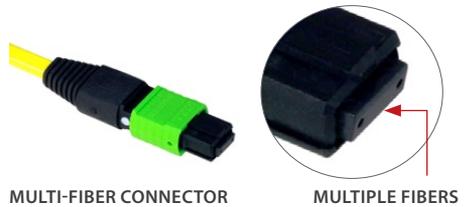


SIMPLEX FIBER CONNECTOR

FIBER

## MULTI-FIBER CONNECTORS

A multi-fiber connector (often called "ribbon fiber connectors") contains one or more rows of fibers in a single connector to provide high-density connectivity. Alignment of the fibers is achieved when the "male" connector, which has outer pins, connects with the "female" connector, which has alignment holes (see page 6). The most common configuration is one row of 12 fibers, but standards exist for up to 6 rows of 12 fibers in one connector. The most common multi-fiber connector type is the MPO, also known by the brand MTP®.



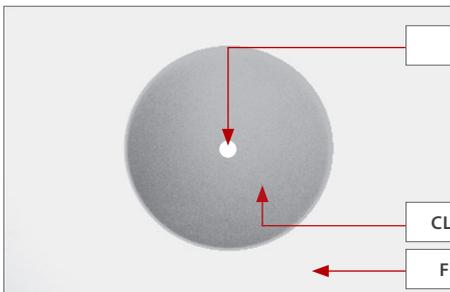
MULTI-FIBER CONNECTOR

MULTIPLE FIBERS

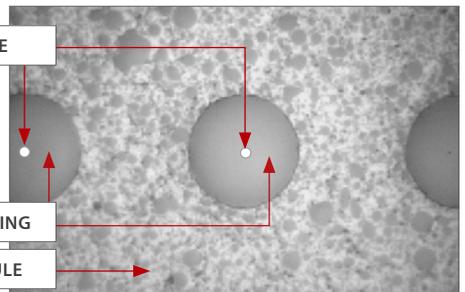
Multi-fiber connectors have a **larger contact area**, and are therefore more susceptible to contamination. All fibers on a multi-fiber connector must be clean for it to function properly. Contamination of one fiber can cause signal degradation on other fibers. For this reason, **inspection and cleaning are even more important for multi-fiber connectors.**

*MTP is a registered trademark of US CONEC, Ltd.*

### SINGLE FIBER



### MULTI-FIBER



**NOTE:** Most single-mode multi-fiber connectors are APC and all multimode connectors are UPC.

# MULTI-FIBER CONNECTORS

## ALIGNMENT MECHANISM

Unlike simplex connectors, which use sleeves located inside the mating adapter body to align the two mated fibers, multi-fiber connectors are equipped with two precision metal guide pins and alignment holes that run parallel to the fibers, keeping the fibers lined up with tight tolerances.

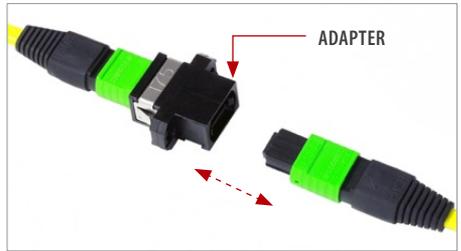


"MALE" CONNECTOR  
(w/ guide pins)



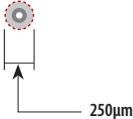
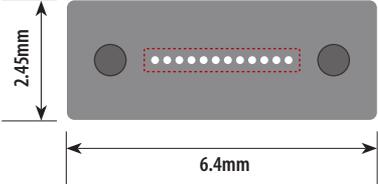
"FEMALE" CONNECTOR  
(w/ alignment holes)

An adapter is used to fasten the keyed architecture of both the "male" and "female" connectors securely in place.



## CONTACT AREA

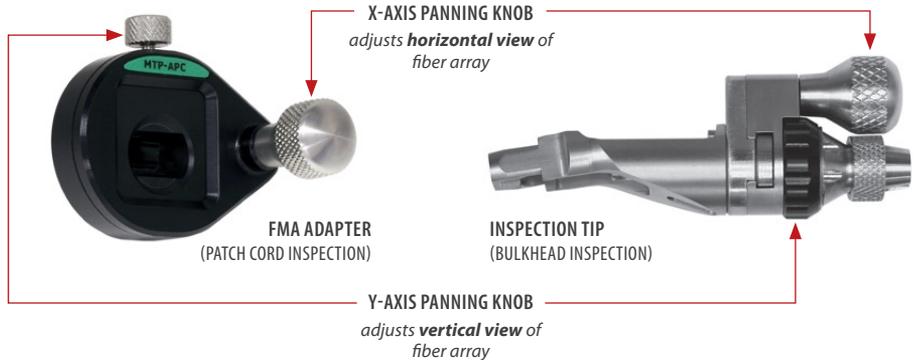
The contact area of multi-fiber connectors is observably larger than the single fiber connector, therefore making it more susceptible to contamination and higher likelihood for signal loss.

