HP3-60-P4

Fiber Inspection & Test System w/Integrated Patch Cord Microscope & Power Meter

HP3-60-P4 Fiber Inspect and Test System with Integrated Patch Cord Microscope and Power Meter

Key Features

- **Inspects both sides of fiber interconnect, and accurately tests and measures optical power with one device**
- **Integrated functions and features eliminate switching between multiple devices**
- **Input for FBP series probe microscope and a dedicated patch cord microscope (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, crisp, detailed images of fiber end faces with optimal resolution**
- **Integrated power meter (OLP-6) 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-λ (with JDSU optical light source)**

Applications

- Inspects fiber end faces and accurately tests and measures optical power in one device
- Quickly and easily inspects both the bulkhead (with probe) and patch cord (with PCM) sides of fiber interconnects
- Measures optical power and attenuation (with JDSU optical light source)
- Measures optical power at 850, 1300, 1310, 1490, and 1550 nm
- Dedicated for all single-mode and multimode applications, such as LAN, TELECOM, CATV, and DWDM testing
- Use with JDSU light source to detect modulation frequency and identify individual fibers
- Promote proper fiber handling workflow and practice

HP3-60-P4 Fiber Inspect and Test System

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

The HP3-60-P4 system, derived from the popular HD3 series, provides high-quality image resolution in a compact, portable design. The integrated power meter offers quick, easy, and convenient field measurement of optical power and attenuation. Easy push-button operation makes the device simple and straightforward, while the inspect-test process establishes optimal workflow practices.

Inspect the Patch Cord with Integrated PCM and the Bulkhead with Probe

Benefits of the Integrated PCM

- Lets users quickly and easily inspect both sides of the fiber interconnect
- Reduces inspection time by more than 50 percent
- Inspects bulkhead with probe microscope and patch cord with PCM
- Eliminates changing inspection tips on the probe to inspect patch cord side
- Prevents misplaced and mishandled inspection tips
- Prevents misrouting by inspecting one port/channel at a time
- Protects *male* (patch cord) ends from contamination by *parking* it in the patch cord module
- A complete selection of FMAE adapters for every application and connector

Integrated Patch Cord Microscope (PCM)

The HP3-60-P4 features an integrated patch cord microscope, adding further value with improved workflow efficiency. Enabling the user to quickly and easily inspect both the *female* (bulkhead) and *male* (patch cord) sides of a fiber interconnect and measure optical power levels makes the HP3-60-P4 the ultimate system for fiber technicians.

JDSU offers a complete selection of FMAE adapters that lets users inspect every application and connector.

Comparison (Display Types)

JDSU Fiber Display Types (with Probe Microscope)

	HD3	HD3-P	HP3-60	HP3-60-P4
• Inspect patch cords (w/Probe microscope)	●	●	●	●
• Inspect bulkheads (w/Probe microscope)	●	●	●	●
• Inspect *both sides* quickly and easily (w/Probe+PCM)		●		●
• Test/measure optical power and attenuation			●	●

Integrated Power Meter

Basic and Reliable

The power meter is used for simple optical power testing, or with a light source for insertion loss measurements at various wavelengths (850, 1300, 1310, 1490, and 1550 nm).

Accurate Measurement and Simple Operation

Three-button operation and a bright, clear display make the power meter very easy to use. When combined with a JDSU light source, the possibility of measurement errors is eliminated because the power meter automatically detects the wavelength being transmitted. As a result, dual wavelength measurements at 850 and 1300 nm or 1310 and 1550 nm can be made quickly and easily using the saved reference levels.

Automatic Identification of Individual Fibers

The power meter can be used with a JDSU light source to detect the modulation frequency of the light coupled into the fiber, for identification purposes.

Universal Push-Pull Interface

Interchangeable UPP adapters let you connect and test any fiber connector.

Efficient Inspection and Test Workflow

1
INSPECT PATCH CORD

2
ACTIVATE PROBE

3
INSPECT BULKHEAD

4
CONNECT

5
TEST

Power Meter Specifications

Display Range	–65 to +10 dBm
Max. Permitted Input Level	+10 dBm
Intrinsic Uncertainty[1]	±0.20 dB (±5%)
Linearity[1] (-50 to +5 dBm)	±0.06 dB
Wavelength Range	780 to 1650 nm
Wavelength & Modulation	270 Hz, 330 Hz, 1 kHz, 2 kHz
1300, 1310, 1490, 1550 nm	–50 to +10 dBm
850 nm	–45 to +10 dBm
Run Time	~180 hours (continuous on)
Auto-shutoff Time	20 minutes
Connectable Fiber Types	9/125 to 100/140 µm
Optical Interface	UPP 2.5 mm adapter *(DIN, ST, FC, SC, E2000)* UPP 1.25 mm adapter *(LC, MU) - sold separately*
Display	LCD, 4-digit
Result Display In	dBm, dB
Resolution	0.01 dB

[1] *Under the following reference conditions: –20 dBm (CW), 1300 nm ± 1 nm, 23°C ± 3K, 45 to 75% relative humidity, 9 to 50 µm fiber*

HP3-60-P4 Specifications

Dimensions	162 x 114 x 42 mm (6.4 x 4.5 x 1.7 in)
Weight	333 g (11.7 oz) with six AA alkaline batteries
Video Display	45.7 mm (1.8 in) TFT LCD
Connector	4-pin Hirose™ input for FBP probes
Power Source	Six AA batteries or AC power adapter (100–240 VAC/9V DC/500mA)
Power Mode	ON (continuous on) OFF
Run Time	~3 hours (continuous on)
Auto-shutoff Time	20 minutes
Horizontal Field-of-View (FOV)	550 µm @ 200X; 350 µm @ 400X
Warranty	1 yr

Hirose is a trademark of Hirose Electronic Corporation.

