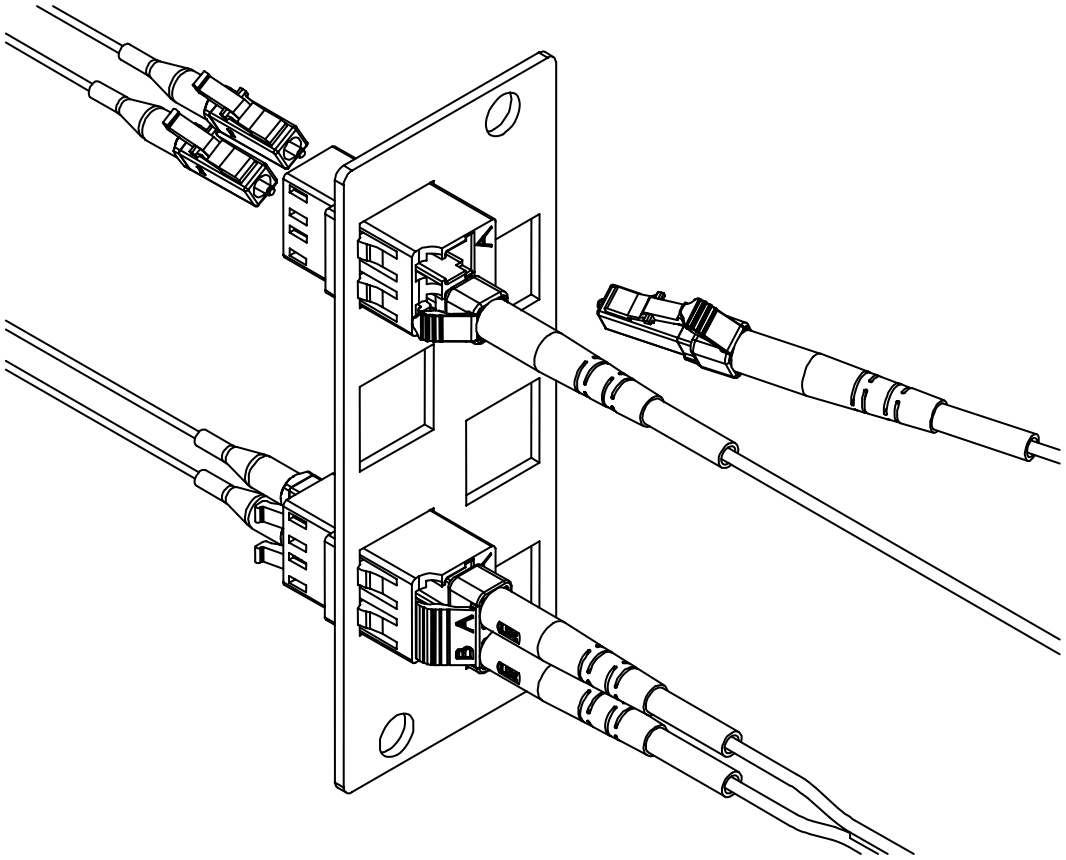


LC Connector Product Specification
Section 3: Patchcords

LC Connector Product Specification

General Definition:

The LC Connector Product is a robust optical connector designed to support Telecom and Datacom networks. The connector family includes but not limited to Jumper Connectors, Behind the Wall connectors (BTW), Adapters, Attenuators, Jumpers and an assortment of connector modules and panels. The connector is defined as the plug portion equipped with a tunable cylindrical ferrule while incorporating unique trigger and latch features. The LC Connector family provides a size reduction relative to traditional connectors, which has coined the term Small Form Factor connectors (SFF). SFF connectors are typically 50% smaller than standard SC and ST fiber products. The LC was designed to be a high performance SFF incorporating traditional technology, advances in latching systems, and versatile enough for both singlemode and multimode fiber applications.

Terms of Specification:

The specification document is intended to provide users of Yazaki LC Connector products a level of confidence and means of understanding the characteristics of purchased product. The product is designed and intended to be manufactured according to the specification document. The product specification is a fluid document, which is only a guideline as to the features and performance of the product, which are subject to change without notice.

Definition of Products:

LC 1.5 to 2.0 mm Unibody Connectors for jumpers: Robust connectors designed to mount onto 1.5 to 2.0 mm fiber cordage and intended to meet the Telcordia specification GR326 Type I Media (~3.0mm). Note that exceptions are made based on smaller size and future changes within GR326 for SFF connectors; however, the Unibody connector was designed to meet Section 4.3.5 Transmission with Applied Load for 3.0 mm cord. Simplex and duplex are available.

LC 3.0 mm Unibody Connectors for jumpers: Robust connectors designed to mount onto 3.0 mm fiber cordage and intended to meet the Bellcore/Telcordia specification GR326 Type I Media (~3.0mm). Note that exceptions are made based on smaller size and future changes within GR326 for SFF connectors; however, the Unibody connector was designed to meet Section 4.3.5 Transmission with Applied Load for 3.0 mm cord. Simplex and duplex are available.

