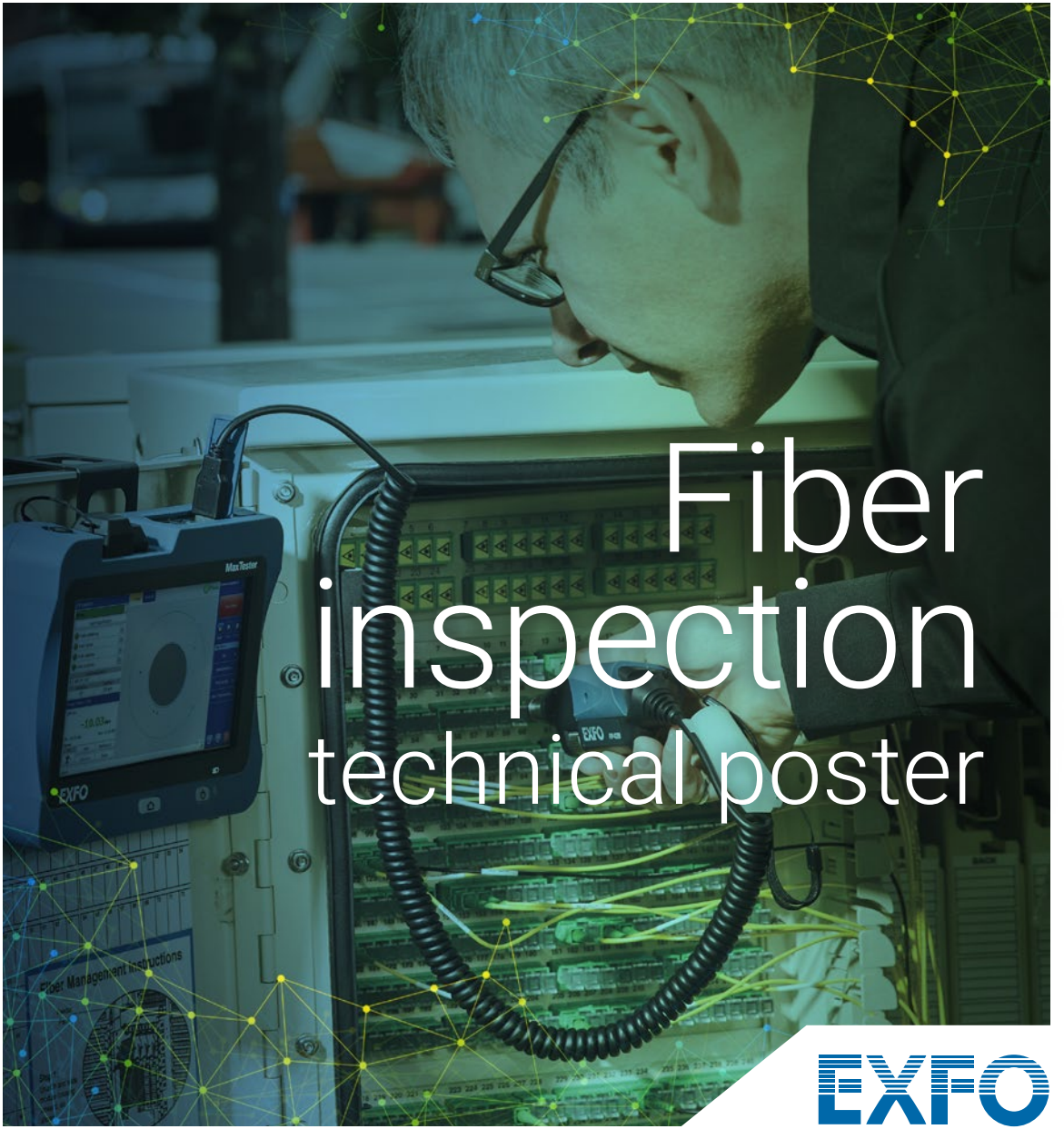


Fiber inspection technical poster

EXFO

Fiber inspection technical poster

No. 1 **cause of network failures is contaminated connectors.**

* NTT-Advanced Technology Research, 2010

AN OUNCE OF PREVENTION IS WORTH A POUND OF CURE

If a chain is only as strong as its weakest link, then fiber networks are only as strong as their weakest connector. It is therefore critical to ensure that they are free of contamination and working properly.

