

# A Quick Start Guide to Fiber Inspection, Cleaning, and Test

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



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<b>Patents</b>	<p>RibbonDrive Tips: US Patent No. 6,751,017 / 6,879,439</p> <p>CleanBlast: US Patent No. 7,232,262</p>
<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. The 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

## FIBER INSPECTION OVERVIEW

**Contamination is the number 1 reason for troubleshooting 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 signal loss and optimizes test conditions. Westover FBP-series video probes, available in digital or analog and single- or dual-magnification (200/400X), 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.

Our comprehensive selection of precision, stainless-steel fiber inspection tips and adapters are carefully engineered to produce consistent and accurate results. They are interchangeable and designed with a unique optics architecture that enables the probe to interface with every connector and application in your network.



HP3-60-P4 System with Integrated Power Meter and Patch Cord Microscope (PCM)

## SIMPLE SOLUTION

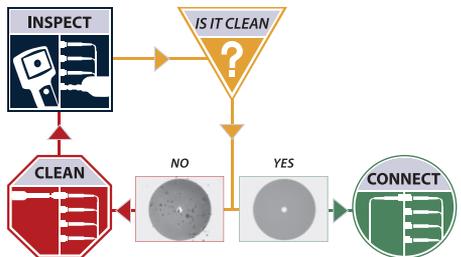
Implementing a **simple yet important** process of proactively inspecting and cleaning before mating can prevent poor signal performance and equipment damage.

## BENEFITS OF PROACTIVE INSPECTION

**Proactively inspecting** fiber optic connectors will...

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

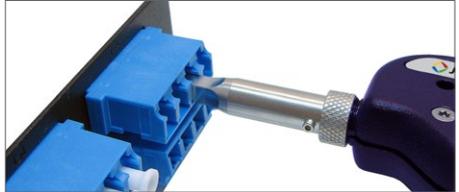
## INSPECT *BEFORE* YOU CONNECT





## BULKHEAD

1. Select the appropriate **bulkhead inspection tip** that corresponds to the connector type and install onto probe.
2. Insert the scope into the bulkhead to inspect.
3. Determine whether **clean or dirty**.
  - If **clean**, **do not touch it** and **CONNECT**.
  - If **dirty**, and cleaning is required, **CLEAN**.



## PATCH CORD WITH PROBE

1. Select the appropriate **patch cord inspection tip** that corresponds to the connector type and install onto probe.
2. Attach the patch cord to the probe.
3. Determine whether **clean or dirty**.
  - If **clean**, **do not touch it** and **CONNECT**.
  - If **dirty**, and cleaning is required, **CLEAN**.



## PATCH CORD WITH PCM

The integrated PCM improves workflow by letting users inspect both the bulkhead and patch cord quickly and easily. Instantly toggle between probe and PCM fiber views with the **A/B switch**.

1. Select the appropriate **patch cord adapter** that corresponds to the connector type and install onto PCM.
2. Attach the patch cord to the PCM.
3. Press **A/B switch** to activate PCM fiber view.
4. Determine whether **clean or dirty**.
  - If **clean**, **do not touch it** and **CONNECT**.
  - If **dirty**, and cleaning is required, **CLEAN**.





**Dirt is everywhere**, and a typical dust particle (2–15  $\mu\text{m}$  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 AND ACCEPTANCE CRITERIA

**Zones** are a series of concentric circles that identify areas of interest on the connector end face. The inner-most 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

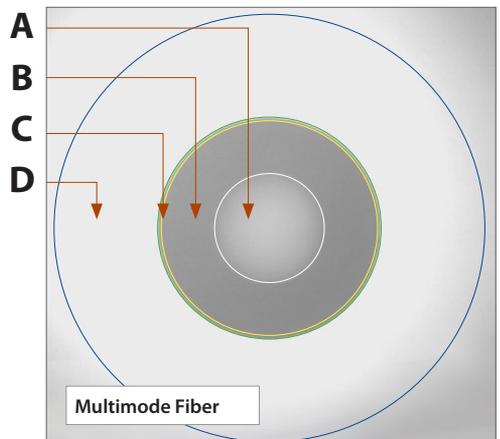
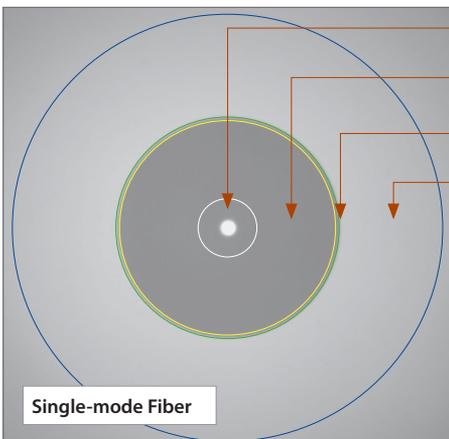
1. Count/measure the particles/contamination that are on the fiber surface.
2. Estimate or use a grading overlay to **grade** the fiber by determining the number and size of each particle present in each of the 4 fiber zones.