Ordering Information

FIT-HP3-60	Handheld display with integrated power meter
FIT-HP3-60-P4	Handheld display with integrated power meter and 400X patch cord microscope
FIT-S105	KIT: Dual-mag (200/400X) fiber inspection probe microscope and tips, handheld display with integrated power meter and 400X PCM, carrying case
FIT-S105-C	KIT: Dual-mag (200/400X) fiber inspection probe microscope and tips, handheld display with integrated power meter and 400X PCM, cleaning materials, carrying case
FIT-HP3-60-EU	Handheld display with integrated power meter - EU plug
FIT-HP3-60-P4-EU	Handheld display with integrated power meter and 400X patch cord microscope - EU plug
FIT-S105-EU	KIT: Dual-mag (200/400X) fiber inspection probe microscope and tips, handheld display with integrated power meter and 400X PCM, carrying case - EU plug
FIT-S105-EU-C	KIT: Dual-mag (200/400X) fiber inspection probe microscope and tips, handheld display with integrated power meter and 400X PCM, cleaning materials, carrying case - EU plug
FIT-HP3-60-AU	Handheld display with integrated power meter - AU plug
FIT-HP3-60-P4-AU	Handheld display with integrated power meter and 400X patch cord microscope - AU plug
FIT-S105-AU	KIT: Dual-mag (200/400X) fiber inspection probe microscope and tips, handheld display with integrated power meter and 400X PCM, carrying case - AU plug
FIT-S105-AU-C	KIT: Dual-mag (200/400X) fiber inspection probe microscope and tips, handheld display with integrated power meter and 400X PCM, cleaning materials, carrying case - AU plug
FIT-HP3-60-UK	Handheld display with integrated power meter - UK plug
FIT-HP3-60-P4-UK	Handheld display with integrated power meter and 400X patch cord microscope - UK plug
FIT-S105-UK	KIT: Dual-mag (200/400X) fiber inspection probe microscope and tips, handheld display with integrated power meter and 400X PCM, carrying case - UK plug
FIT-S105-UK-C	KIT: Dual-mag (200/400X) fiber inspection probe microscope and tips, handheld display with integrated power meter and 400X PCM, cleaning materials, carrying case - UK plug

Test & Measurement Regional Sales

NORTH AMERICA	LATIN AMERICA	ASIA PACIFIC	EMEA	www.jdsu.com/inspect
TOLL FREE: 1 866 228 3762	TEL: +1 954 688 5660	TEL: +852 2892 0990	TEL: +49 7121 86 2222	
FAX: +1 301 353 9216	FAX: +1 954 345 4668	FAX: +852 2892 0770	FAX: +49 7121 86 1222	

30162621 000 0109 HP360P4.DS.FIT.TM.AE January 2009

Promotes **INSPECT *BEFORE* YOU CONNECT℠** *Best Practices*

Introducing the New HP3-60 Series

Integrated Fiber Inspection & Test System

Inspect and Test Fiber with One Device!

- Promotes best practices in fiber handling by combining inspection and testing into one device
- Easily inspect both the bulkhead with the probe, and the patch cord with the integrated PCM
- Integrated functions and features eliminate the need to switch from one device to another
- Significantly reduces total inspection and test time for superior workflow efficiency
- Reduce the number of tools and accessories you carry and manage
- Available standalone and in kitted configurations

Efficient Inspection *and* Test Workflow

1 INSPECT PATCH CORD

2 ACTIVATE PROBE

3 INSPECT BULKHEAD

4 CONNECT

5 TEST

Integrated Power Meter

- Easy-to-use, straightforward operation and functions
- Suitable for all single-mode and multimode applications, such as LAN, TELECOM, CATV, and DWDM testing
- Use with JDSU light source to detect modulation frequency and identify individual fibers
- Three-year calibration period
- Universal Push-Pull adapters for 2.5 mm and 1.25 mm connectors

Patch Cord Microscope (PCM) Display *with* Probe Microscope

- Quickly and easily inspect both sides of fiber interconnect
- Reduce inspection time by more than 50 percent
- Eliminate changing inspection tips on the probe to inspect patch cord side
- Inspect one port/channel at a time to prevent misrouting

JDSU

2007 FROST & SULLIVAN Global Communications Test & Measurement Company of the Year Award

HP3-60-P4 Fiber Inspect & Test System
with Integrated Patch Cord Microscope and Power Meter

Components *and* Functions

Configurations *and* Contents

FIT-HP3-60
Basic Model

FIT-HP3-60-P4
with 400X PCM

FIT-S105
Inspection and Test Kit

FIT-S105-C
Inspection, Cleaning, and Test Kit

HP3-60-P4 System Features

- Inspect fiber and test/measure optical power with same device
- Integrated power meter measures optical power at 850, 1300, 1310, 1490, and 1550 nm
- 1.8-inch TFT LCD for viewing clear, crisp, detailed image of fiber end face
- Dedicated patch cord inspection with the integrated PCM
- Compatible with JDSU's extensive line of adapters for inspecting any connector type *(Universal 2.5 mm FMAE adapter included)*
- Probe input enables addition of probe microscope for bulkhead inspection
- A/B Switch easily toggles patch cord (PCM) and bulkhead (probe) fiber views
- Rugged, lightweight, ergonomic design for easy operation
- Hanging hook for hands-free operation