- Prevent optical network failures
- Avoid permanent connector damage
- Ensure more accurate testing results
- Decrease unnecessary connector replacements
- Lower maintenance costs
- Future-proof your network for upcoming 40G/100G or higher speeds expansion

Common fiber connector types

APC: Angled-polished connector
UPC: Ultra-polished connector

Single-fiber connectors

Adapter tips APC					Adapter tips UPC	
Male	Female				Male	Female
FIPT-400-U25MA	FIPT-400-SC-APC		SC Simplex		FIPT-400-U25M	FIPT-400-FC-SC
			SC Duplex			
	FIPT-400-FC-APC		FC Simplex			
	N/A		ST Simplex			FIPT-400-ST
	FIPT-400-E2000-APC		E2000 Simplex			FIPT-400-E2000
			E2000 Duplex			
FIPT-400-U12MA	FIPT-400-LX5-APC		LX-5 Simplex		FIPT-400-U12M	FIPT-400-LX.5
			LX-5 Duplex			
	N/A		MU Simplex			FIPT-400-MU
			MU Duplex			
	FIPT-400-LC-APC		LC Simplex			FIPT-400-LC-SQ
FIPT-400-LC-D-APC			LC Duplex		FIPT-400-LC-D	

MPO connectors

Jumper			Bulkhead	
FIPT-400-MF-MPO *		MPO 12-24 UPC	FIPT-400-MF-MPO *	
FIPT-400-MF-MPO-APC *		MPO 12-24 APC	FIPT-400-MF-MPO-APC *	
FIPT-400-MF-MPO-X *		MPO 16-32 UPC	FIPT-400-MF-MPO-X *	

FTTA connectors

Socket			Plug	
FIPT-400-ODC-S		Outdoor connector (ODC) 2 fibers	FIPT-400-ODC-2PIN-P-K	
		Outdoor connector (ODC) 4 fibers	FIPT-400-ODC-4PIN-P-K	
FIPT-400-MF-QODC-12 *		Outdoor connector Q-ODC-12 UPC	FIPT-400-MF-QODC-12 *	
FIPT-400-MF-QODC-12-APC *		Outdoor connector Q-ODC-12 APC	FIPT-400-MF-QODC-12-APC *	

FTTH connectors

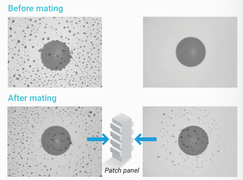
Drop cable			Terminal port	
FIPT-400-U25MA		OptiTap® (OptiSheath® multiport terminal, in-line tether extender or flexible service terminals)	FIPT-400-OTAP-APC	
FIPT-400-MF-OTIP-MT-APC *		OptiTip® and HMFOC® up to 12 fibers	FIPT-400-MF-OTIP-MT-APC *	

* Requires FIP-400B MF-Ready

Connector issues

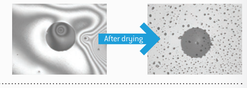
Dust/dirt residue

- **If not cleaned properly**, residues will transfer and can lead to permanent damage when mating
- Soil, such as sand and dust, can chip ferrules when mated and lead to permanent damage



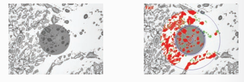
Wet residue

- Most often caused by an incorrect cleaning techniques—fibers must be carefully dried after a wet cleaning



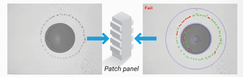
Oily residue

- Most often caused by touching with fingers—technicians must never touch fiber ends
- An oily residue may act as a matching gel:
  - May not affect insertion loss (IL) and optical return loss (ORL) in the short term
  - May trap dust and increase IL and ORL over time



Circular residue

- Most often caused by an incorrect cleaning technique
- Occurs when fiber is mated while still wet
- Typically happens in the contact area
- Contamination will migrate from male to female fiber ends



Adhesive region defects

- May occur during the manufacturing process or from mishandling
- Epoxy residue and chips may occur in the adhesive region
- Normal if size does not exceed standards

Dirty/damaged connector

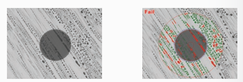
- Most often results from poor handling or cleaning
- Defects appear small, but may still affect network performance and fail inspection criteria

Scratches

- May appear as light or dark defects
- May be hard to see with the naked eye
- Critical when in the core area of singlemode fibers

Wipe on a shirt

- Inexperienced technicians use their clothes to "clean" a fiber connector
- While common, this issue is often not taken seriously; teaching the best practices will prevent it

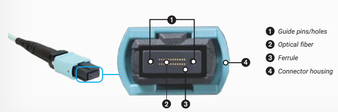


Chips on connector or in cladding

- Drywall dust, concrete dust, sand, etc.
- Can damage the endface when pressure is applied to mate the connectors