SINGLE VS. MULTI-FIBER CONNECTORS		
	SINGLE	MULTI-FIBER
ALIGNMENT	Sleeve	Pins & Holes
FIBER DENSITY	1	4 – 72 (linear array)
SIZE & DIMENSIONS	<p>Multi-mode Single Fiber</p> 	<p>12-fiber Array Multi-fiber</p> <p><b>Larger Area = More Susceptible to Contamination</b></p> 

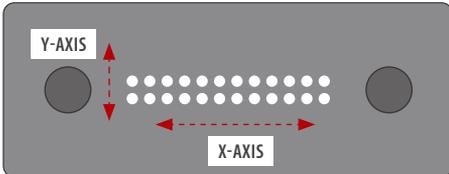
# PATENTED X- & Y-AXIS PANNING KNOBS

## PANNING KNOBS

JDSU's patented panning knobs make the **RibbonDrive™ Tips** truly unique by allowing the user to inspect multiple fibers in a both the x- and y-axis planes.

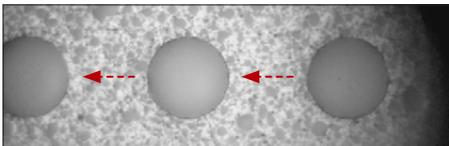
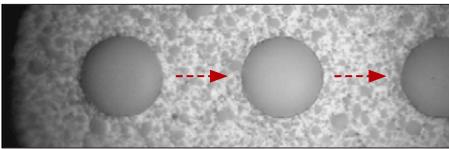


## 24-FIBER CONNECTOR

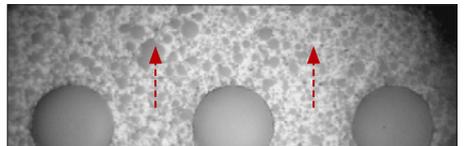
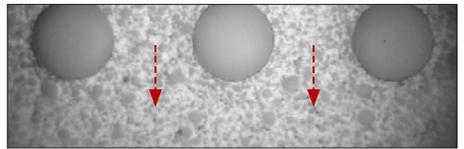


The **Y-AXIS PANNING KNOB** provides the **industry's only solution to inspecting connectors with multiple rows of fiber**. Allowing the user to easily pan up and down rows of fibers provides significant advantages in workflow and efficiency, and makes visually inspecting ALL individual fibers on the connector possible.

## X-AXIS PANNING KNOB



## Y-AXIS PANNING KNOB



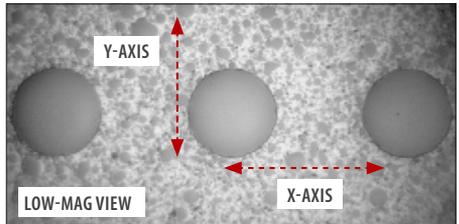
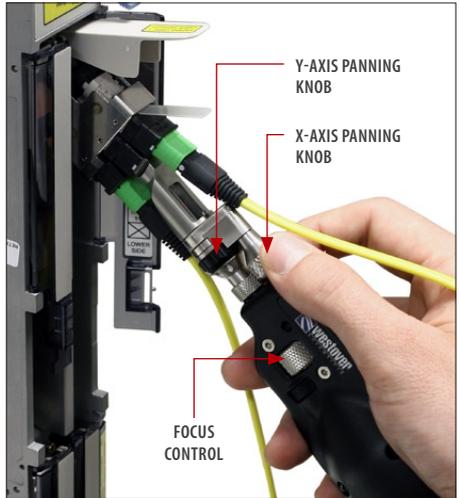
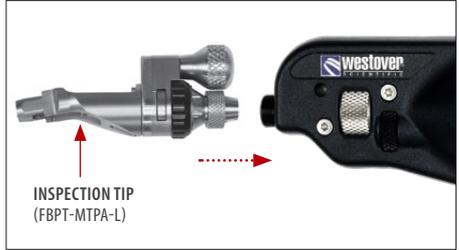