JDSU

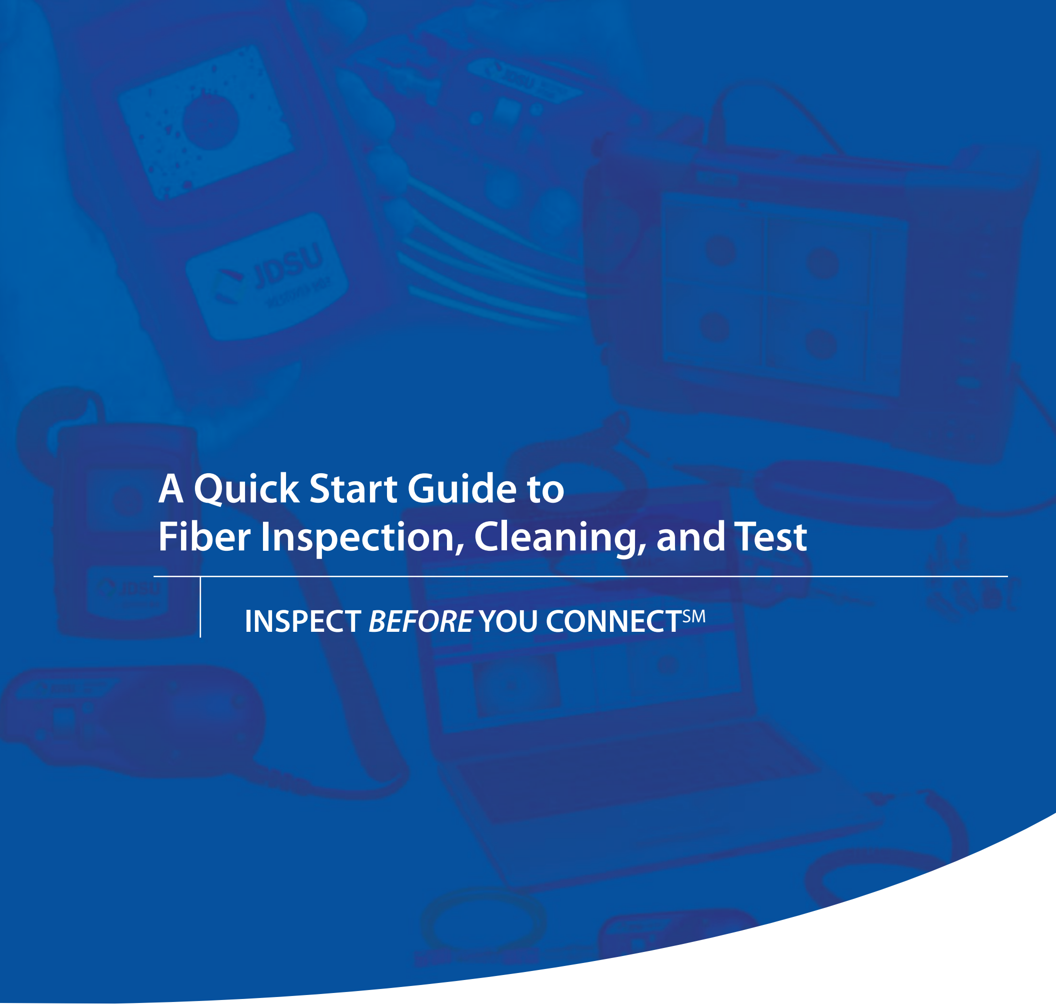
NORTH AMERICA
TEL: 1 866 228 3762
FAX: 1 301 353 9216

LATIN AMERICA
TEL: +1 954 688 5660
FAX: +1 954 345 4668

ASIA PACIFIC
TEL: +852 2892 0990
FAX: +852 2892 0770

EMEA
TEL: +49 7121 86 2222
FAX: +49 7181 86 1222

www.jdsu.com/inspect



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

INSPECT *BEFORE* YOU CONNECT[SM]

JDSU

Notice Every effort was made to ensure that the information in this document was accurate at the time of printing. However, information is subject to change without notice, and JDSU reserves the right to provide an addendum to this document with information not available at the time that this document was created.

Trademarks JDSU is a trademark of JDSU in the United States and other countries.

CleanBlast is a registered trademark of JDSU.

RibbonDrive is a trademark of JDSU.

Hirose is a trademark of Hirose Electric Group.

MTP is a registered trademark of US Conec, Ltd.

IBC is a trademark of US Conec, Ltd.

Optipop is a trademark of NTT Advanced Technology Corporation.

Molex is a registered trademark of Molex Incorporated.

OptiTip and OptiTap are trademarks of Corning Incorporated.

Sony is a registered trademark of Sony Corporation.

Specifications, terms, and conditions are subject to change without notice. All trademarks and registered trademarks are the property of their respective companies.

Patents RibbonDrive Tips: US Patent No. 6,751,017 / 6,879,439

CleanBlast: US Patent No. 7,232.262

Tested Equipment 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.

FCC Information Electronic test equipment is exempt from Part 15 compliance (FCC) in the United States.

European Union 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.

Independent Laboratory Testing This unit has undergone extensive testing according to the European Union Directive and Standards.

CONTENTS

INTRODUCTION TO FIBER INSPECTION

FIBER INSPECTION OVERVIEW

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

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.

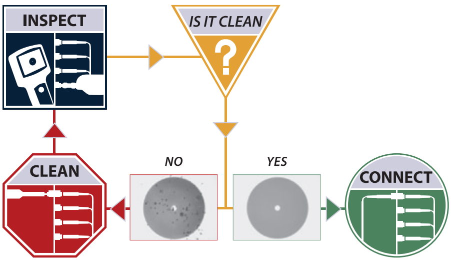
The JDSU video fiber inspection probe and handheld display system is used to quickly and easily inspect connector end faces, which ultimately minimizes signal loss and optimizes test conditions. Westover FBP-series video probes, available in digital or analog and single- or dual-magnification (200/400X), 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.

SIMPLE SOLUTION

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

INSPECT *BEFORE* YOU CONNECT



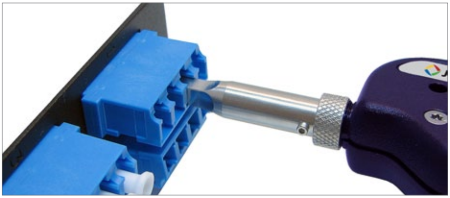
BENEFITS OF PROACTIVE INSPECTION

Proactively inspecting fiber optic connectors will...

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

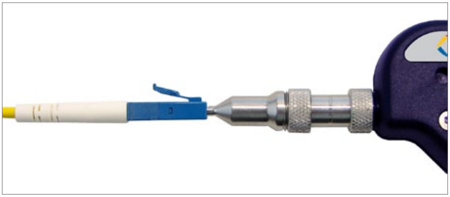
INSPECT

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.**

IS IT CLEAN?

Dirt is everywhere, and a typical dust particle (2–15 µm 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

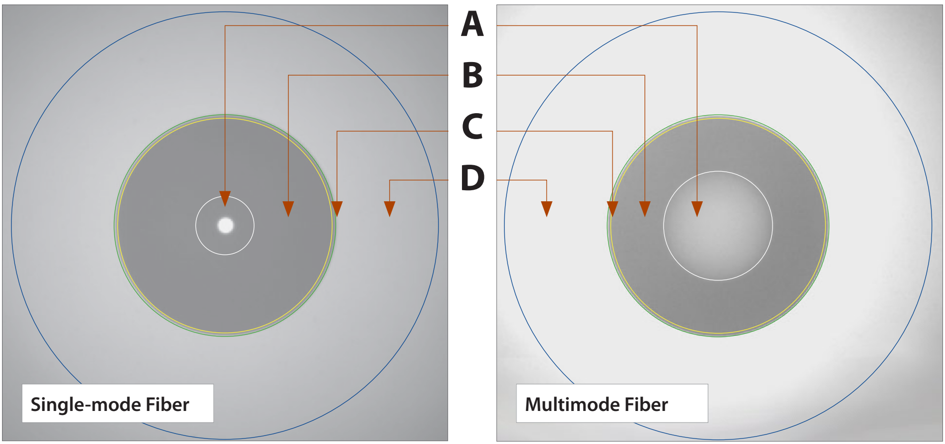
1. Count/measure the particles/contamination that are on the fiber surface.
2. Estimate or use a grading overlay to ***grade*** the fiber by determining the number and size of each particle present in each of the 4 fiber zones.