*\*Note: In most cases, there are **no limits** to the number/size of contamination present on **Zone C** (Adhesive/Epoxy).*

- If acceptable, **do not touch it** and **CONNECT**.
- If not acceptable, **CLEAN**.

- A. Core Zone
- B. Cladding Zone
- C. Adhesive / Epoxy Zone\*
- D. Contact / Ferrule Zone

## Zones Overlays





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	Defects	Scratches
<b>A. CORE Zone</b>	0 – 25 $\mu\text{m}$	none	none
<b>B. CLADDING Zone</b>	25 – 120 $\mu\text{m}$	no limit < 2 $\mu\text{m}$ 5 from 2 – 5 $\mu\text{m}$ none > 5 $\mu\text{m}$	no limit $\leq$ 3 $\mu\text{m}$ none > 3 $\mu\text{m}$
<b>C. ADHESIVE Zone</b>	120 – 130 $\mu\text{m}$	no limit	no limit
<b>D. CONTACT Zone</b>	130 – 250 $\mu\text{m}$	none $\geq$ 10 $\mu\text{m}$	no limit

## MULTIMODE CONNECTORS

Zone Name	Diameter	Defects	Scratches
<b>A. CORE Zone</b>	0 – 65 $\mu\text{m}$	4 $\leq$ 5 $\mu\text{m}$ none > 5 $\mu\text{m}$	no limit $\leq$ 5 $\mu\text{m}$ 0 > 5 $\mu\text{m}$
<b>B. CLADDING Zone</b>	65 – 120 $\mu\text{m}$	no limit < 2 $\mu\text{m}$ 5 from 2 – 5 $\mu\text{m}$ none > 5 $\mu\text{m}$	no limit $\leq$ 5 $\mu\text{m}$ 0 > 5 $\mu\text{m}$
<b>C. ADHESIVE Zone</b>	120 – 130 $\mu\text{m}$	no limit	no limit
<b>D. CONTACT Zone</b>	130 – 250 $\mu\text{m}$	none $\geq$ 10 $\mu\text{m}$	no limit



## IBC™ Cleaner



1. Select the appropriate cleaning tool for the connector type.
2. Pull off the **guide cap**.

### DRY CLEAN

3. Insert the cleaning tool into the bulkhead adapter and **push the cleaner into the bulkhead 2 times (2 clicks)**.

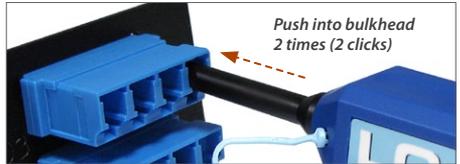
**Note:** For hard-to-reach places, push the **nozzle extender lock** and pull the **nozzle** out.

### INSPECT

5. 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

6. Apply fiber optic cleaning solution onto a clean fiber wipe.
7. Dab the cleaning tool onto the wet area of the wipe to moisten the cleaning tip, then **go to STEP 3**.



Repeat steps 3, 4, and 5 if necessary.



## IBC™ Cleaner



1. Select the appropriate cleaning tool for the connector type.
2. Pull off the **guide cap cover**.

### DRY CLEAN

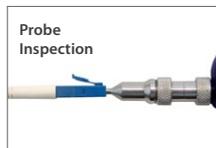
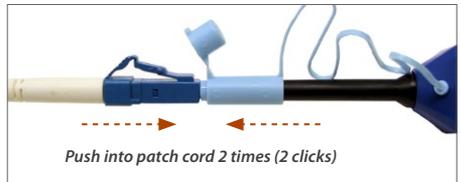
3. Attach the cleaning tool to the connector and **push the cleaner into the patch cord 2 times (2 clicks)**.