Multifiber connectors/MPO-style

- Multifiber connectors can be used in many high-density fiber applications such as FTTH, data centers, FTTA, ROADMs, etc.
- Common types include the MPO, MTP®* and OptiTip®*

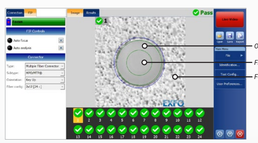


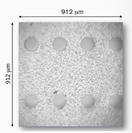
1. Guide pins/holes
2. Optical fiber
3. Ferrule
4. Connector housing

* MTP® is a registered trademark of US Conec Ltd. and OptiTip® is a registered trademark of Corning Cable Systems

Inspecting multifiber connectors requires a special inspection tool. An automated multifiber inspection solution requiring only three clicks, makes it impossible to skip a fiber. It can inspect connectors with 12/24 fibers or 16/32 fibers.

Inspecting a multifiber connector requires a tool that can scan both the x and y axes simultaneously.





Inspection probe field of view (FOV) is key when inspecting multifiber and multirow connectors. The larger the FOV, the greater the number of fibers that can be identified at once.

Solutions

Manual inspection

Microscope
- Only inspects male connectors
- Not always secure enough to inspect live fibers
- Risk of eye exposure to laser radiations
- No pass/fail analysis, result subject to human interpretation

Manual inspection probe and display
- Inspects male and female connectors
- Very secure, no direct eye exposure to laser radiations
- Requires many manipulations
- Final result still subject to human interpretation

Automated inspection

Automated inspection probe and test platform with analysis software
- Fast and hassle-free requiring minimal fiber handling skills
- Removes all subjectivity from the test process—no risk of misinterpretation
- Integrated solutions for multitest capabilities (optical, T&D, copper)

Where to inspect/clean

The following items should always be on your inspection/cleaning list:
- Patch panel (e.g., splitter cabinet)
- Test jumpers
- Cable connectors

Did you know that using a probe with an autocentering function can reduce inspection time by up to 57%*?

57% shorter inspection time

* Data sourced from EXFO's case study, with calculation based on typical analysis time.

When to clean

The very first step is connector inspection. This applies to all testing phases—construction, activation and maintenance. **Connectors should be cleaned only if the inspection reveals that they are dirty.**

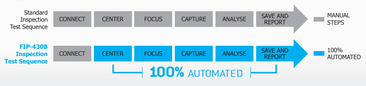
How to inspect

Using a manual inspection probe.

1. Connect the probe to the connector and select the corresponding IEC standard.
2. Set magnification to high.
3. Find the fiber image, center it and adjust the focus.
4. Start the analysis using the Capture button.
5. View the Pass or Fail result.
6. Clean or replace the connector depending on the result.
7. Save the analysis report.

Using an automated inspection probe.

When using a fully automated solution such as EXFO's ConnectorMax FIP-430B or FIP-435B, **the only step** is to connect the probe tip to the connector under test and let the tool do all the hard work.



Contaminated/Defective connectors

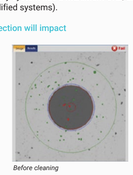
1. Impact on higher data rates

Higher speed networks (i.e., 40G, 100G), such as in data centers or metro-core networks, have very limited loss budget. 1 or 2 dB loss from a dirty/bad connector can lead to link failure.

2. Impact on general test results

Since dirty connectors typically exhibit more reflectance and loss, the ORL and IL readings taken by an OTDR , OLTS or PM/LS will be higher. Every system has a maximum ORL, and clean connectors help keep reflectance at a minimum (e.g., single Raman-amplified systems).

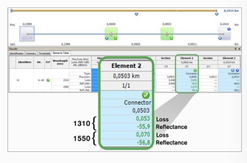
Contaminants in a connection will impact reflectance and loss.



Before cleaning

Acceptable values for loss at 1310/1550 nm are:
- Less than 0.35 dB/connection (industry average)
- Less than −50 dB reflectance if UPC, less than −65 dB if APC

After cleaning



3. Impact on OTN bit error rate tests (BERT)

Dirty connectors affect the signal-to-noise ratio at the receiver, and most PIN receivers react the same way to noise (i.e., a proportional increase in BER).
- Erratic readings during 40G/100G OTN BERTs
- Forward error correction (FEC)
- Alarm indication signal (AIS)
- Backward defect indicator (BDI)
- Unnecessary Tx/Rx troubleshooting