   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



ACCEPTANCE CRITERIA

IS IT CLEAN ?

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
A. CORE Zone	0 – 25 µm	none	none
B. CLADDING Zone	25 –120 µm	no limit < 2 µm 5 from 2 – 5 µm none > 5 µm	no limit ≤ 3 µm none > 3 µm
C. ADHESIVE Zone	120 – 130 µm	no limit	no limit
D. CONTACT Zone	130 – 250 µm	none ≥ 10 µm	no limit

MULTIMODE CONNECTORS

Zone Name	Diameter	Defects	Scratches
A. CORE Zone	0 – 65 µm	4 ≤ 5 µm none > 5 µm	no limit ≤ 5 µm 0 > 5 µm
B. CLADDING Zone	65 –120 µm	no limit < 2 µm 5 from 2 – 5 µm none > 5 µm	no limit ≤ 5 µm 0 > 5 µm
C. ADHESIVE Zone	120 – 130 µm	no limit	no limit
D. CONTACT Zone	130 – 250 µm	none ≥ 10 µm	no limit

CLEAN: BULKHEAD

IBC™ Cleaner

1. Select the appropriate cleaning tool for the connector type.

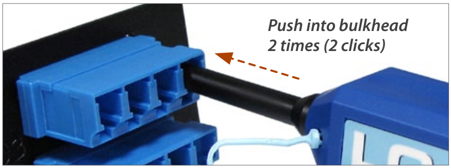
2. Pull off the ***guide cap***.

DRY CLEAN

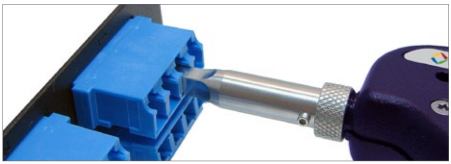
Repeat steps 3, 4, and 5 if necessary.

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.*



4. **INSPECT**



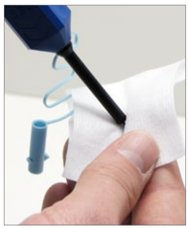
5. Determine whether **clean or dirty.**

- **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.**



CLEAN: PATCH CORD

IBC™ Cleaner

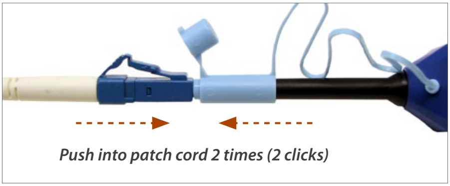
1. Select the appropriate cleaning tool for the connector type.

2. Pull off the ***guide cap cover.***

DRY CLEAN

Repeat steps 3, 4, and 5 if necessary.

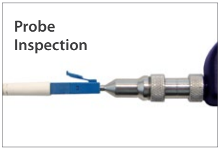
3. Attach the cleaning tool to the connector and ***push the cleaner into the patch cord 2 times (2 clicks).***



4. **INSPECT**

5. Determine whether **clean or dirty.**

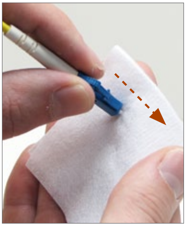
- **If clean, *do not touch it*** and **CONNECT.**
- **If dirty,** either repeat **DRY** cleaning ***or*** go to **WET→DRY** cleaning.



WET → DRY CLEAN

6. Apply fiber optic cleaning solution onto a clean fiber wipe.

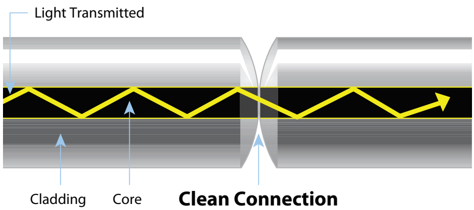
7. Wipe the end of the fiber connector on the wet area of the wipe, then **go to STEP 3.**



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-λ *(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

TEST

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 [λ] to select wavelength.
7. Press [dBm/dB] to select **dBm.**
8. The optical power measurement is displayed on the power meter display.

TEST: REFERENCE MEASUREMENT

TEST

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.

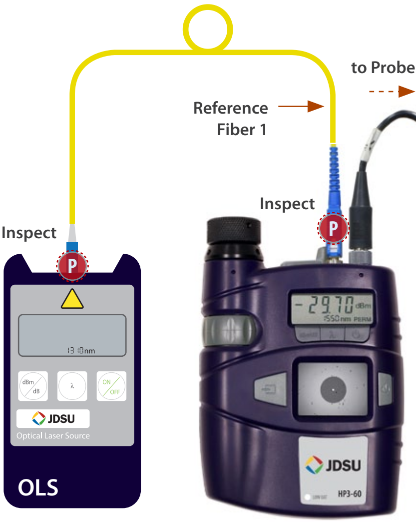
Relative power level *(attenuation measurement)* is the amount of power lost *(attenuated)* by the optical link being tested, measured in **dB.** The source of this power is typically a handheld optical light source. This test determines whether the optical link is constructed properly, either as a qualification 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 [power button] to turn both the power meter and light source **ON.**

4. Press λ to select wavelength.

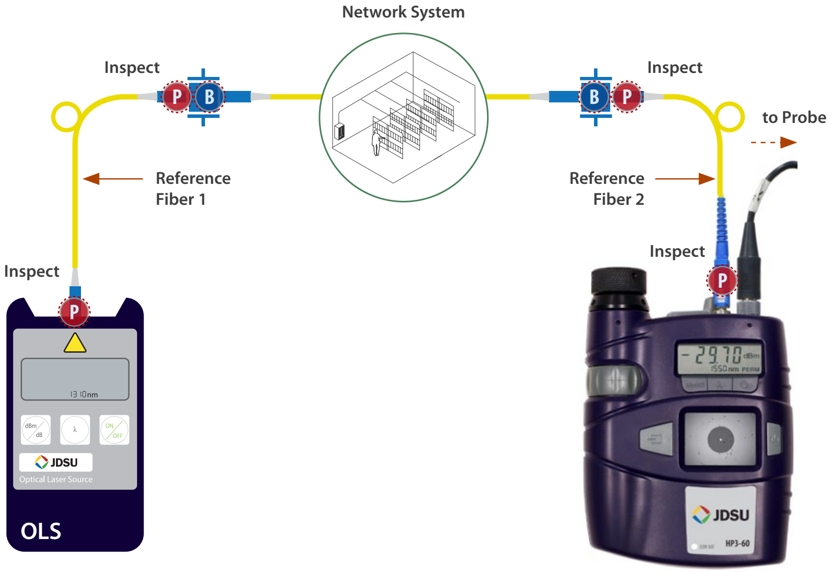
5. Press and hold dBm/dB until a reference level of **0.00 dB** is displayed on the power meter display. ***For attenuation measurement, continue to next page.***

