3A+G Technology & Turnkey Production Solution

BY

XFS COMMUNICATIONS, INC.

1 Influence of Connectors' Attenuation on Fiber Network Performance

The larger the attenuation, the greater the decrease in power received, thus increasing the bit-error-rate (BER). A receiver discards damaged packets due to bit errors and asks for them to be retransmitted, thus adding to latency. Connectors with extremely low attenuation help to lower BER at the receiver and to reduce latency, thereby boosting network performance.

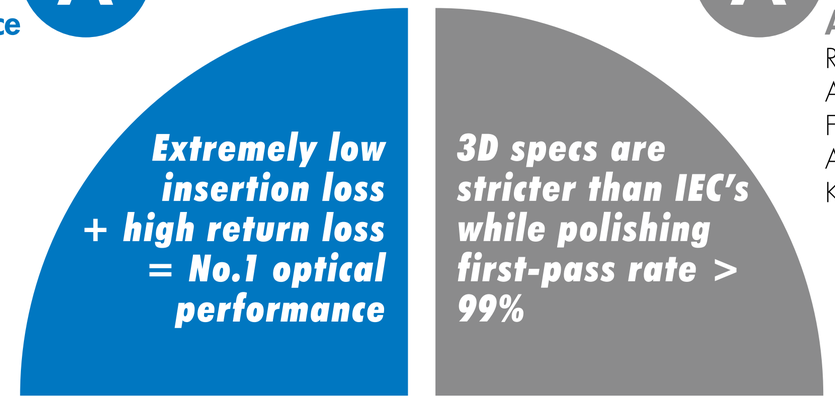
As the data rate continues to increase, the influence of the connectors' attenuation on network performance will become more pronounced. Extremely low loss connectors are a future proof solution.

2 "3A+G": World's No.1 Fiber Optic Connector

A

A-grade Optical Performance

Random mated insertion loss (SM)
≤ 0.07dB (average)
≤ 0.12dB (for 97% of samples)
Return loss (APC) ≥ 70dB
Return loss (UPC) ≥ 55dB



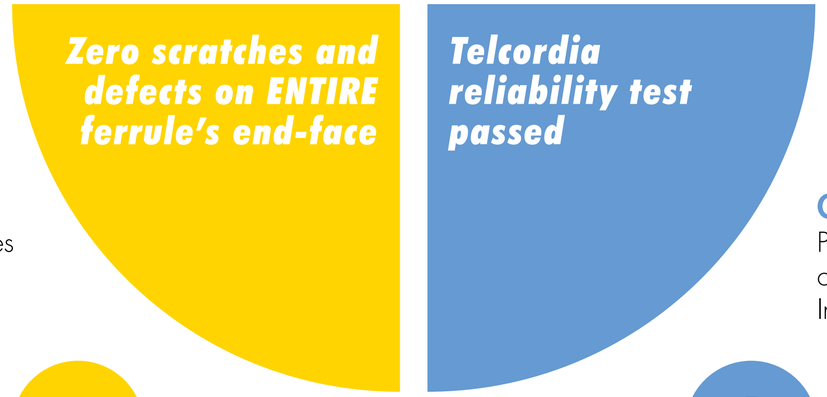
A

A-grade 3D Geometry

Radius of curvature (mm): 6.5 ≤ x ≤ 9 (SC/APC)
Apex offset (μm): 0 ≤ x ≤ 30
Fiber height (nm): -30 ≤ x ≤ 30
APC angle (°): 7.8 ≤ x ≤ 8.2
Key error (°): -0.2 ≤ x ≤ 0.2

A-grade End-face Quality

100% of the entire ferrule end-faces of our fiber optic connectors are free of dirt, scratch and chipping



A

G

GR-326-CORE Certified

Passed Telcordia GR-326-CORE testing conducted by Telcordia Network & Product Integrity (NPI) in Piscataway, NJ, USA

Fiber optic connectors are widely known as the weakest and most problematic points in a fiber network. XFS proposes "3A+G" as the performance and reliability level for our single-fiber connectors with the types of SC, LC, FC, ST and LSH(E2000).

5G – READY
Ultra Reliable & Low Latency Connection

3 "3A+G": World's No.1 Fiber Optic Connector

A A-GRADE OPTICAL PERFORMANCE

3A+G Connector's Optical Performance (single-fiber connector)