LC BTW Connectors: Shorter LC connectors designed for 0.9 mm buffered fiber. This product is intended to meet Telcordia specification GR326 Type II Media (0.9 mm).

LC BTW Unibody Connectors: Robust connectors based on the Unibody connector and equipped to mount onto 0.9 mm buffered fiber and intended to meet the Telcordia specification GR326 Type II Media (0.9 mm). A unique feature; this simplex BTW connector is duplexable**!**

LC Patchcords (Jumpers): Connectorized with 1.5, 1.6, 2.0 or 3.0 mm cordage in various lengths and fiber counts. Jumpers are produced in a vast array of hybrid configurations allowing interconnection between LC based product and other connector styles. These products are intended to meet Telcordia specification GR326 Type I Media.

LC Adapters: Two sided port configuration, which holds two LC connectors while providing the alignment mechanism for the cylindrical ferrules. Adapters are designed in simplex, duplex and can be ganged for higher density configurations based on application needs.

LC Attenuators: Fixed plug-in style optical attenuators are available in 1-dB steps from 0 to 20 dB, plus 25-dB. These doped-fiber based attenuators are spectrally flat over the 1260 to 1610 nm wavelength range and have precise values. Special values and tolerancing are available on request. Attenuator products are designed to plug into any standard LC adapter. The design is structured from a connector front and a simplex receptacle rear portion, and they are capable of +30 dBm (1W).

Product Identification:
LC products are easy to identify in accordance with industry standard colors:

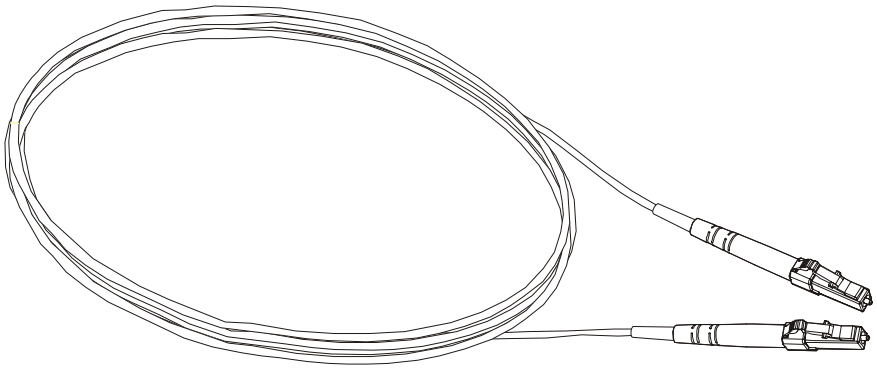
- Blue represents Singlemode
- Beige represents Multimode
- Green represents Singlemode 8° Angled End Faces
- Our LC Products meet these Standards:
  - ⇒ TIA 568 for A & B port identification on duplex adapters and connectors
  - ⇒ TIA/EIA-604-10A, FOCIS 10 Fiber Optic Connector Intermateability Standard – Type LC
  - ⇒ Fibre Channel Physical Interfaces (Physical Interface 11) for LC
  - ⇒ IEC 61754-20 (2002-08) Fibre Optic Connector Interfaces – Part 20: Type LC Connector Family

Additional Sections of LC Product Specification:

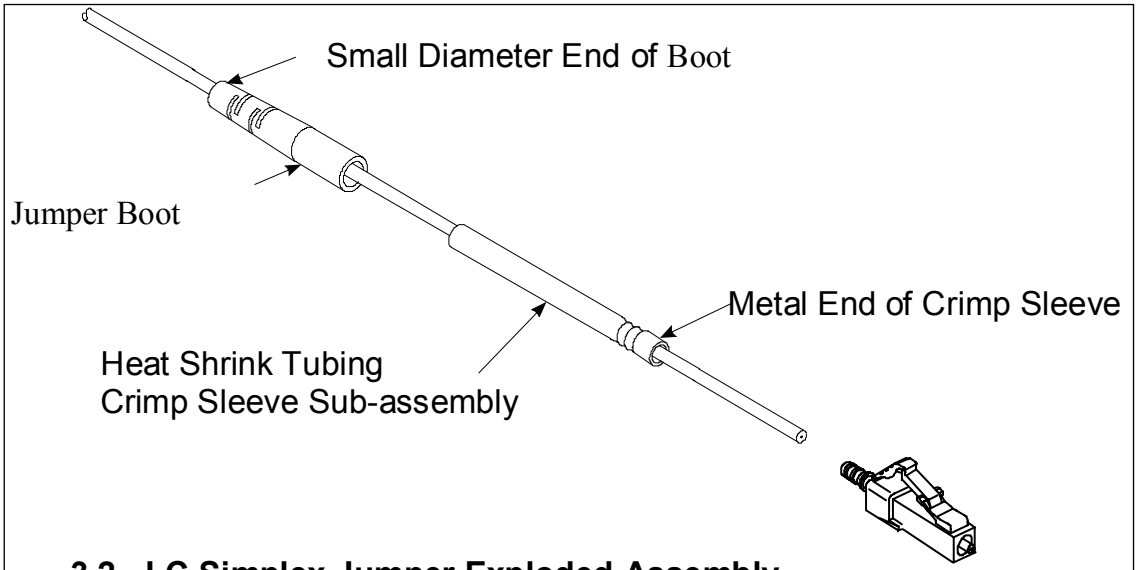
- Connectors: Section 1, Doc. No. OCD-EE-401-1
- Adapters: Section 2, Doc. No. OCD-EE-401-2
- Attenuators: Section 4, Doc. No. OCD-EE-401-4
- Environmental & Physical Performance Results: Section 5, Doc. No. OCD-EE-401-5