Connector inspection criteria

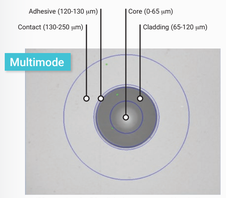
Standards-based criteria

IEC 61300-3-35
Fiber-optic interconnecting devices and passive components—basic test and measurement procedures
webstore.iec.ch

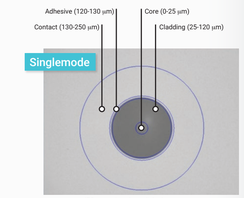
IPC 8497-1
Cleaning methods and contamination assessment for optical assembly
www.ipc.org

A connector endface has multiple zones

- Dimensions will depend on the connector and fiber type
- Multimode and singlemode connectors have different sizes
- Zone tolerances will differ



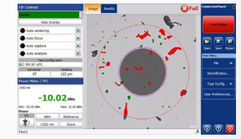
IEC zone sizes for PC polished connectors, multimode fibers



IEC zone sizes for polished connectors, singlemode non-dispersion shifted fiber, RL ≥45 dB

Connector endface pass/fail analysis

Thanks to the powerful processing capabilities of EXFO test platforms, technicians can perform IEC and IPC automatic pass/fail analysis via ConnectorMax2, the most powerful field-analysis tool on the market. In just a few seconds, a full connector certification test is performed and a test report is generated. All this at the touch of a button—no training required.



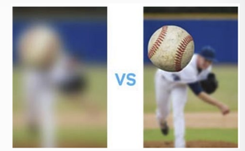
ConnectorMax2

- Guarantees a uniform level of acceptance:
  - Between users within an organization
  - Between suppliers and customers
  - Between contractors and network operators
- Facilitates the decision-making process by removing subjectivity

Boost accuracy with autofocus

Ever heard of false-positives?

Have you ever noticed that some failing connectors can result in a pass verdict if the analysis is performed on an out-of-focus image? This is called a false-positive result.



Automatic focus adjustment and optimization

Autofocus
- Ensures that each connector image is captured with maximum quality
- Boosts the accuracy and repeatability of inspection test results
- Facilitates the identification of defects
- Prevents false-positives

Focus protection
- Prevents image capture in the event of improper focus adjustment
- No defects or residues affecting performance are ignored
- Prevents false-positives

ConnectorMax solutions: Testing capability chart

Features	USB wired			Wireless	
	Basic FIP-410B	Semi-automated FIP-420B	Fully automated FIP-430B	Semi-automated FIP-425B	Fully automated FIP-435B
Three magnification levels	√	√	√	√	√
Image capture	√	√	√	√	√
Five-megapixel CMOS capturing device	√	√	√	√	√
Automatic fiber image-centering function	X	√	√	√	√
Automatic focus adjustment	X	X	√	X	√
Onboard pass/fail analysis	X	√	√	√	√
Pass/fail LED indicator	X	√	√	√	√
WiFi connectivity	X	X	X	√	√
Automated multifiber/MPO inspection	√	√	√	√	√

No tip swapping: Save time and manipulations

The ConnectorMax fiber inspection probe series uses the same tip to inspect a patch panel and a patchcord.

Bulkhead inspection

1- Connect the bulkhead tip to the inspection probe.

2- Inspect the patch-panel connector.

Patchcord inspection

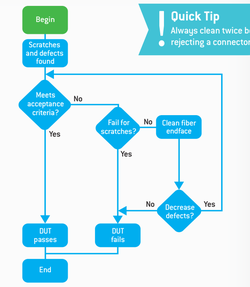
1- Connect the mating adapter to the patch cord.

2- Inspect the patch-cord connector.

Cleaning connectors

Suggested inspection/cleaning procedure

If the fiber fails inspection, the user shall clean the fiber and repeat the inspection process.



Quick Tip
Always clean twice before rejecting a connector.

Dry cleaning

Dry cleaning using a mechanical cleaner is recommended as the first step. If, after two dry cleaning attempts, soil is still present on the connector, try hybrid cleaning.

Single-fiber mechanical cleaner (male/female)

Multifiber mechanical cleaner (MTP/MPO) (male/female)

Patch-cord mechanical cleaner (female only)

How to dry clean

Insert the jumper and push the outer shell to begin cleaning. A click sound will indicate that the cleaning is complete.

Some mechanical cleaners are compatible with male and female jumpers as well as with MPO and other connectors.

Hybrid cleaning

Hybrid cleaning is a mix of the wet and dry cleaning methods and involves using a solvent. The first step is to clean the connector endface with a solvent and then dry any remaining residue with either a wipe or a swab.

If, after using the hybrid cleaning method, the connector still fails to meet the acceptance criteria, consider replacing the connector.