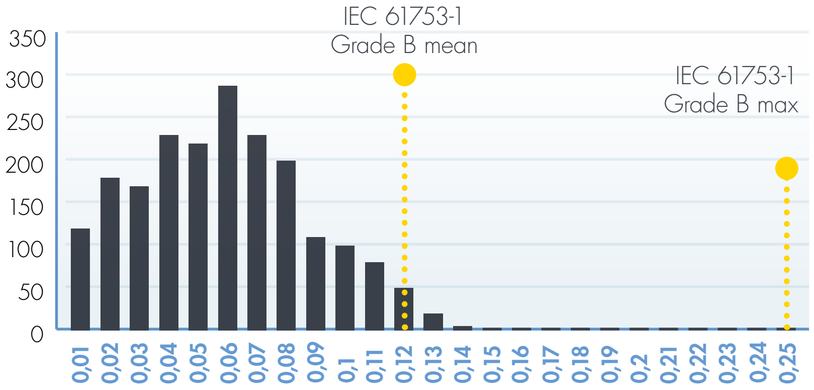
Item	Parameter		Reference
	Single mode	Multimode	
Insertion loss	Random mated average ≤ 0.07dB;	Random mated average ≤ 0.05dB;	IEC 61300-3-34
	Random mated for 97% ≤ 0.12dB	Random mated for 97% ≤ 0.10dB	
Return loss	≥ 70dB (APC);	≥ 45dB	IEC 61300-3-6
	≥ 55dB (UPC)		

"3A+G" connector has an average random mated insertion loss of just 0.05dB to 0.07dB, exceeding the performance level of IEC 61753-1 Grade B. Its power loss is merely 1.1% to 1.6%, or one-tenth of the industry average. "3A+G" manufacturing process is easy to operate and produce, delivers high yields, and uses ordinary materials to produce superb optical performance. It is a revolutionary production technology that produces **the best quality for low costs.**

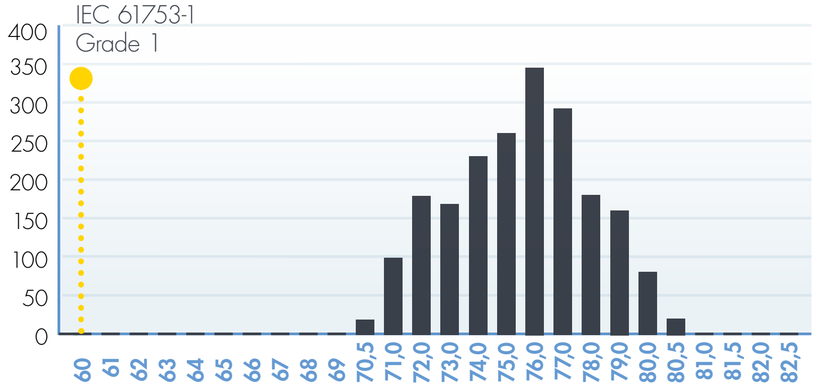
4 "3A+G": World's No.1 Fiber Optic Connector

A A-GRADE OPTICAL PERFORMANCE

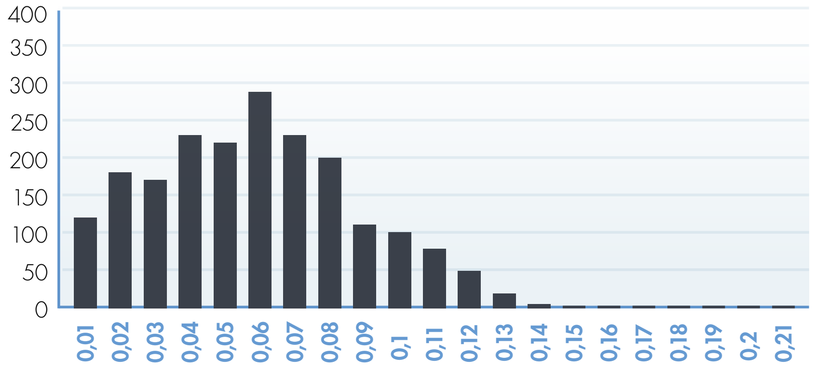
SM APC Random Mated Insertion Loss Distribution