Table of Contents

3.0 - LC Patchcord Product Specification

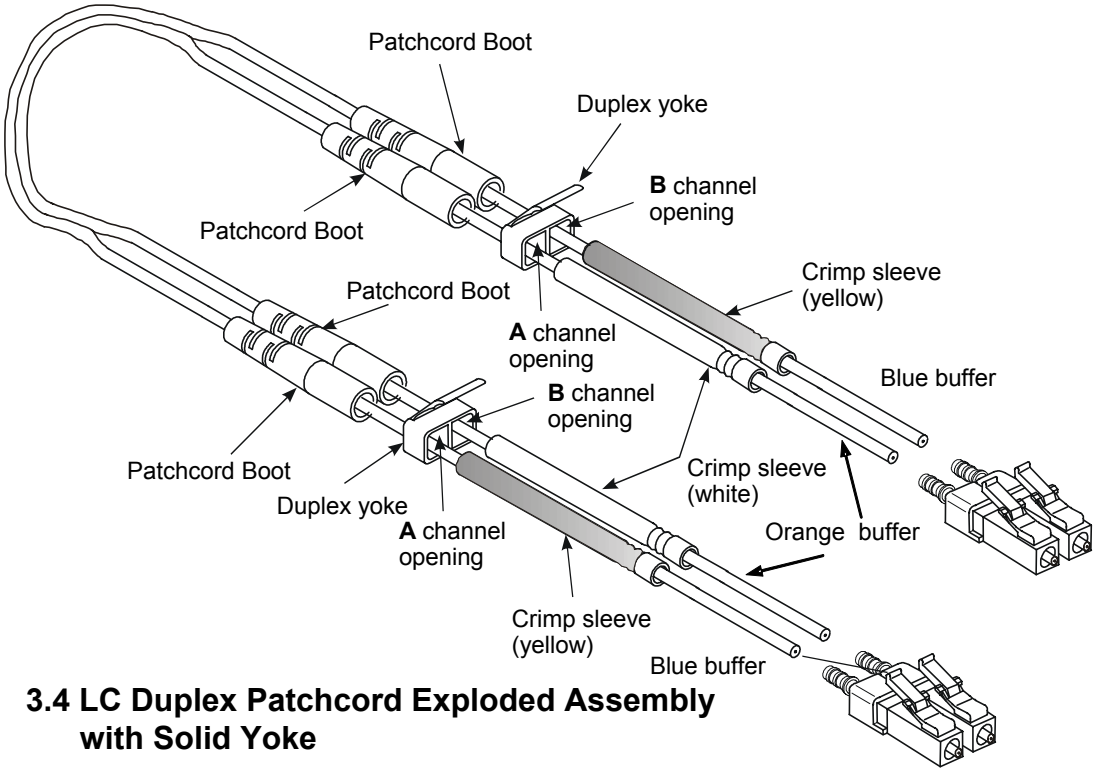


3.1 - LC Simplex Jumper on 1.5, 1.6, 2.0 & 3.0-mm Cordage

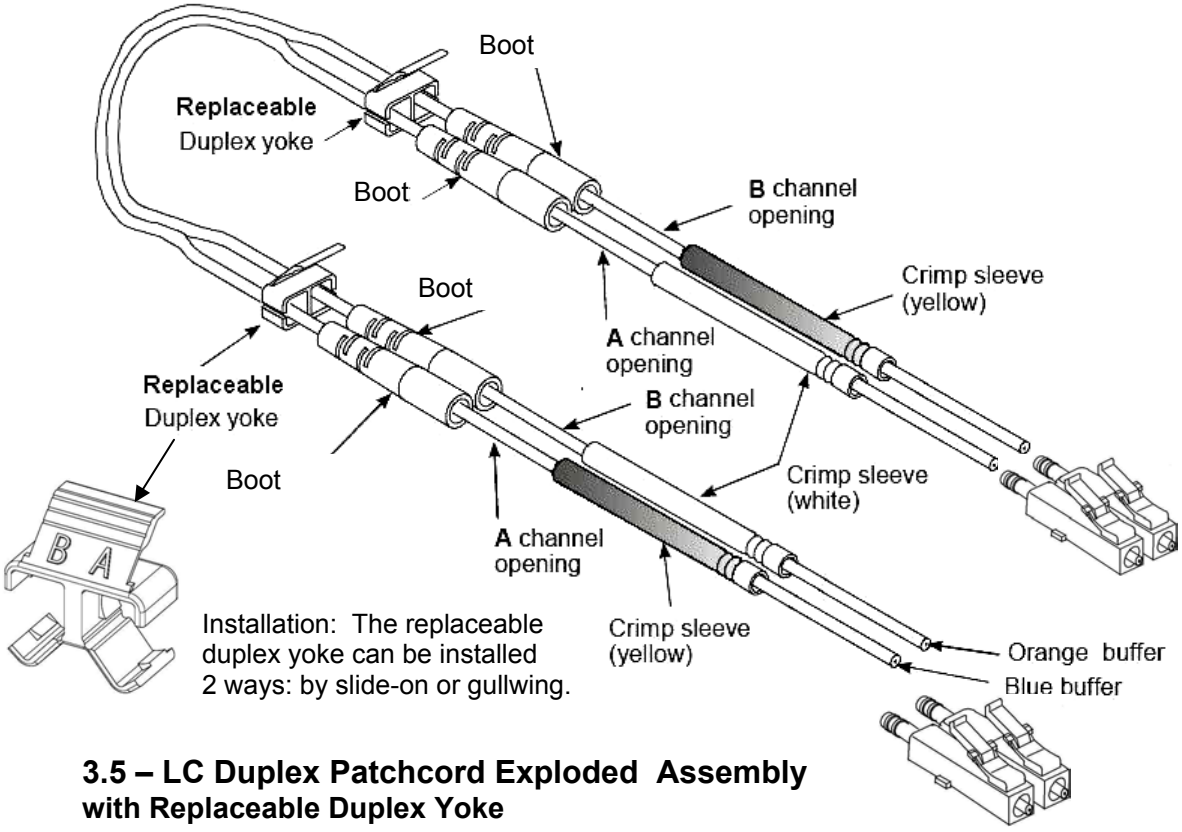


3.2 - LC Simplex Jumper Exploded Assembly

3.3 - LC Duplex Patchcord as per Standards



3.4 LC Duplex Patchcord Exploded Assembly with Solid Yoke



3.5 – LC Duplex Patchcord Exploded Assembly with Replaceable Duplex Yoke

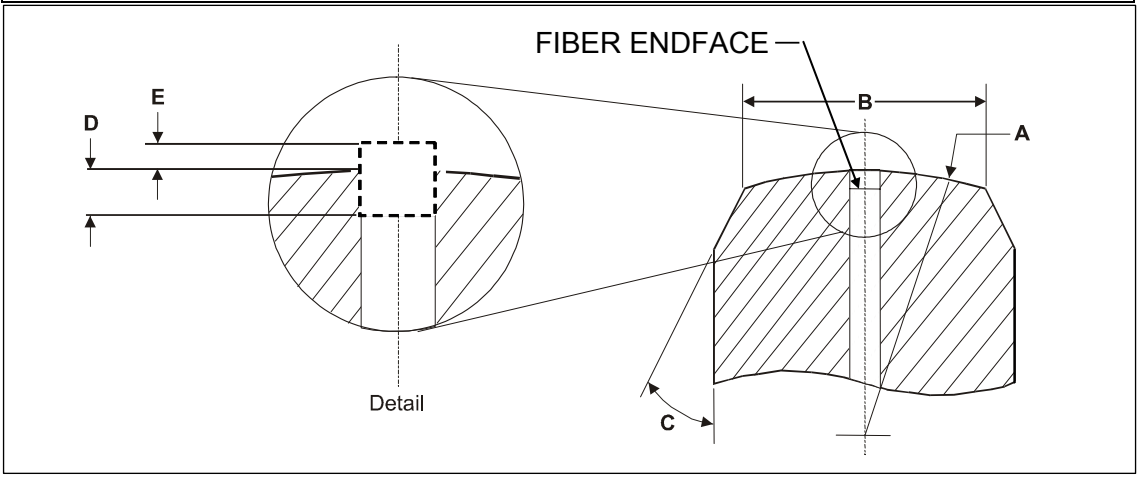
3.6 - LC Patchcord/Connector Materials UL 94 rating or equivalent			
Patchcord Component	**Material**	**UL 94 Rating**	**Oxygen Index**
Connector Housing	Engineering Plastic	V-0	50
Extender Cap	Engineering Plastic	V-0	50
Patchcord Boot	Thermoplastic Rubber	V-0	
Heat Shrink Tubing (H.S.T.)	Polyolefin	UL 224 VW-1	T.B.D.
Boot	PVC	V-0	>28
Simplex Collar	Nylon	V-0	>28
Duplex Yoke	Nylon	V-0	>28
Dust Cap	Plastic	V-0	>28
Spring	Metal	-	-
Ferrule	Ceramic	-	-
Crimp Sleeve	Metal	-	-
Strength Member Tube	Metal	-	-
Barrel for Ferrule	Metal	-	-
Guide Tube for Barrel	PTFE	V-0	>28
1.5, 1.6, 2.0 & 3.0-mm		UL 1666*	
Jacket	PVC		
Buffer	Nylon or PVC		
Strength Material	Aramid Yarn		