### INSPECT

5. 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

6. Apply fiber optic cleaning solution onto a clean fiber wipe.
7. Wipe the end of the fiber connector on the wet area of the wipe, then **go to STEP 3**.



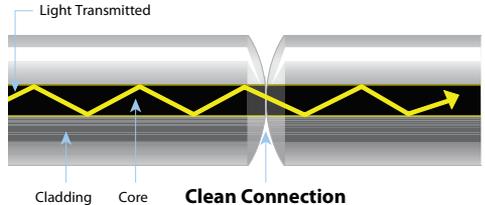
Repeat steps 3, 4, and 5 if necessary.



## 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 reason for troubleshooting 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 re-configure the network and provision services. If contamination is present in the light path, system performance will be degraded.

**Note:** Always **inspect** and, if necessary, **clean** the contamination from the optical port and optical cable 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.

**Note:** Always **inspect** and, if necessary, **clean** the contamination from the network port and test lead before connecting.

# INSPECT + TEST SYSTEM



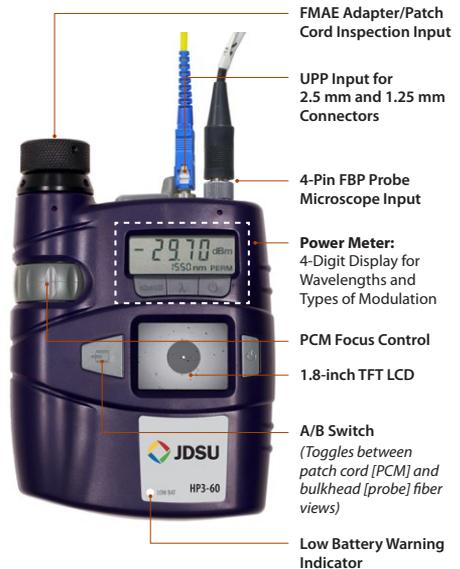
## HP3-60-P4 SYSTEM

The HP3-60-P4 fiber inspection and test system (with integrated patch cord microscope [PCM]) combines fiber inspection and optical power measurement into a single seamless handheld device. The result is a significant increase in workflow efficiency and decrease in total inspection and test time.



## KEY FEATURES

- Inspect both sides of fiber interconnect, and accurately test and measure optical power with one device
- Integrated functions and features eliminate switching between multiple devices
- Integrated power meter for all single-mode and multimode applications, such as LAN, TELECOM, CATV, and DWDM testing
- Modulation frequency detection lets users identify individual fibers
- Three-year calibration period
- TWINtest and Auto- $\lambda$  (with JDSU optical light source)
- Input for FBP-series probe microscope and a dedicated PCM let users quickly and easily inspect both sides fiber interconnects
- Integrated PCM eliminates need for changing inspection tips, prevents misrouting, and protects patch cords
- 1.8-inch TFT LCD to view clear, detailed fiber end face images



# TEST: POWER MEASUREMENT



## ABSOLUTE POWER

The **absolute power level** (*system power measurement*) is the amount of optical power present in the system, measured in **dBm**. The source of this power is the transmitter or transceiver sending information through the system. This test determines whether the signal has enough power to operate the receiver or transceiver at the end of the link.



1. Select the connector you are testing and disconnect from the system.
2. **Inspect**, and if necessary, **clean** both the patch cord and bulkhead ends of the fiber interconnect.
3. **Inspect**, and if necessary, **clean** both ends of the **test lead** fiber.
4. Connect the **test lead** connector to the power meter and to the system.
5. Press  to turn the power meter **ON**.
6. Press  to select wavelength.
7. Press  to select **dBm**.
8. The optical power measurement is displayed on the power meter display.



## RELATIVE POWER

**Attenuation measurements** (*optical link loss*) on optical components or fiber optic links (*e.g., fiber connectors, cable assemblies, installed fiber optic links*) are acquired by measuring the **relative power level (dB)** at the far end of the link or device under test.