## TIP INSTALLATION

1. Install the **FBPT-MTPA-L** inspection tip to the probe microscope.

## INSPECT

2. Insert the scope into the bulkhead to inspect.
3. Turn the **FOCUS CONTROL** on the probe to focus the fiber image on the display.
4. Turn the **X- and Y-AXIS PANNING KNOBS** to view and inspect the individual fibers.
5. Determine whether **CLEAN** or **DIRTY**.
  - **IF EVERY FIBER IN THE ARRAY IS CLEAN, DO NOT TOUCH IT and CONNECT.**
  - **IF EVEN ONE FIBER IS DIRTY, then cleaning is required. CLEAN.**





## ADAPTER INSTALLATION

### 1. INSTALL PATCH CORD ADAPTER

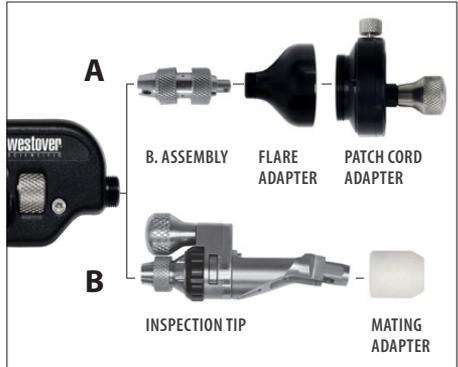
A. Install the barrel assembly (**FBPP-BAP1**), the universal flare adapter (**FBPT-UFMA**) and the appropriate patch cord adapter (**FMA-MTPA shown**) to the probe.

**OR**

B. Install the inspection tip (**FBPT-MTPA-L shown**) and the patch cord mating adapter (**FCLT-MTP-MA shown**) to the probe.

## INSPECT

2. Insert the patch cord into the adapter.
3. Turn the **FOCUS CONTROL** on the probe to focus the fiber image on the display.
4. Turn the **X- and Y-AXIS PANNING KNOBS** to view and inspect the individual fibers.
5. Determine whether **CLEAN** or **DIRTY**.
  - **IF EVERY FIBER IN THE ARRAY IS CLEAN**, DO NOT TOUCH IT and **CONNECT**.
  - **IF EVEN ONE FIBER IS DIRTY**, then cleaning is required. **CLEAN**.





**DIRT IS EVERYWHERE**, and a typical dust particle (2–15 $\mu$  in diameter) can significantly affect signal performance and cause permanent damage to the fiber end face. Most field test failures can be attributed to dirty connectors, and most connectors are not inspected until the problem is detected, **AFTER** permanent damage has already occurred.

## ZONES & ACCEPTANCE CRITERIA

**ZONES** are a series of concentric circles that identify areas of interest on the connector end face. The innermost zones are more sensitive to contamination than the outer zones.

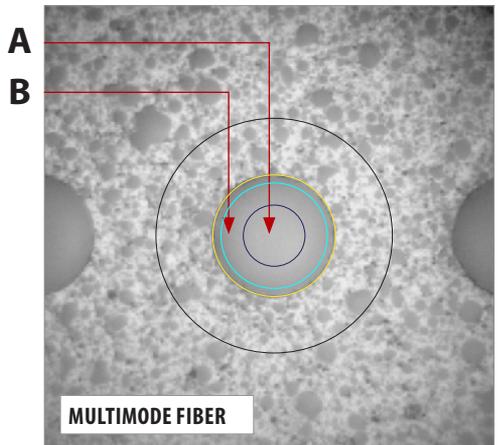
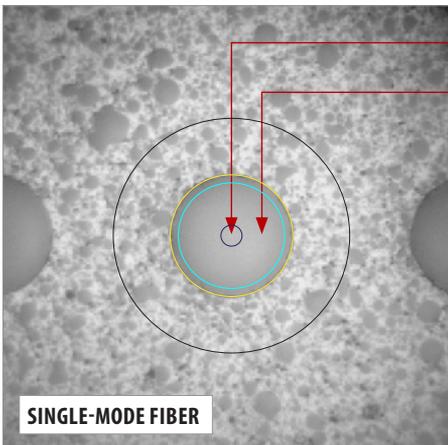
**ACCEPTANCE CRITERIA** are a series of failure thresholds that define contamination limits for each zone.

## GRADING PROCESS

1. Count/measure the particles/contamination that are on the fiber surface.
2. Estimate or use a grading overlay to **GRADE** the fiber by determining the number and size of each particle that are present in each of the 2 fiber zones.
  - **IF ACCEPTABLE**, DO NOT TOUCH IT and **CONNECT**.
  - **IF NOT ACCEPTABLE**, **CLEAN**.