***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).*

TEST: ATTENUATION MEASUREMENT

ATTENUATION MEASUREMENT



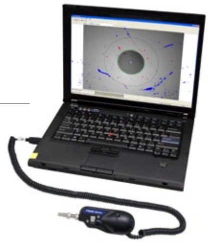
1. Disconnect the power meter from ***reference fiber 1***.
   Note: DO NOT *disconnect* ***reference fiber 1*** *from the light source (OLS).*
2. **Inspect**, and if necessary, **clean** all ends of the system port.
3. Connect ***reference fiber 1*** to the system port.
4. **Inspect**, and if necessary, **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

Test and Measurement Regional Sales

NORTH AMERICA	LATIN AMERICA	ASIA PACIFIC	EMEA	www.jdsu.com/inspect
TEL: 1 866 228 3762	TEL: +1 954 688 5660	TEL: +852 2892 0990	TEL: +49 7121 86 2222	
FAX: 1 301 353 9216	FAX: +1 954 345 4668	FAX: +852 2892 0770	FAX: +49 7181 86 1222	

Achieving IEC Standard Compliance for Fiber Optic Connector Quality through Automation of the Systematic Proactive End Face Inspection Process

Matt Brown

Executive Summary

It is widely known in the fiber optic industry that scratches, defects, and dirt on fiber optic connector end faces negatively impact network performance. As bandwidth requirements continue to grow and fiber penetrates further into the network, dirty and damaged optical connectors increasingly impact the network. If dirty and damaged end faces are not dealt with systematically, these defects can degrade network performance and eventually take down an entire link.

In the effort to guarantee a common level of performance from the connector, the International Electrotechnical Commission (IEC) created Standard 61300-3-35, which specifies pass/fail requirements for end face quality inspection before connection. Designed to be a common reference of product quality, use of the IEC Standard supports product quality throughout the entire fiber optic life cycle, but only when compliance to the standard occurs at each stage.

In response, current best practices recommend systematic proactive inspection of every fiber optic connector end face before connection. While current research shows that this practice is eliminating the installation of contaminated fibers and improving network performance, the uncontrollable variables of technician eyesight and expertise, ambient lighting, and display conditions keep manual inspection and analysis from being a 100-percent reliable and repeatable method of assuring IEC compliance. In addition, because manual inspection does not create a record of the inspection process, certification of quality at the point of installation is not practical.

Because compliance to the IEC Standard is the only way to achieve the promise of today's fiber-rich, high-connectivity networks, this white paper proposes the automation of the inspection process through the addition of analysis software programmed to the Standard's pass/fail criteria to the practice of systematic proactive inspection.

Automation of the systematic proactive inspection process using software programmed to the IEC Standard eliminates the variables associated with manual inspection, provides a documentable record of the quality of the connector end face at the point of installation, and provides a 100-percent repeatable and reliable process. Combined, these benefits make automated end face inspection the most effective method available to assure and certify compliance to the IEC Standard throughout the fiber optic product life cycle, and achieve the promise of next-generation networks.

IEC Standard 61300-3-35

IEC Standard 61300-3-35 is a global common set of requirements for fiber optic connector end face quality designed to guarantee insertion loss and return loss performance. The Standard contains pass/fail requirements for inspection and analysis of the end face of an optical connector, specifying separate criteria for different types of connections (for example, SM-PC, SM-UPC, SM-APC, MM, and multi-fiber connectors). For more detail on the Standard, copies of the copyrighted document are available for purchase at www.ansi.org by searching for "61300-3-35".

These criteria are designed to guarantee a common level of performance in an increasingly difficult environment where fiber is penetrating deeper into the network and being handled by more technicians, many of whom may be unfamiliar with the criticality of fiber optical connector end face quality or possess the experience and technical knowledge required to properly assess it.

The standard is designed to be used as a common quality reference between supplier and customer, and between work groups in several ways:

- As a requirement from the customer to the supplier (for example, integrator to component supplier or operator to contractor)
- As a guarantee of product quality and performance from the supplier to the customer (for example, manufacturer to customer, contractor to network owner, or between work groups within an organization)
- As a guarantee of network quality and performance within an organization

As more stages in the fiber optic product life cycle, shown in Figure 1, are outsourced to disparate vendors, the standard takes on renewed importance in ensuring the optimized performance of today's fiber-dense networks.