Cleaning pen
Used to dispense optical grade solvent to clean optical connectors

Cleaning swabs
Used to clean the inside of female connectors and adaptors

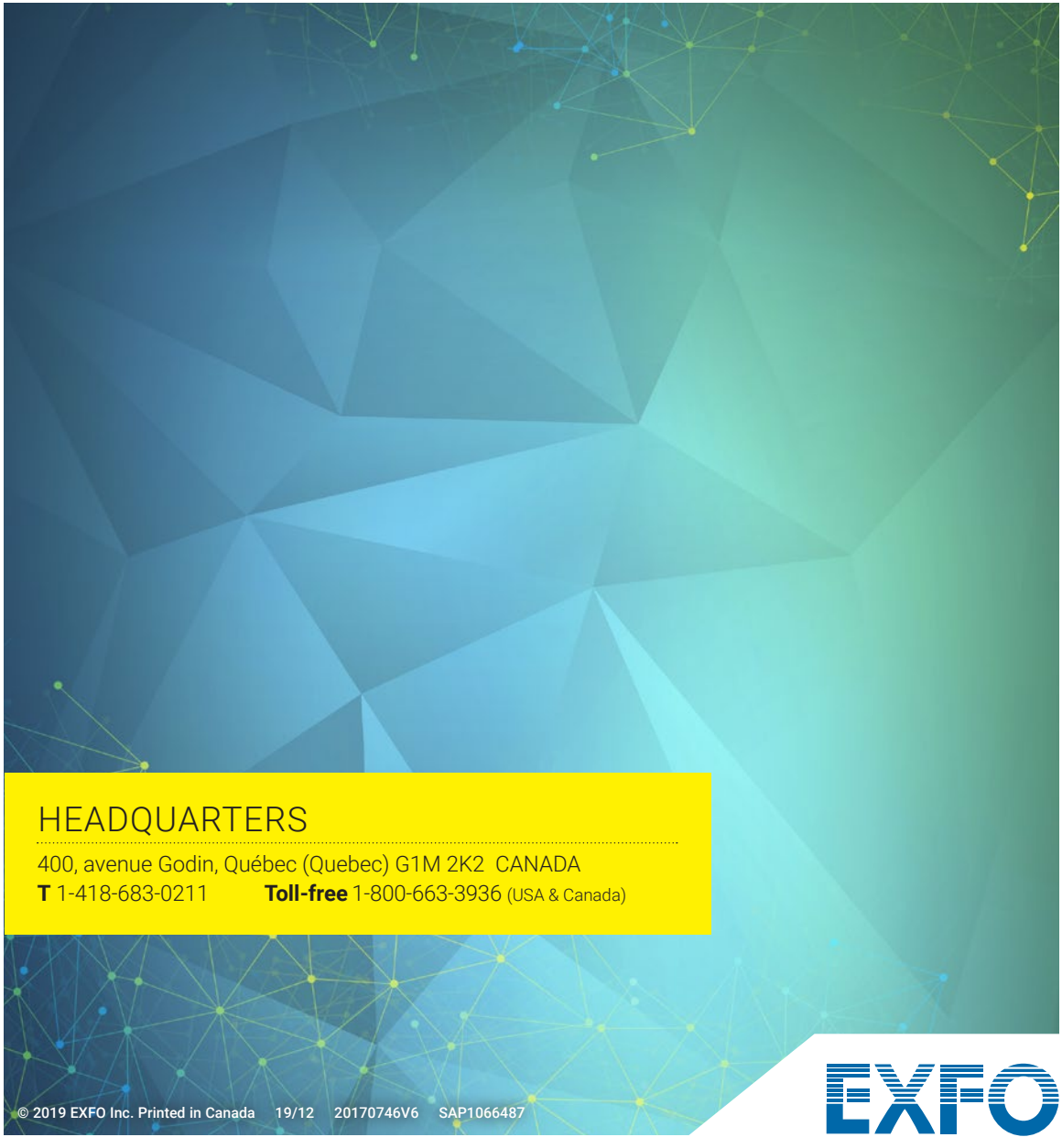
Lint-free wipes
Used in dry cleaning procedures and also used to dry off any solvent

How to clean using the hybrid method

1. Wet a corner of the wipe with solvent.
2. In a smooth linear motion, trace the endface of the jumper twice over the wet area.
3. In a smooth linear motion, trace the endface of the jumper three times over the dry area.

SEE THE FULLY AUTOMATED PROBE IN ACTION

www.EXFO.com/keepthefocus



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