**Relative power level** (*attenuation measurement*) is the amount of power lost (*attenuated*) by the optical link being tested, measured in **dB**. The source of this power is typically a handheld optical light source. This test determines whether the optical link is constructed properly, either as a qualification test or when troubleshooting the network.

**To measure attenuation, you must:**

1. Get a reference measurement (*page 13*)
2. Get attenuation measurement (*page 14*)

**Note:** Loss testing of **single-mode** fiber links is specified in ANSI/TIA/EIA-526-7 and ISO/IEC-TR-14763-3.  
Loss testing of **multimode** fiber links is specified in ANSI/TIA/EIA-526-14A and ISO/IEC-TR-14763-3.

## REFERENCE MEASUREMENT



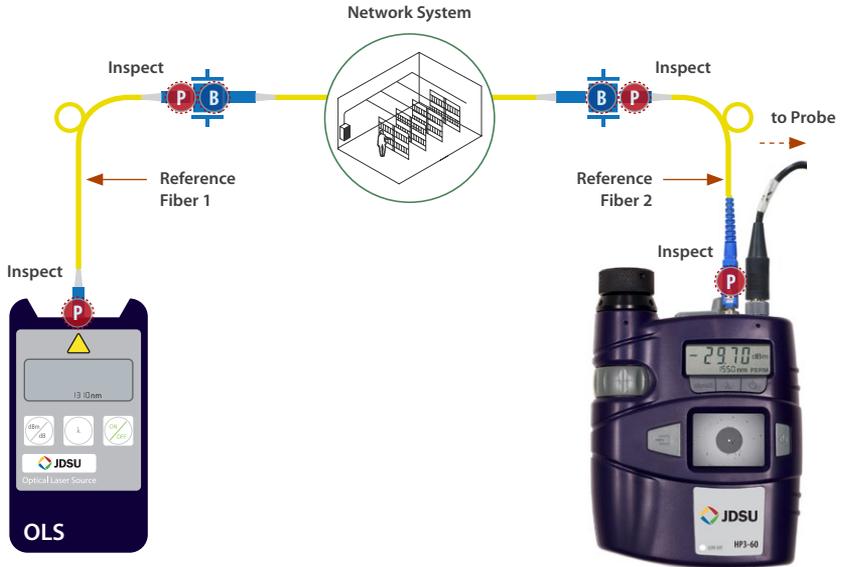
1. **Inspect**, and if necessary, **clean** both ends of **reference fiber 1**.
2. Connect the optical light source (OLS) to the power meter using **reference fiber 1**.
3. Press  to turn both the power meter and light source **ON**.
4. Press  to select wavelength.
5. Press and hold  until a reference level of **0.00 dB** is displayed on the power meter display. **For attenuation measurement, continue to next page.**

**Note:** REF will flash briefly on the power meter to indicate that the reference level is saved.

**Note:** **DO NOT** disconnect the **reference fiber** from the light source (OLS).



## ATTENUATION MEASUREMENT



1. Disconnect the power meter from **reference fiber 1**.  
**Note: DO NOT disconnect reference fiber 1 from the light source (OLS).**
2. **Inspect**, and if necessary, **clean** all ends of the system port.
3. Connect **reference fiber 1** to the system port.
4. **Inspect**, and if necessary, **clean** both ends of **reference fiber 2**.
5. **Inspect**, and if necessary, **clean** the fiber at the far end of the optical link.
6. Connect **reference fiber 2** to the system port and the power meter at the far end of the optical link.
7. Press  to turn both the power meter and light source **ON**.
8. Press  to select wavelength.
9. The **attenuation measurement** (*insertion loss*) of the optical link is displayed on the power meter.

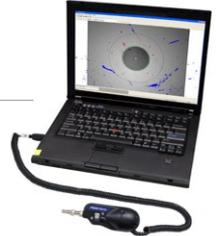
# APPENDIX: JDSU VIDEO PROBE MICROSCOPES

## DIGITAL PROBE

The **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 PROBE

The **Westover FBP and FBE** analog probe microscopes connect directly to **HD displays** (*HD1, HD2, HD3, or HP3-60 series*), or to a PC/laptop, or JDSU test platform (*T-BERD/MTS or FST*) via a **USB analog-to-digital converter**.



with HP3-60-series systems



with USB converter





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