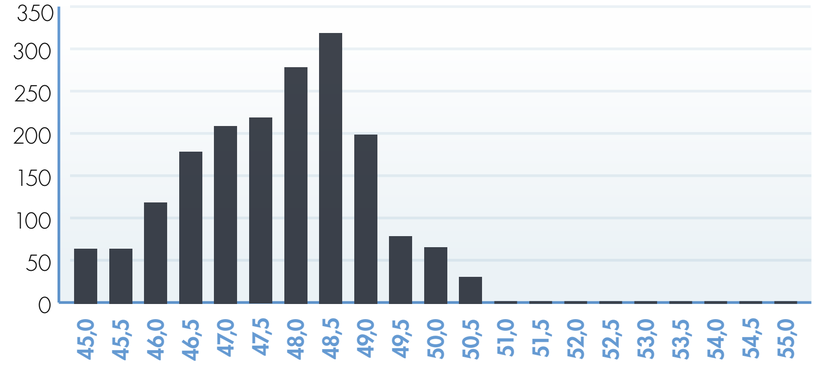
SM APC Return Loss Distribution



MM Random Mated Insertion Loss Distribution



MM Return Loss Distribution

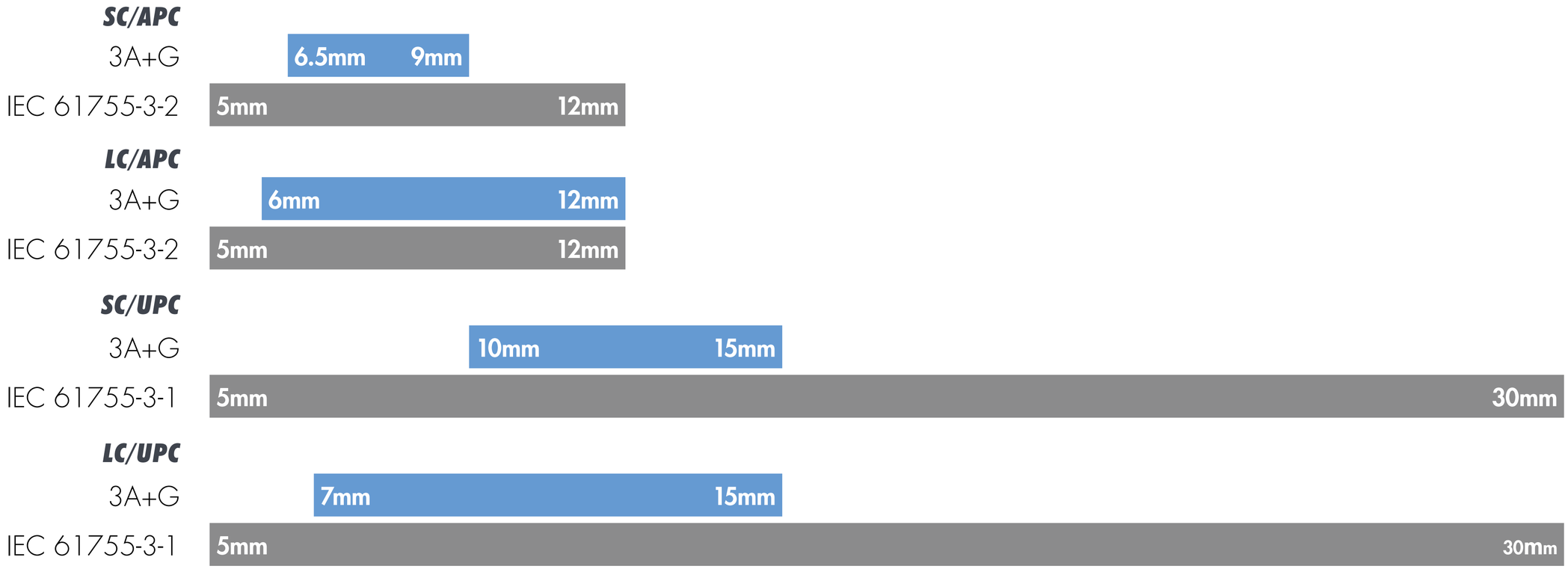


5 "3A+G": World's No.1 Fiber Optic Connector

A A-GRADE 3D GEOMETRY

"3A+G" fiber optic connector has more rigorous end-face geometry than IEC: the radius of curvature, apex offset, fiber height and APC angle have all been effectively controlled for exceptional product consistency and optical performance. More importantly, despite such rigorous specifications, "3A+G" manufacturing process can still achieve a **polishing first-pass yield of over 99%.**

Radius of curvature



6 "3A+G": World's No.1 Fiber Optic Connector

A A-GRADE 3D GEOMETRY

Fiber height

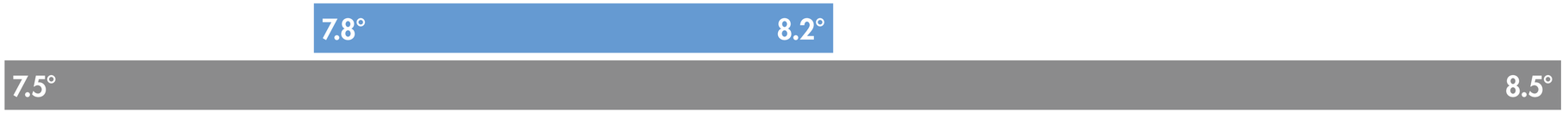
SC/APC, LC/APC, SC/UPC, LC/UPC

Apex offset

SC/APC, LC/APC, SC/UPC, LC/UPC

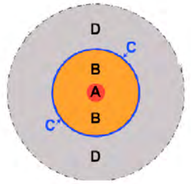
APC angle

SC/APC, LC/APC



7 "3A+G": World's No.1 Fiber Optic Connector

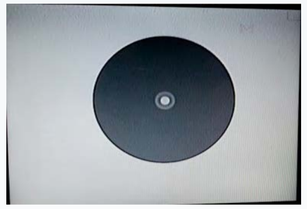
A A-GRADE END-FACE QUALITY



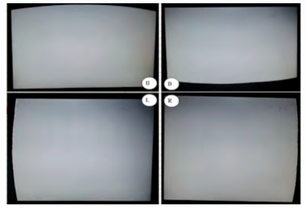
End-face Examination Standard (SM)