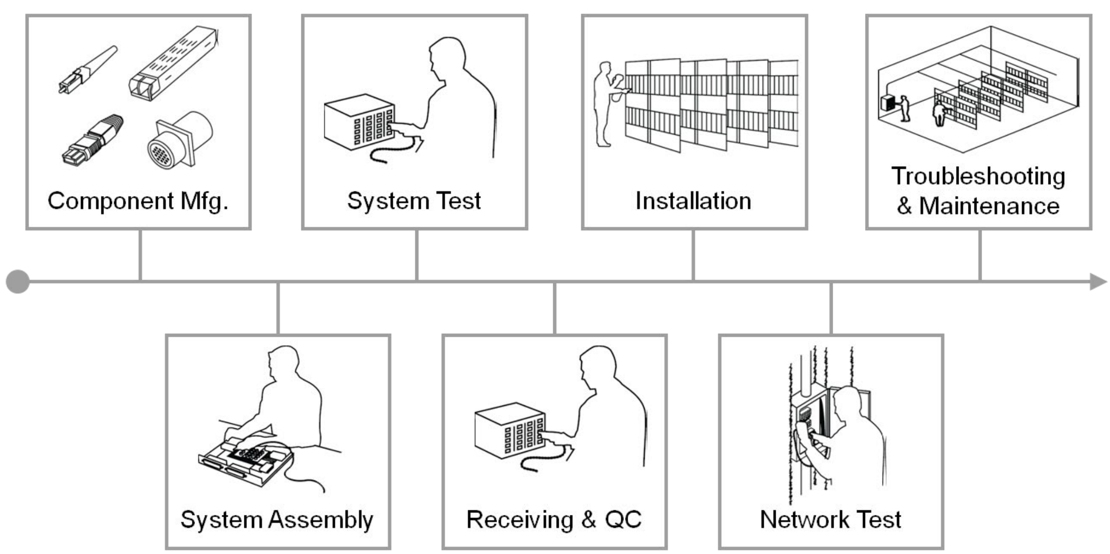


Figure 1: Fiber Optic Product Life Cycle

The Development of the IEC Standard

The quality values used in the IEC standard are the result of years of extensive testing of scratched, damaged, or dirty optical connectors conducted by a coalition of industry experts including component suppliers, contract manufacturers, network equipment vendors, test equipment vendors, and service providers. This work has been published previously in a number of papers as noted in the References section of this paper.

Understanding the variables and limitations of manual visual inspection, fiber optic test and measurement manufacturer JDSU contributed its automated objective inspection and analysis software FiberChek2™, as illustrated in Figure 2, to the IEC for use in the development of the 61300-3-35 visual inspection standard. Automating the pass/fail process using research-based parameters extracted from testing conducted by the aforementioned industry coalition provided the IEC with a repeatable standard of quality that would guarantee a common level of performance, creating a positive impact on both product and network performance.

More than 8 years of testing on a constantly expanding database of fibers and fiber devices (for example, SM, MM, Ribbon, E2000, SFP/XFP, Bend-insensitive fibers, Lenses, and other interfaces), combined with widespread use in the industry by component manufacturers, integrators/CMs, OEMs, third-party installers, and service providers, makes the JDSU software program the only proven automated objective inspection software program that assures compliance to the IEC standard at every step of the fiber optic life cycle.

Testament to this is the fact that this software program is currently used by three of the top five U.S. cable assembly manufacturers, along with six of the largest optical component manufacturers, five of the largest network equipment vendors, and five of the top Network Service Providers (NSPs) in the world, making JDSU FiberChek2 software the current worldwide industry standard for automated objective fiber optic connector end face inspection.

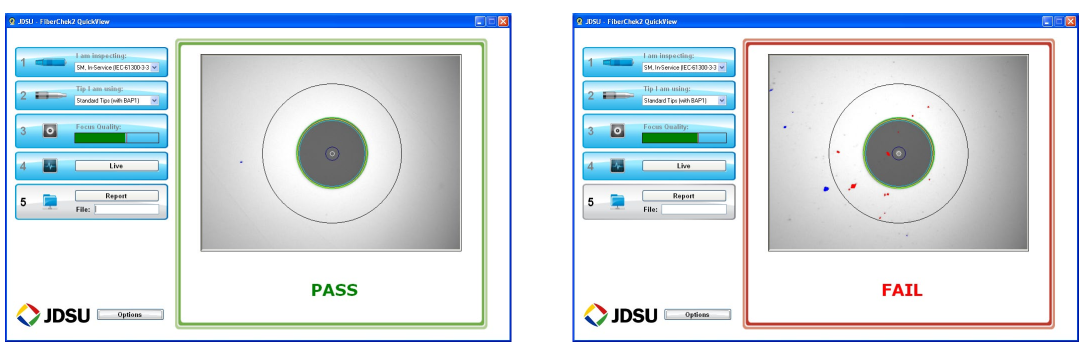


Figure 2: Example of the Proven Inspection and Analysis Software Program FiberChek2 from JDSU

The criteria in the IEC Standard requires the user to know the exact location and size of surface defects (for example, scratches, pits, and debris) on the fiber optic connector end face. As a result, it is only through the use of automated inspection and analysis software that compliance to the IEC Standard (or customer specification) can be tested and certified.

The combination of common requirements (the IEC Standard) and automated inspection and analysis (FiberChek2) have measurably impacted product quality through the supply chain. This is providing improved repeatability and stability of inspection analysis throughout the fiber optic product life cycle, ensuring consistent product performance regardless of the number and expertise of vendors and technicians involved in the manufacture, installation, and network administration processes.

Proactive Inspection Model: Step One Toward Achieving IEC Compliance

Despite its role in the development of the IEC Standard and usage by industry leaders, automated inspection and analysis software is not yet in widespread use across the fiber optic industry. In an effort to enable compliance to the Standard even when using manual visual inspection equipment alone, IEC and industry leaders are supporting the promotion of fiber handling best practices. An example of one such educational effort is the proactive inspection model developed and promoted by fiber optic test equipment manufacturer JDSU, "Inspect Before You Connect" (IBYC), as illustrated in Figure 3.

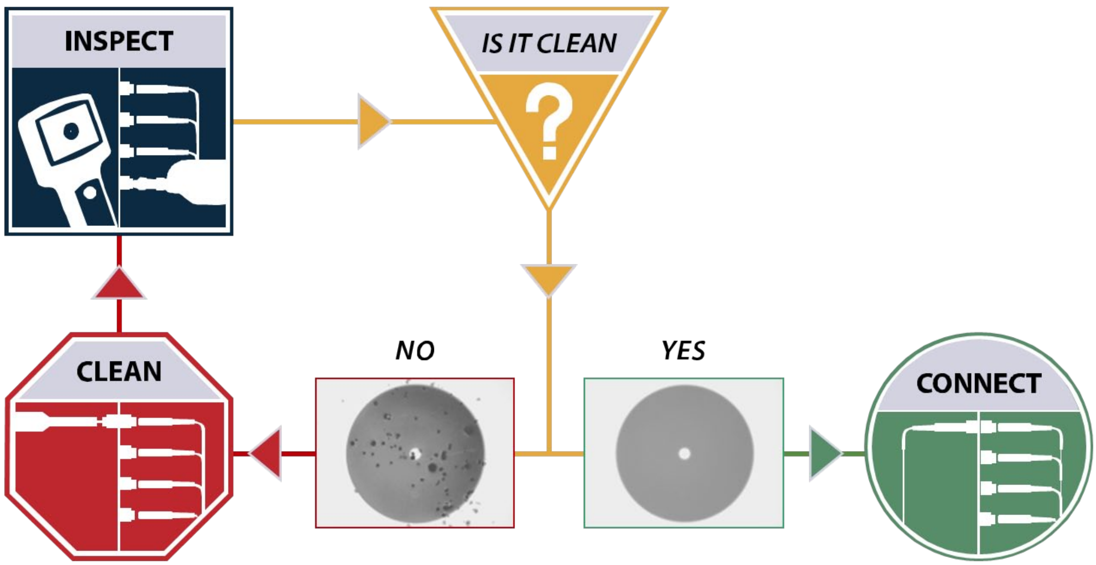


Figure 3: Example of the Proactive Inspection Model: Inspect Before You Connect™

The simple four-step IBYC model, which supports and is mandated by the IEC Standard, effectively guides technicians of varying levels of expertise in the proper implementation of systematic proactive inspection.