* - Various cables, diameters, fiber-counts & ratings are available; please contact your Yazaki Sales Representative.

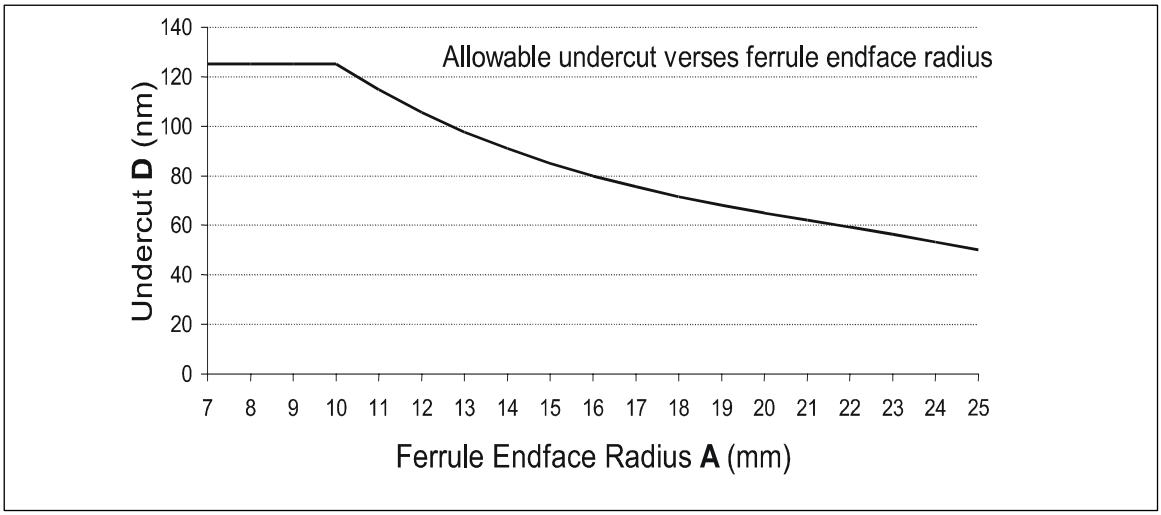
3.7 - Cordage Technical Specifications	
Fiber Dimensions	
Multimode Fiber	50/125 & 62.5/125 micron, or custom**
Singlemode Fiber	9/125 microns, or custom**
Coating	250 micron
Buffer	0.9mm micron
Jacket OD	1.5, 1.6, 2.0 & 3.0-mm
Fiber Proof Test	100 kpsi

** - Custom fiber, please contact your Yazaki Sales Representative.

3.8 - LC Singlemode Ferrule Endface Geometry



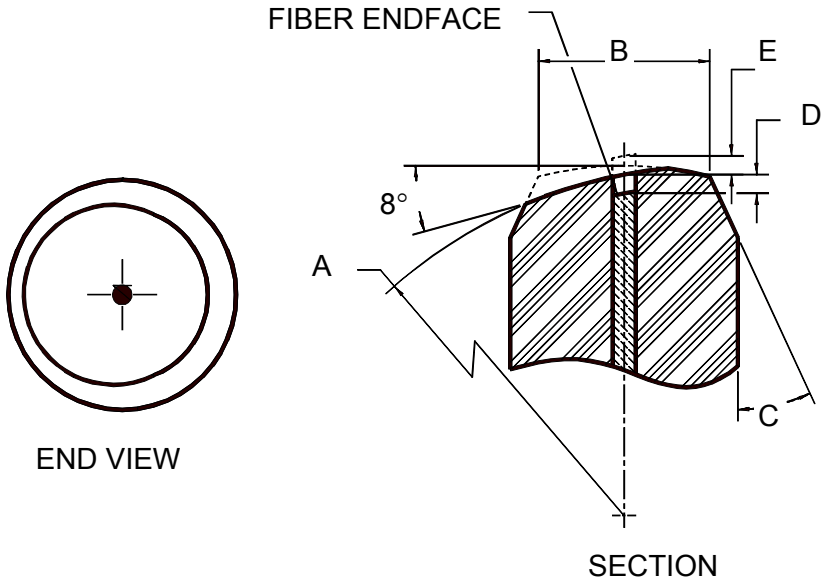
Item	Reference	Minimum	Maximum	Dimensions
Radius	A	7	25	mm
Pedestal*	B	0.60	0.85	mm
Dome Ecc.	—	0	0.070	mm
Chamfer	C	32.5	37.5	degrees
Undercut	D	—	See Graph A	nm
Protrusion	E	—	50	nm