Zone	Range (μm)	XFS		IEC 61300-3-35 ed2.0 (APC)	
		Scratches	Defects	Scratches	Defects
A: Core	0 to 25	None	None	4 ≤ 3μm	None
B: Cladding	25 to 115	None	None	No limit	No limit < 2μm 5 from 2μm to 5μm None > 5μm
C: Adhesive	115 to 135	None	None	No limit	No limit
D: Contact	135 to 250	None	None	No limit	None > 10μm
E: Rest of ferrule		None	None	No limit	No limit

For end-face quality, IEC guidelines allow a small number of defects that are small in size. "3A+G" fiber optic connector is the first in the industry to deliver connectors with **zero defects on the entire ferrule end face.** Thus the connector's light-extraction efficiency is optimized, and its top-notch optical performance can hardly be matched by other manufacturers.



Zero defects in the Core, Cladding and Adhesive zones



The Contact zone and its edges are also free of defects

8 "3A+G": World's No.1 Fiber Optic Connector

G GR-326-CORE CERTIFICATION BY TELCORDIA/ERICSSON

- Flammability Test
- Intermateability Test
- Optical Performance Test
- Thermal Age Test
- Thermal Cycle Test
- Humidity Aging Test
- Humidity/Condensation Cycling Test
- Post-Condensation Thermal Cycle Test
- Vibration Test
- Flex Test
- Twist Test
- Proof Test
- Transmission With Applied Tensile Load Test
- Impact Test
- Durability Test
- End of Test Criteria Test
- Dust Test
- Adhesive Testing
- Airborne Contaminants Test
- Salt Spray Test
- Immersion/Corrosion Test
- Groundwater Immersion Test
- Ferrule Endface Geometry Test
- Connector Installation Test
- Extended Thermal Age Test
- Extended Humidity Test
- Extended Thermal Cycle Test

Telcordia GR-326-CORE is one of the most rigorous reliability testing criteria in the industry. "3A+G" APC optical jumpers have passed the GR-326-CORE testings conducted by Telcordia's NPI division in New Jersey, USA.


Certified by Telcordia

TESTING COMPLETED CERTIFICATE

Certification Type:	Testing Completed
Testing Criteria:	Telcordia GR-326-CORE
Manufacturer:	XFS Communications, Inc. SiYan, Baoan District, Shenzhen, China
Product:	SC/APC Optical Connectors and Jumper Assemblies
Testing Completion Date:	October 14, 2014
Certificate Number:	140801

This Certificate documents that Telcordia has completed testing of samples of XFS SC/APC Optical Connectors and Jumper Assemblies with 3mm PVC patch cord to the requirements contained in Telcordia GR-326-CORE, *Generic Requirements for Single-Mode Optical Connectors and Jumper Assemblies*, Issue 4, February 2010.

For details on the scope of testing and product testing results, please refer to Telcordia Report DA-2058, *Analysis of the XFS Singlemode SC/APC Optical Connectors and Jumper Assemblies Using GR-326-CORE*, available from XFS Communications, Inc.

Richard G. Kluge
Engineering Manager
Telcordia Network & Product Integrity (NPI)

XFS SC/APC 3.0mm Jumper Testing Certificate


Certified by Telcordia

GR-326-CORE TESTING CERTIFICATE

Certification Type:	Testing Completed
Testing Criteria:	Telcordia GR-326-CORE
Manufacturer:	XFS Communications, Inc. SiYan, Baoan District, Shenzhen, China
Product:	SC/APC Optical Connectors and Jumper Assemblies
Testing Completion Date:	October 2016
Certificate Number:	161201

Telcordia has completed an analysis of XFS SC/APC Optical Connectors and Jumper Assemblies with 0.9 mm cable against the requirements contained in GR-326-CORE, *Generic Requirements for Single-Mode Optical Connectors and Jumper Assemblies*, Issue 4, February 2010.

For details on the scope of the analysis and results, please refer to Telcordia Report DA-3110, *Analysis of the XFS SC/APC Connectors and Jumper Assemblies Against GR-326* available from XFS.

Richard G. Kluge
Engineering Manager
Telcordia Network Infrastructure Solutions (NIS)

XFS SC/APC 0.9mm Jumper Testing Certificate

9 400G Datacenter-Ready: MPO/MTP® Connector with No.1 Optical Performance

EXTREMELY LOW LOSS MPOS: THE BEST SOLUTION FOR DATACENTER INTERCONNECT

Optical Performance (12c MPO Connector)

Item		Parameter		Reference
		Single mode	Multimode	
Insertion loss	Typ.	0.1dB	0.05dB	IEC 61300-3-4
	Max.	0.25dB	0.15dB	
Return loss		APC: ≥65dB; UPC: ≥50dB	≥40dB	IEC 61300-3-6

"With XFS' proprietary polishing technology, we can produce low-loss MPOs without using low-loss MT ferrules."