A. CORE ZONE  
B. CLADDING ZONE

## ZONES OVERLAYS



# ACCEPTANCE CRITERIA



The tables below list the **ACCEPTANCE CRITERIA** standardized by the **International Electrotechnical Commission (IEC)** for single-mode and multimode connectors as documented in *IEC 61300-3-35 Ed. 1.0*.

## SINGLE-MODE CONNECTORS

ZONE NAME (Diameter)	SCRATCHES	DEFECTS
<b>A. CORE Zone</b> (0–25 $\mu$ m)	none	none
<b>B. CLADDING Zone</b> (25–115 $\mu$ m)	no limit $\leq$ 3 $\mu$ m none $>$ 3 $\mu$ m	no limit $<$ 2 $\mu$ m 5 from 2–5 $\mu$ m none $>$ 5 $\mu$ m

## MULTIMODE CONNECTORS

ZONE NAME (Diameter)	SCRATCHES	DEFECTS
<b>A. CORE Zone</b> (0–65 $\mu$ m)	no limit $\leq$ 5 $\mu$ m 0 $>$ 5 $\mu$ m	4 $\leq$ 5 $\mu$ m none $>$ 5 $\mu$ m
<b>B. CLADDING Zone</b> (65–115 $\mu$ m)	no limit $\leq$ 5 $\mu$ m 0 $>$ 5 $\mu$ m	no limit $<$ 2 $\mu$ m 5 from 2–5 $\mu$ m none $>$ 5 $\mu$ m



## CLEANBLAST® - ADVANCED FIBER CLEANING SYSTEM (PORTABLE)



6.4" TFT LCD DISPLAY (OPTIONAL)

FIBER INSPECTION PROBE (OPTIONAL)

CLEANING SOLVENT REFILL

HANDSET

5' CLEANING HOSE

1. Install the MTP® cleaning tip (**FCLT-MTP**) to the CleanBlast® handset.
2. Insert the handset into the bulkhead, apply light pressure and push the **RUN BUTTON** to initiate cleaning.
3. **INSPECT** the bulkhead.
4. Determine whether **CLEAN** or **DIRTY**.
  - **IF CLEAN**, DO NOT TOUCH IT and **CONNECT**.
  - **IF DIRTY**, repeat **CLEAN**.

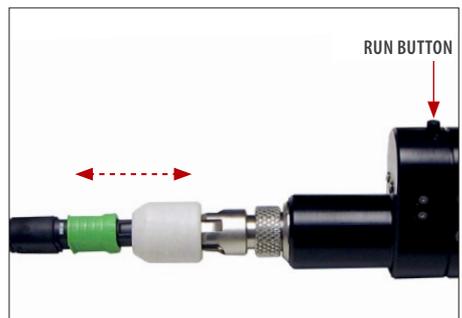
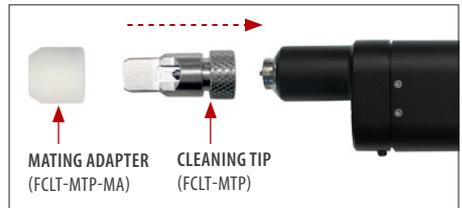




## CLEANBLAST® - ADVANCED FIBER CLEANING SYSTEM (PORTABLE)

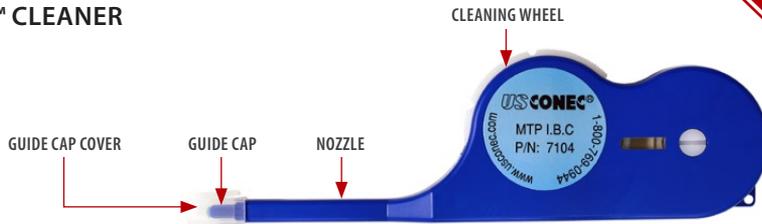


1. Install the MTP® cleaning tip (**FCLT-MTP**) and the patch cord mating adapter (**FCLT-MTP-MA**) to the CleanBlast® handset.
2. Insert the patch cord into handset, apply light pressure and push the **RUN BUTTON** to initiate cleaning.
3. **INSPECT** the patch cord.
4. Determine whether **CLEAN** or **DIRTY**.
  - **IF CLEAN**, DO NOT TOUCH IT and **CONNECT**.
  - **IF DIRTY**, repeat **CLEAN**.