Graph A. Recommended Fiber Undercut (Reference D)

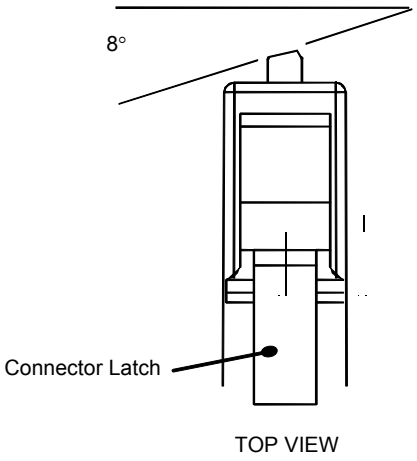
Note: The dimensions in table above are for reference only and apply after polishing procedures have been completed. End-face geometry is reference information (non-critical inspection points). Return loss and insertion loss are critical inspection criteria.
* - IEC SC86B Pedestal 0.60-0.85 mm; legacy pedestal 0.8 – 1.0 mm also acceptable.

3.9 - LC APC Ferrule Endface Geometry



Item	Reference	Minimum	Maximum	Dimensions
Radius	A	5	12	mm
Pedestal*	B	0.60	0.85	mm
Dome Ecc.	—	0	0.050	mm
Chamfer	C	32.5	37.5	degrees
Undercut	D	—	100	nm
Protrusion	E	—	100	nm

Note: The dimensions in table above are for reference only and apply after polishing procedures have been completed. End-face geometry is reference information (non-critical inspection points). Return Loss and insertion loss are critical inspection criteria. * - Use 0.60-0.85 mm pedestal for APC, easier polishing.



3.10 - LC APC Ferrule/Angle Orientation

3.11 – LC Factory Made Patchcords – Specifications
- Standard Quality -

Yazaki made LC Patchcords meet or exceed **R**equirements of Telcordia GR-326, Iss. 3.

Fiber Type	**Singlemode PC**	**APC**	**Multimode**
Loss[1]: Avg./Std. Dev.	0.06 dB/0.06 dB (Tuned)	0.06 dB/0.06 dB	0.10 dB/0.10 dB
Loss[1]: Maximum	0.25 dB	0.25 dB	-
Return Loss Minimum	55 dB	65 dB	20 dB
Mating Durability (500 Reconnects) Insertion Loss Change	≦ 0.3 dB	≦ 0.3 dB	< 0.3 dB
Transmission with Applied Load[2], Insertion Loss Change	≦ 0.3 dB	≦ 0.3 dB	<0.3 dB
Temp. Stability (-40 °C to 75 °C) Insertion Loss Change	< 0.3 dB	< 0.3 dB	< 0.3 dB

Note: 1 Complete connection concatenated statistics 9/125 fiber, 50/125 & 62.5/125 fiber. Dry connection. The performance is representative of all LC factory patchcords herein (Tuned). $X_{max} \approx X_{avg} + 3\sigma = 0.24$ dB. Performance representative of product to product concatenation.
2. Yazaki uses 0.3 dB maximum loss change which is lower (better) than the 0.5 dB specified in GR-326, Issue 3.

3.12 – LC SM Patchcord Tuning Configuration & Performance

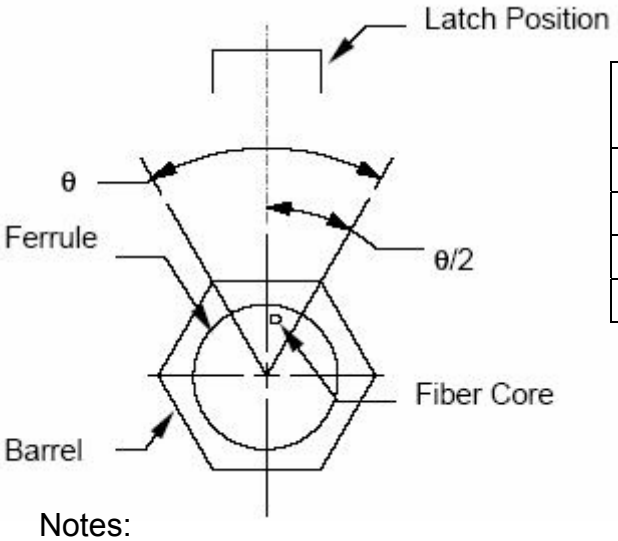


Table 3.12 - LC Performance - Typical Hole Size Product-to-Product (mean / std. dev.)