MPO connectors are well-suited for high-density, high-traffic applications. XFS' manufacturing process employs one of the most advanced polishing technologies for producing MPOs with the best optical performance in the industry.

Endface Geometry (12c MPO Connector)

	XFS	IEC 61755-3-31:2015
Minus Coplanarity (nm)	≤200	≤400
Ferrule Surface X-Angle (°)	-0.075 to +0.075	-0.15 to +0.15
Ferrule Surface Y-Angle (°) (SM)	7.85 to 8.15	7.8 to 8.2
Ferrule Surface Y-Angle (°) (MM)	-0.075 to +0.075	-0.15 to +0.15
Fiber Height (nm)	1100 to 1500	1000 to 3500
Fiber Differential Height-All (nm)	≤150	Not defined
Fiber Differential Height-Adj. (nm)	≤100	≤300
Fiber Tip Spherical Radius (mm)	≥1	≥1
Ferrule Surface X-Radius (mm)	≥2000	≥2000
Ferrule Surface Y-Radius (mm)	≥50	≥5
Core Dip (nm; for MM)	0 to 100	Not defined
Geometry Limit	≤10	≤17.4

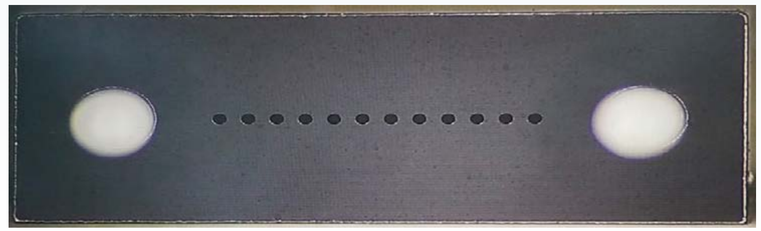
10 400G Datacenter-Ready: MPO/MTP® Connector with No.1 Optical Performance

Endface Visual Quality (12c MPO Connector)

Zone	Range (μm)	XFS (MPO/APC)		IEC 61300-3-35 ed2.0 (APC)	
		Scratches	Defects	Scratches	Defects
A: Core	0 to 25	None	None	4 ≤ 3μm	None
B: Cladding	25 to 115	None	None	No limit	No limit < 2μm 5 from 2μm to 5μm None > 5μm
Rest of ferrule		None	None	Not defined	Not defined

ENDFACE VISUAL QUALITY

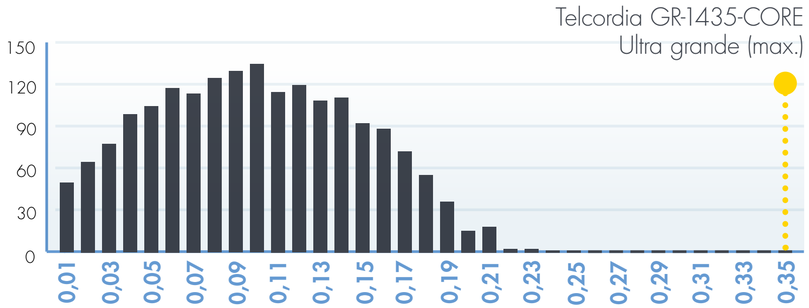
MPO/MTP® connector's optical performance is in large part associated with its ferrule's endface, which is susceptive to dirt or contamination. XFS' proprietary manufacturing process delivers an endface with exceptional geometry and cleanness.



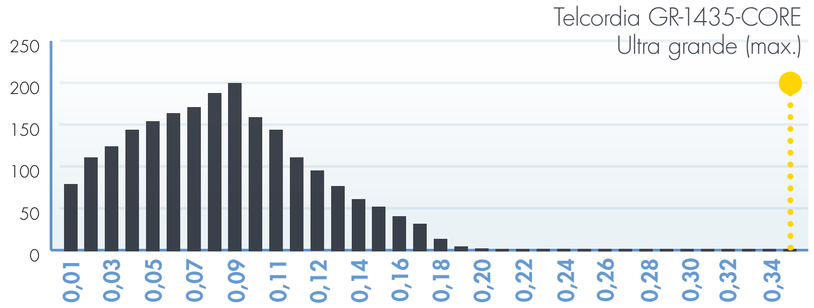
11 400G Datacenter-Ready: MPO/MTP® Connector with No.1 Optical Performance