## IBC™ CLEANER



1. PULL OFF the **GUIDE CAP**.

### DRY CLEAN

2. Insert the cleaning tool into the bulkhead and turn the **CLEANING WHEEL BACKWARDS** UNTIL "CLICK" 2 TIMES.
3. **INSPECT** the bulkhead.
4. Determine whether **CLEAN** or **DIRTY**.
  - **IF CLEAN**, DO NOT TOUCH IT and **CONNECT**.
  - **IF DIRTY**, either repeat **DRY** cleaning **OR** go to **WET → DRY** cleaning.

### WET → DRY CLEAN

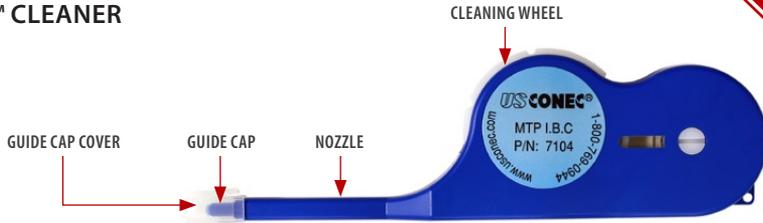
5. Apply/pump the cleaning solvent onto a sheet of clean fiber wipe.
6. Dab the cleaning tool onto the wet area of the wipe to moisten the cleaning tip, then **GO TO STEP 2**.



REPEAT STEPS 2, 3, AND 4 IF NECESSARY



## IBC™ CLEANER



1. Carefully **PULL OUT** the **GUIDE CAP COVER**.

### DRY CLEAN

2. Insert the patch cord into the cleaning tool, apply slight pressure and turn the **CLEANING WHEEL BACKWARDS UNTIL "CLICK" 2 TIMES**.
3. **INSPECT** the patch cord.
4. Determine whether **CLEAN** or **DIRTY**.
  - **IF CLEAN**, DO NOT TOUCH IT and **CONNECT**.
  - **IF DIRTY**, either repeat **DRY** cleaning **OR** proceed to **WET → DRY** cleaning.



### WET → DRY CLEAN

5. Apply/pump the cleaning solvent onto a sheet of clean fiber wipe.
6. Wipe the end of the fiber connector on the wet area of the wipe, then **GO TO STEP 2**.



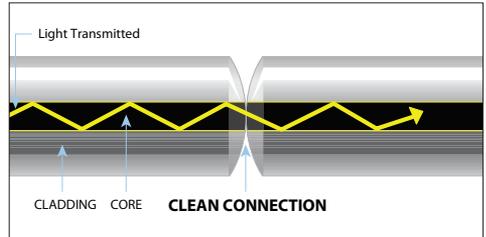
REPEAT STEPS 2, 3, AND 4 IF NECESSARY



## GOOD FIBER CONNECTION

There are **3 BASIC PRINCIPLES** that are critical to achieving an efficient fiber optic connection:

1. **PERFECT CORE ALIGNMENT**
2. **PHYSICAL CONTACT**
3. **PRISTINE CONNECTOR INTERFACE**



Today's connector design and production techniques have eliminated most of the challenges to achieving **CORE ALIGNMENT** and **PHYSICAL CONTACT**.

What remains challenging is maintaining a **PRISTINE END FACE**. As a result, **CONTAMINATION IS THE #1 SOURCE OF TROUBLESHOOTING** in optical networks.

## FIBER CONNECTIONS

Optical connections are made for one of two reasons:

### 1. **COMPLETING A SYSTEM LIGHT PATH (Tx to Rx)**

Connectors are used extensively throughout optical networks. They give us the ability to reconfigure the network and provision services. If contamination is present in the light path, system performance will be degraded.

Always **INSPECT** and, if necessary, **CLEAN** the optical port and optical cable for contamination before connecting.

### 2. **CONNECTING A TEST DEVICE TO PART OF THE SYSTEM**

Test devices are frequently connected and disconnected to elements of the network. Often, test leads are systematically connected to each port in a network element in sequence. This duty cycle makes test leads especially prone to contamination and damage. If a test lead is contaminated, it can quickly spread that contamination through a large portion of the network.

Always **INSPECT** and, if necessary, **CLEAN** the network port and test lead for contamination before connecting.

# APPENDIX A: JDSU RIBBONDRIVE™ TIPS

## RIBBONDRIVE™ TIPS

JDSU's patented **RIBBONDRIVE™** tips are specialty tips that allow inspection of high-density, multi-fiber array connectors that are mounted within a bulkhead adapter. Each tip mates securely with connectors using a precision-keyed mating adapter interface. The patented “panning knobs” allow the user to view each fiber individually in both the X- and Y-AXIS.