Hole Size (um)	Not Tuned dB	Tuned dB
126.0	0.15 / 0.17	0.08 / 0.07
125.5	0.09 / 0.10	0.06 / 0.06
125.0	0.05 / 0.04	0.03 / 0.02

Notes:

1. Tuning is required to minimize loss. The eccentricity of the fiber core is to be located relative to the connector latch within the angle θ as shown.
2. θ ≦ 180°.
3. Table 4.12 shows typical results. The results can vary slightly for differences in wavelength or MFD. Sample size is typically N = 50 or 54.
4. Hole sizes: Use 126.0 μm for easy insertion of fiber, 125.5 is standard ferrule, and 125.0 is for best performance.

3.13 - Visual Inspection Criteria for Fiber Optic Connectors

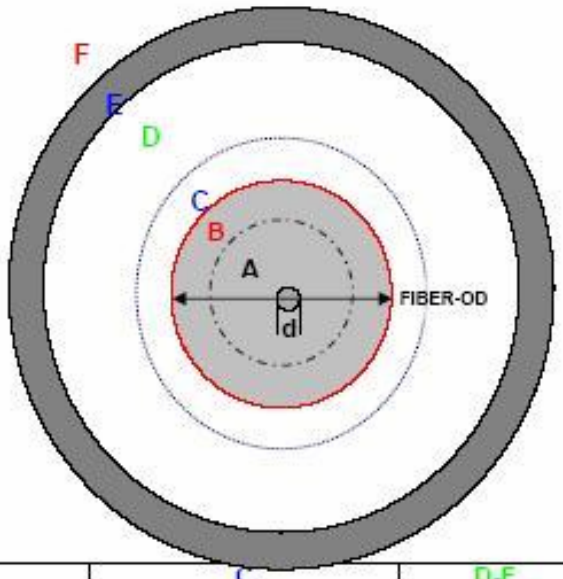
Definition of regions and defects

A = RESTRICTED AREA
A=(fiber OD+d)/2

Fiber OD=125 microns
d- Is the core diameter of the fiber
d for SM = 9 microns
d for MM is 62 microns
A=66 microns for SM fiber
A=95 microns for MM fiber

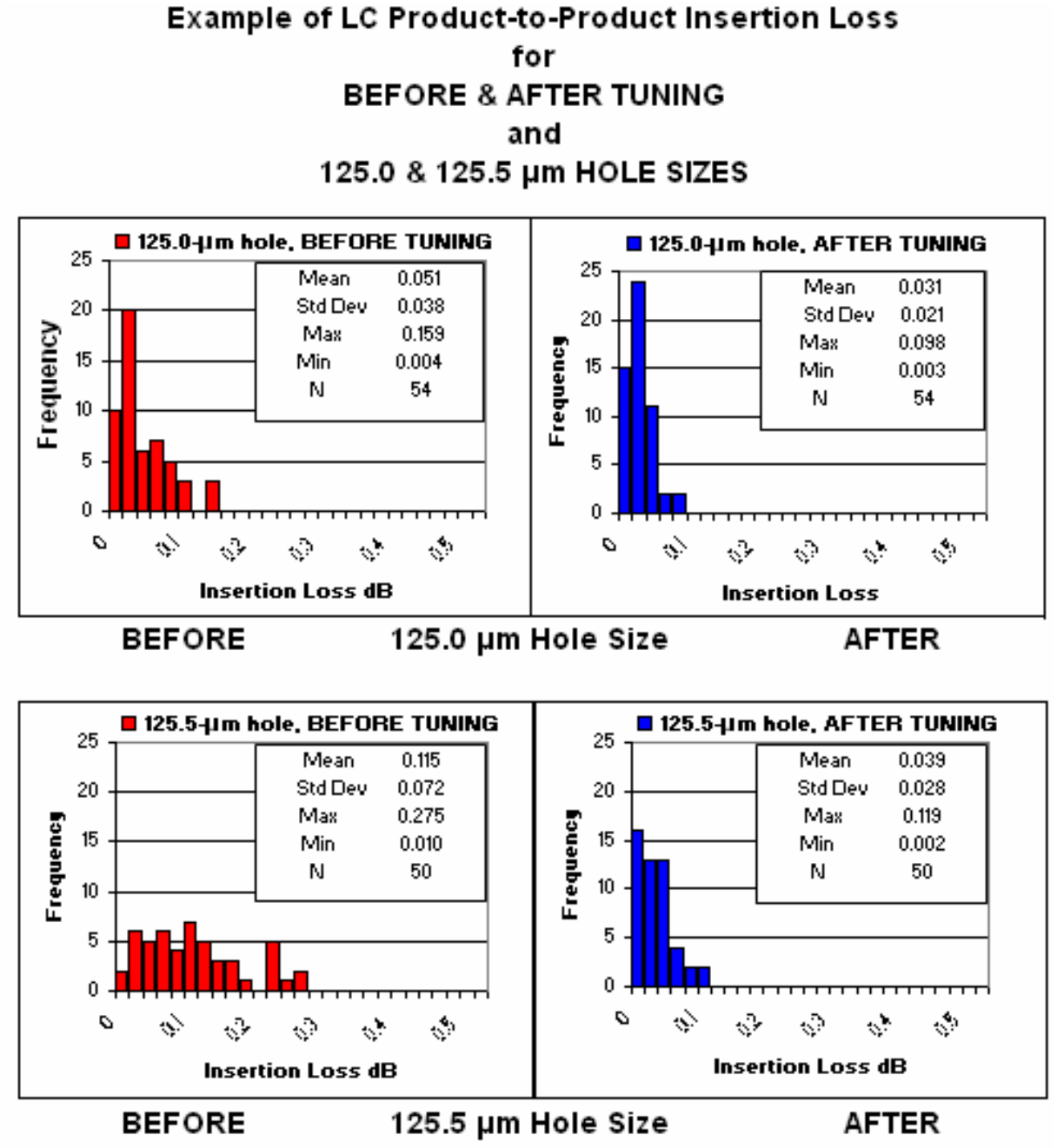
B = FIBER SURFACE
AREA OUTSIDE RESTRICTED "A" TO EDGE OF FIBER(125 UM)