EXTREMELY LOW LOSS MPOS: THE BEST SOLUTION FOR DATACENTER INTERCONNECT

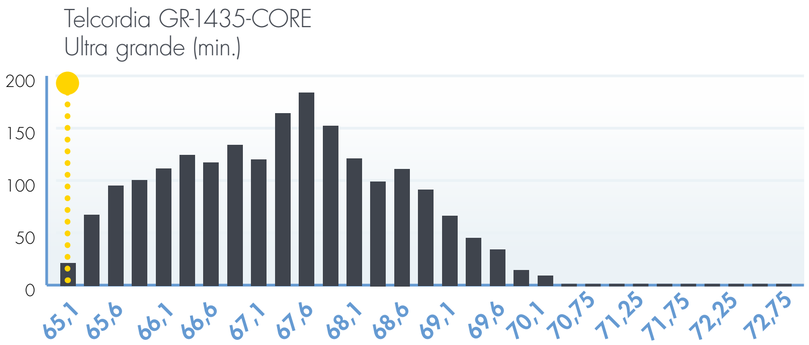
XFS Standard SM MPO Insertion Loss Distribution



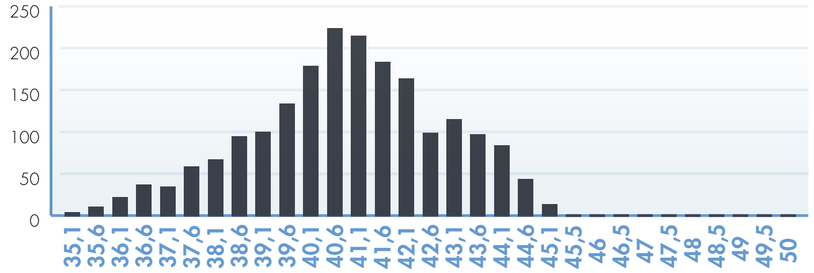
XFS Standard MM MPO Insertion Loss Distribution



XFS Standard SM MPO Return Loss Distribution



XFS Standard MM MPO Return Loss Distribution



EXTREMELY LOW LOSS CONNECTION
AAA
100% TESTED

Revolutionary Production Technology for Manufacturing Fiber Optic Connectors

PEOPLE

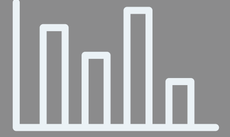
The production process is greatly simplified and drastically different from traditional ones. Operator training time is reduced from 30 to 7 days. Jigs are used for all procedures for reducing human error and improving efficiency.

MACHINE

Innovative, self-developed equipment: High performance polishing machine for realizing top quality optical termination with low cost. Multi-functional inspection machine for efficient quality checking.

MATERIAL

Comprehensive material control: Unique material supply chain and production monitoring system for effectively controlling material quality. 3A+G process uses only ordinary materials for producing with the best performance.



SYSTEM

Process control system: Self-developed. First in the industry. Using barcode management means the state of every work station is known and immediate action can be taken, greatly boosting management efficiency and improving yields.

12 3A+G Production Technology

"3A+G" production technology made systematic, scientific and revolutionary changes to the four main factors in manufacturing: people, machine, material and system. It is a complete manufacturing solution with self-developed processes, machines, tools, material management system and quality control system. "3A+G" production technology achieves what has never been achieved in the industry before: **consistent mass production of A-Grade fiber optic connectors at a low cost.**

13 3A+G Production Technology: Patents

Patent name: AN END-TO-END METHOD FOR MANUFACTURING FIBER OPTIC CONNECTORS WITH ZERO INSERTION LOSS AND HIGH RETURN LOSS

Type: invention patent
Applicant: XFS Communications, Inc.
Patent No.: 2016102665278

This invention discloses a method for manufacturing fiber optic connectors with zero loss. The method includes trimming, pre-assembly, fiber fixing, back-assembly, adhesive removal and polishing treatment. The aforementioned polishing treatment uses independently controlled polishing jigs to perform the polishing procedure in a spiral manner. During the polishing process, the abrasive in progressively reduced in size. The aforementioned fiber optic connector product is affixed to the aforementioned polishing jig and polished on high-precision polishing machines to become the final fiber optic connector product. The manufacturing method of zero-loss fiber optic connectors in this invention possesses the following features: consistent quality, low quality risk, high production efficiency, excellent optical performance, low signal transmission lose, good overall performance and low cost.

Patent name: A POLISHING METHOD USED FOR MAKING FIBER OPTIC CONNECTORS WITH ZERO INSERTION LOSS AND HIGH RETURN LOSS

Type: invention patent
Applicant: XFS Communications, Inc.
Patent No.: 2016102701378

This invention discloses a polishing method used for making lossless fiber optic connectors. The fiber optic connector uses independent controlled polishing jigs to perform a spiral polishing process. The polishing jig includes the jig body. The jig body features connector holding cavities parallel and independent of each other. All connector holding cavities have a connector mount at the base. Attached to the connector mount is a holding column for securing the fiber optic connector in place. At the top of the holding column is a uni-directional screw that is used to move the top of the connector holding cavity. A spring that can move up and down is set into the top of the connector holding column. During the polishing process, the abrasive is progressively reduced in size. The fiber optic connector product is affixed to the polishing jig and polished on the high-precision polishing machine. This polishing method for manufacturing zero-loss fiber optic connectors in this invention possesses the following features: excellent optimal performance, low signal transmission lose, good overall performance and low cost.