**NOTE:** Additional multi-fiber (*RibbonDrive™*) inspection tips are available for other types of connectors (e.g., *MPX, MT ferrule, HBMT, OGI, Molex, SMC, etc.*).

CONNECTOR TYPE	INSPECTION TIP		APPLICATION
 MTP®/UPC	FBPT-MTP		Inspects <b>MTP®/UPC</b> connector through a bulkhead (female interface).
	FBPT-MTP-A6		Inspects <b>MTP®/UPC</b> connector through a bulkhead (female interface) - <b>60° ANGLE</b> .
 MTP®/APC	FBPT-MTPA		Inspects <b>MTP®/APC</b> connector through a bulkhead (female interface).
	FBPT-MTPA-L		Inspects <b>MTP®/APC</b> connector through a bulkhead (female interface) - <b>LONG REACH w/ Y-AXIS panning knob</b> .
 MOLEX® AR8	FBPT-AR8-24 FBPT-AR8G		The FBPT-AR8-24 tip & AR8G guide allow inspection of <b>MOLEX® AR8</b> array connectors ( <i>plug and receptacle</i> ) w/ <b>Y-AXIS panning knob</b> .
 OPTITIP®	FBPT-COD-MT		Inspects <b>OPTITIP® flat-polish</b> connector ( <i>plug and receptacle</i> ).
	FBPT-COD-MTA		Inspects <b>OPTITIP® angle-polish</b> connector ( <i>plug and receptacle</i> ).
FMA Adapter & Flare Adapter	FMA-MTPA & FBPT-UFMA		Inspects <b>MTP®</b> patch cords (male interface).
Mating Adapter	FCLT-MTP-MA		Mating adapter for inspecting <b>MTP®</b> patch cords (male interface).

# APPENDIX B: JDSU WESTOVER VIDEO PROBE INSPECTION

## DIGITAL VIDEO PROBE

JDSU's **WESTOVER P5000** digital probe microscope connects directly to PC/laptops via a USB 2.0 connection, and operates with **FIBERCHEK2™**, an advanced software that determines the acceptability of optical fiber end faces through advanced automated inspection and analysis.



USB 2.0 connection to PC/laptop



## ANALOG VIDEO PROBE

JDSU's **WESTOVER FBP and FBE** analog probe microscopes connect directly to **WESTOVER HD DISPLAYS** (*HD1, HD2 or HD3*) or to a PC/laptop or JDSU test platform (*T-BERD/MTS or FST*) via a **USB ANALOG TO DIGITAL CONVERTER**.



with HD Series displays



with USB converter module



# APPENDIX C: JDSU CLEANBLAST® SYSTEMS

JDSU's **CLEANBLAST®** system is an advanced fiber cleaning instrument that provides a fast, effective, repeatable and cost-effective (*less cost per clean than conventional cleaning methods at under \$0.01 per clean*) solution for removing loose dirt and debris from optical connectors. It utilizes a highly filtered stream of pressurized gas to create a high flow rate jet consisting of specially formulated cleaning solvent that blasts across the surface of the fiber, with nearly 100% effectiveness. Precision cleaning tips and adapters are also available for multiple configurations and connector types, allowing users to optimize their cleaning efficiency and performance. The CleanBlast® system also includes an input for an optional probe microscope, as well as a video output that can be connected to an external monitor or to a mounted LCD.

## PORTABLE CLEANBLAST®



## BENCH-TOP CLEANBLAST®



## FEATURES & BENEFITS

- Provides rapid, controlled, and repeatable cleaning & removal of contamination from fiber end faces
- Utilizes a precise non-contact “air-solvent-air” combination to blast, remove and dissolve contamination
- Faster, more effective, and less cost per clean than other conventional cleaning methods
- Precision cleaning tips & adapters available to clean various types of “male” and “female” fiber connectors, including SC, FC, LC, ST, E2000, MPO, MPX, MT, MTP®, transceivers, etc.
- Inputs for optional video probe microscope and LCD display for fiber inspection
- Multiple system configurations for different applications

CLEANING TIP & ADAPTER	APPLICATION
FCLT-MTP 	Cleans MTP® connectors through a bulkhead (female interface).
FCLT-MTP-MA 	Mating adapter for cleaning MTP® patch cords (male interface).

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## Test and Measurement Regional Sales

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