- **Step 1 Inspect:** Use the microscope to inspect the fiber. If the fiber is dirty, go to Step 2. If the fiber is clean, go to Step 4.
- **Step 2 Clean:** If the fiber is dirty, use a cleaning tool to clean the fiber end face.
- **Step 3 Inspect:** Use the microscope to re-inspect and confirm the fiber is clean. If the fiber is still dirty, go back to Step 2. If the fiber is clean, go to Step 4.
- **Step 4 Connect:** If both the male and female connectors are clean, they are ready to connect.

Consistent use of the IBYC model ensures that proactive inspection is performed correctly every time and that fiber optic end faces are clean prior to mating connectors, eliminating the installation of dirty or damaged fibers into the network and optimizing network performance. As a result, IBYC has been incorporated into manufacturing procedures for the majority of the world's leading organizations using fiber, increasing knowledge of this process and helping it become routine practice around the world.

Automated Inspection and Analysis: Achieving and Certifying IEC Compliance

Even with the aid of the IBYC model, manual inspection using only a video microscope can be difficult depending on the technician's expertise and can result in variable connector quality and network performance. Reliant on technician eyesight and expertise along with variable display settings and ambient lighting, manual inspection and analysis is not 100 percent reliable, repeatable, or certifiable. Because it produces no visual record of the end face condition in the manual inspection process, certifying compliance at the point of installation through images or reporting is both unreliable and impractical, as Figure 4a shows.

To ensure IEC compliance is achieved, automated inspection of fiber optic connector end faces using inspection and analysis software built on the IEC Standard's pass/fail criteria is the most effective method available. With it technicians of all skill levels can effectively accomplish both compliance and certification through images and reports, as Figure 4b shows.

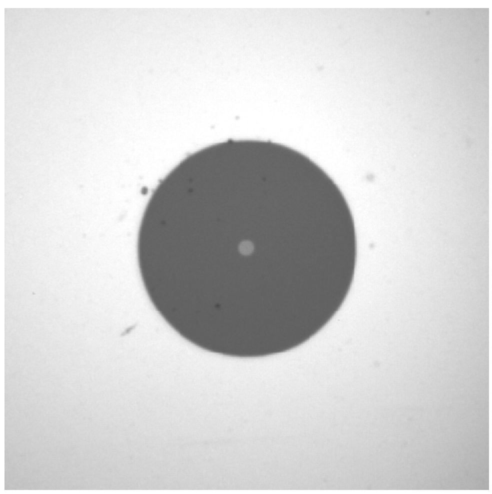


Figure 4a: Manual Inspection requires technicians to judge whether the connector complies with the IEC Standard.

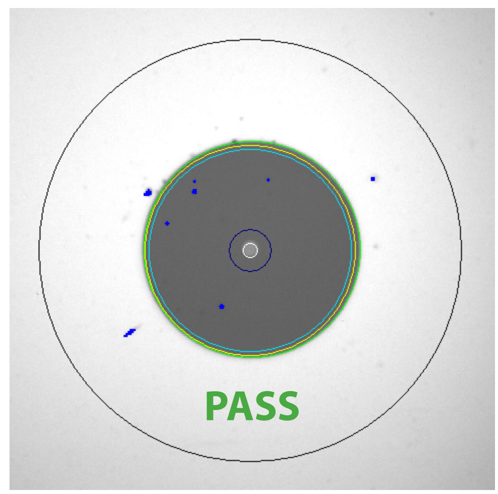


Figure 4b: Automated Inspection gives technicians a pass or fail result.

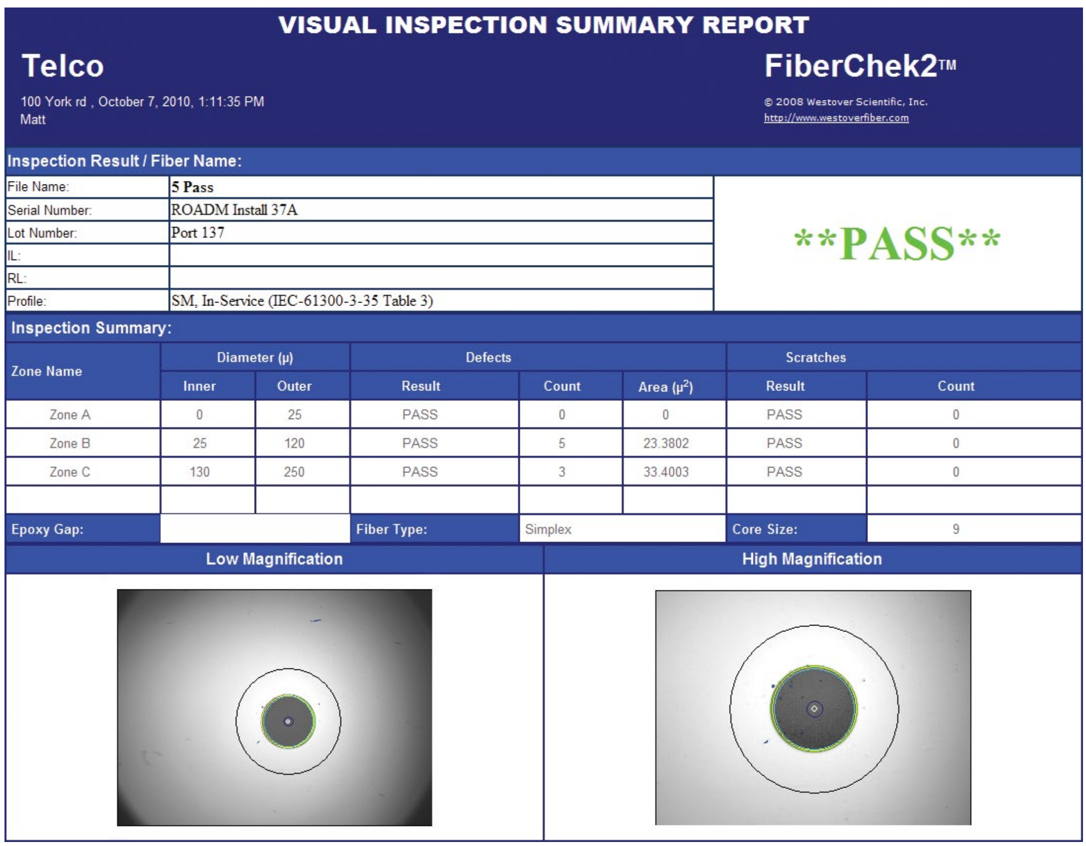
Using the software, automated inspection and analysis can produce a visual record of the end face condition as shown in Figure 5, which can be used in reports and archived for future reference.)