Patent name: HIGH-PRECISION INTELLIGENT POLISHING MACHINE

Type: utility model patent
Applicant: XFS Communications, Inc.

Patent name: HIGH-EFFICIENT 3D GEOMETRY INTERFEROMETRIC TESTING METHOD & TOOL

Type: utility model patent
Applicant: XFS Communications, Inc.

Patent name: INSERT LOSS AND END-FACE COMBINED INSPECTION MACHINE

Type: utility model patent
Applicant: XFS Communications, Inc.

Patent name: LONGITUDINAL FIBER STRIPPING TOOL

Type: utility model patent
Applicant: XFS Communications, Inc.

14 3A+G Production Technology: Competitive Advantages

A-grade product with optimized optical performance and reliability

- Self-developed longitudinal heat stripping technology for eliminating fiber damage
- Self-developed constant temperature curing technology for effectively blocking the impact of environment on adhesive and greatly increasing connector's tensile strength
- Self-developed intelligent polishing technology with fully digital control and high-precision polishing surface
- Self-developed simplified 3D inspection technology for reducing testing time by 90%

Optimized SOPs for eliminating human error, realizing high yields and efficiency

- All production process are carried out with jigs for simplifying manual operations and reducing human error
- Multi-functional equipment are employed to greatly reduce production time
- Factory zoning is applied to realize a flexible production, improving efficiency for both high-volume, low-mix and low-volume, high-mix production
- Self-developed Process Control System for real-time monitoring, analyzing and controlling of production process to effectively improve yields and efficiency

Optimized low-cost manufacturing, realizing top-notch quality with competitive cost structure

- A vertically integrated model is employed that most of the components, jigs, tools and equipments are made in-house
- Multiple polishing procedures of short durations are employed for greatly reducing consumption of polishing films and pads
- The compatibility issue between fiber and ferrule core is effectively addressed, in that ordinary ferrules and connector kits can be used for producing A-grade products
- Innovative on-line cleaning procedure (OCP) effectively controls the cleanness of end face, in that a clean room is not needed for achieving 100% A-grade output

Turnkey production module optimized for fast deployment of manufacturing line and MP

- 3A+G production technology is integrated into a modularized, end-to-end turnkey plant export solution including production line planning and establishment; design and manufacturing of jigs, tools and equipment; installation/testing/operation/maintenance of jigs, tools and equipment; personnel training; raw material and consumable selection; pilot to mass production and quality assurance; follow-up technical support

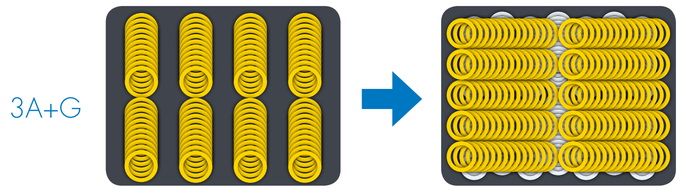
15 3A+G Production Technology: APC Polishing

Proprietary polishing process reinvents traditional polishing machine for intelligent, high-precision, “One-Button Operation” surface polishing.

The technology is based on independent polishing. The pressure is applied to each connector by an individual spring. The polishing path of each connector is separate with overlap so grime and powder does not cross over. The technology progressively reduces abrasive size over six polishing procedures: D30, D15, D9, D3, D1 and ADS. Each of the six polishing procedures last for not over 30 seconds. Multiple short polishing procedures allow timely removal of produced powder, improving polishing quality and extending polishing films’ re-use times.

POLISHING FILM USAGE PROCEDURE

POLISHING PATH ON A POLISHING FILM



Fully utilize the top, down, left, right side of polishing film

16 World's First Patchcord Factory Turnkey Production Solution

17 Modularized Turnkey Production Solution

With over 30 years of experience of manufacturing fiber patchcords for the most prestigious customers in the industry, XFS now proudly introduces the world's first patchcord factory turkey production solution for helping worldwide manufacturers establish the capability of producing the world-class quality patchcords with low capital expenditure and competitive product cost structure.

The turnkey solution includes: the end-to-end production line planning and establishment; design and manufacturing of equipment, fixtures and tools; installation/testing/operation/maintenance of equipment, fixtures and tools; personnel training; material and consumable selection; pilot production and quality assurance; and continued technical support.

The turnkey solution is based on one module producing 3500 ends of SC/APC (or 4500 ends of LC/APC) connections with 100% "3A+G" level over one 10-hour shift.