As a result, automated inspection and analysis presents several clear advantages over subjective inspection:

- Eliminates variation in results
- Certifies and records product quality at time of inspection
- Enables technicians of all skill levels to certify quality reliably and systematically
- Makes advanced pass/fail criteria simple to use
- Improves product and network performance and yields

Using a fiber optic inspection and analysis software program that is preloaded with the IEC Standard specifications, such as JDSU FiberChek2 software, any technician can effectively:

- Inspect and certify compliance with IEC 61300-3-35 or other customer-specified standards at every stage of the fiber optic product life cycle at the push of a button
- Implement simple pass/fail acceptance testing; no skill in quality judgment is necessary
- Generate detailed analysis reports that can be archived



VISUAL INSPECTION SUMMARY REPORT

Telco

100 York rd , October 7, 2010, 1:11:35 PM
Matt

FiberChek2™

© 2008 Westover Scientific, Inc.
http://www.westoverfiber.com

Inspection Result / Fiber Name:

File Name:	5 Pass
Serial Number:	ROADM Install 37A
Lot Number:	Port 137
IL:	
RL:	
Profile:	SM, In-Service (IEC-61300-3-35 Table 3)

PASS

Inspection Summary:

Zone Name	Diameter (μ)		Defects			Scratches	
	Inner	Outer	Result	Count	Area (μ²)	Result	Count
Zone A	0	25	PASS	0	0	PASS	0
Zone B	25	120	PASS	5	23.3802	PASS	0
Zone C	130	250	PASS	3	33.4003	PASS	0

Epoxy Gap:		Fiber Type:	Simplex	Core Size:	9

Low Magnification | High Magnification

Figure 5: Automated inspection enables the technician to certify compliance to the standard by producing a date stamped test report.

Conclusion: Business Impact of Automated End Face Analysis

The combination of common requirements (the IEC Standard) and automated fiber optic inspection and analysis software (FiberChek2) has positively impacted product quality across the supply chain. The business impacts of reliable, repeatable automated fiber optic connector inspection and certification include:

- Insured and repeatable product quality through the quantification of connector end face condition at installation
- Assurance of customer satisfaction and supplier protection through the reliable documentation of connector end face quality
- Competitive advantage for component and system vendors, and for installation contractors who can cost-effectively document end face quality
- A common, repeatable system provides correlation through the supply chain
- Easy deployment of custom requirements analysis

Combined, these benefits make automated end face inspection the most effective method available to assure and certify compliance to the IEC Standard throughout the fiber optic product life cycle, and achieve the promise of next-generation networks.

References

1. "Qualification of Scattering from Fiber Surface Irregularities," Journal of Lightwave Technology, V.20, N 3, April 2002, pp. 634–637.
2. "Optical Connector Contamination/Scratches and its Influence on Optical Signal Performance," Journal of SMTA, V. 16, Issue 3, 2003, pp. 40–49.
3. "At the Core: How Scratches, Dust, and Fingerprints Affect Optical Signal Performance," Connector Specifier, January 2004, pp. 10–11.
4. "Degradation of Optical Performance of Fiber Optics Connectors in a Manufacturing Environment," Proceedings of APEX2004, Anaheim, California, February 19–Feb 26, 2004, pp. PS-08-1-PS-08-4.
5. "Cleaning Standard for Fiber Optics Connectors Promises to Save Time and Money", Photonics Spectra, June 2004, pp. 66–68.
6. "Analysis on the effects of fiber end face scratches on return loss performance of optical fiber connectors", Journal of Lightwave Technology, V.22, N 12, December 2004, pp. 2749–2754.
7. "Development of Cleanliness Specification for Single-Mode Connectors," Proceedings of APEX2005, Anaheim, California, February 21–26, 2005, pp. S04-3-1, 16.
8. "Keeping it clean: A cleanliness specification for single-mode connectors," Connector Specifier, August 2005, pp. 8–10.
9. "Contamination Influence on Receptacle Type Optical Data Links," Photonics North, 2005, Toronto, Canada, September 2005.
10. "Development of Cleanliness Specifications for 2.5 mm and 1.25 mm ferrules Single-Mode Connectors," Proceedings of OFC/NFOEC, Anaheim, California, March 5–10, 2006.
11. "Standardizing cleanliness for fiber optic connectors cuts costs, improves quality," Global SMT & Packaging, June/July 2006, pp. 10–12.
12. "Accumulation of Particles Near the Core during Repetitive Fiber Connector Matings and De-matings," Proceedings of OFC/NFOEC2007, Anaheim, CA, March 25–29, 2007, NThA6, pp.1–11.
13. "Development of Cleanliness Specifications for Single-Mode, Angled Physical Contact MT Connectors," Proceeding of OFC/NFOEC2008, San Diego, February 24–28, 2008, NThC1, pp. 1–10.
14. "Correlation Study between Contamination and Signal Degradation in Single-Mode APC Connectors," Proc. SPIE, Vol. 7386, 73861W (2009); doi:10.1117/12.837545.

Test & Measurement Regional Sales

NORTH AMERICA	LATIN AMERICA	ASIA PACIFIC	EMEA	WEBSITE: www.jdsu.com/test
TEL: 1 866 228 3762 FAX: +1 301 353 9216	TEL: +1 954 688 5660 FAX: +1 954 345 4668	TEL: +852 2892 0990 FAX: +852 2892 0770	TEL: +49 7121 86 2222 FAX: +49 7121 86 1222	