FACTORY ESTABLISHMENT

Optimize factory layout, equipment placement and personnel allocation based on profit target

EQUIPMENT SUPPORT

Turnkey plant export of equipment and tools; training on equipment operation; long-term maintenance service

OPERATOR TRAINING

Unique operator training system for minimizing human error while production

PRODUCTION SUPPORT

Experienced technical team is stationed on-site for solving production problems and ramping up yield and efficiency

MATERIAL SUPPLY

Comprehensive material supply support system collaborating seamlessly with 3A+G manufacturing process

CONTINUED UPGRADE

XFS has continued to refine its manufacturing process over years. Improvements are exported to customers on a regular basis

18 Modularized Turnkey Production Solution

XFS "MODULE"

- The standardized 3A+G production process for manufacturing fiber interconnect products including pigtails, patchcords, pre-terminated cables and MPO assemblies are combined into a module built around the 3A+G polishing process
- Each module has 6 polishing machines and needs a total of 10 operators
- The turnkey solution is based on one module producing 3500 ends of SC/APC (or 4500 ends of LC/APC) connections with 100% "3A+G" level over one 10-hour shift.
- Self-developed equipment and tools with simplified SOPs are employed for minimizing investment cost, maximizing production efficiency and achieving the best quality

CABLE CUTTING

- High-precision, high-efficiency automated equipment
- Fuzzy color identification of length for efficiency and convenience
- Standard operating process

CONNECTOR KITS ASSEMBLY

- Fixed longitudinal stripping for consistent length
- Stripping jig for high efficiency
- Easy-to-use visual alignment method

FIBER CURING

- Fiber stripping machine can be set for fixed time and temperature for high efficiency without fiber damage
- Small oven insulated from ambient temperature for stable curing

BACK-END ASSEMBLY

- Inner and external assembly frames for efficiency, convenience and error proofing
- Long moment arm with high pressure riveting press for steady pressure and good results

GLUE REMOVAL

- Quick and effective removal of cured glue on front end of the core
- Easy to use, more effective and much cheaper than conventional laser cleaver for glue removal

FERRULE'S EXTRUSION LENGTH MEASUREMENT

- CCD visual inspection
- Set up different polishing groups based on ferrule's length to ensure consistent polishing pressure and height

POLISHING

- Multiple short polishing procedures improve polishing and increase first-pass rate
- Next-generation high-precision polishing machine for even more stable polishing
- Simple 3D geometry and end face inspectors to significantly improve QA efficiency

PACKAGING

- Sort into cartons and package in order for high efficiency

GLUE ROOM

- Store glue at constant temperature and humidity to ensure consistent quality
- Thorough mixing of AB glue by precisely controlled ratio

FIXTURE CENTER

- Constant cleaning and maintenance of polishing fixtures to ensure high level of consistency in polishing quality
- Polishing fixtures' dimensions and spring pressure are under constant monitoring

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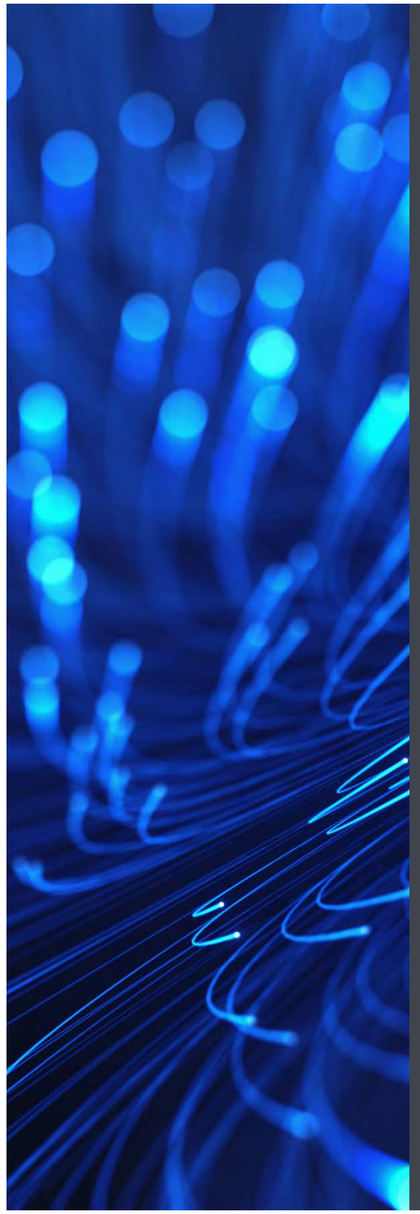

- Product performance (IL, RL, 3D, end face quality) is the best in the world
- Product reliability has GR-326-CORE certification by Telcordia/Ericsson
- High yield; 3D geometry polishing first-pass rate > 99%
- Production process is simple, stable and efficient, thus less operators are needed and skilled workers are not needed, greatly reducing labor costs
- Ordinary ferrules, connector kits and consumables are sufficient for producing A-grade products, greatly reducing material costs
- All equipment and tools are self-developed, greatly reducing the investment in fixed assets

"3A+G" production process is a revolutionary technology that can consistently produce high-quality products at low cost. Our turnkey solution can give patchcord manufacturers a quantum leap in technological advancement in a short amount of time!

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"For the past 30 years, we focus only on making the best optical termination in the world."

— Charles Sun, CEO, XFS