C = FERRULE SURFACE
FERRULE AREA COVERING AREA FROM 125 TO 250 MICRONS
D = FERRULE PEDESTAL
E = CHAMFER
F=OUTSIDE CYLINDRICAL SURFACE



DEFECT	A	B	C	D-F
CRACK	not acceptable	No Cracks when extended can intersect the core		N/A polished end See Ferrule Spec
CHIP	not acceptable	One defect up to 10um in diameter is acceptable Defect <2.0 um don't count	Multiple defects <10um each are acceptable (can't touch fiber edge) Defects <2.0 um do not count Sum of all defect types<30um	N/A for polished end See Ferrule Spec
PIN HOLES/VOIDS			Multiple defects <10um each are acceptable (can't touch fiber edge) Defects <2.0 um do not count Sum of all defect types<30um	N/A for polished end See Ferrule Spec
SCRATCHES (SM)	No scratches in core Tangent to core acceptable If less than 2 um width	Scratches are acceptable if they do not exceed 2um width		
SCRATCHES (MM And APC connectors)	Scratches in the core are acceptable if transmission requirements are met	Scratches are acceptable if they do not exceed 2um width		
FERRULE SCRATCHES			No scratches > 2 um	acceptable
EPOXY RING		Epoxy ring is acceptable if the width is less than 5 um		
FIXED CONTAMINATION BLACK SPOTS	not acceptable	One defect up to 10um in diameter is acceptable Defect <2.0 um don't count	Multiple defects <10um each are acceptable (can't touch fiber edge) Defects <2.0 um do not count Sum of all defect types<30um	acceptable
RAISED CONTAMINATION	not acceptable	not acceptable	not acceptable	acceptable
LOOSE CONTAMINATION	not acceptable	not acceptable	not acceptable	acceptable

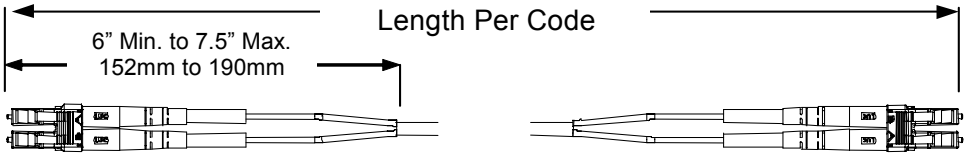
3.14 - LC SM Patchcord Performance*



* - This Chart shows data for Product-to Product performance of the same connections before and after tuning. Tuning consists of orienting the fiber core offset in the direction of the connector key (for LC, the key is the latch direction). Typical performance is shown in Table 3.12 for three ferrule hole sizes (125, 125.5 and 126 μm).

3.15 - LC Patchcords and Hybrid Patchcords - Standard Length Tolerances

Please see Table 3.17 for Patchcord Part Numbers.
Several Hybrid Patchcords are available.



Example: LC-LC Duplex Jumper on duplex Cordage

Standard Length Tolerances. Special order by request.

Standard Tolerances in feet	
Less than 15 ft	+0.5 / 0 ft
15 to < 100 ft	+1 / 0 ft
100 ft and greater	+2% of length

Standard Tolerances in meters	
Less than 5.0-m	+0.15/-0.0 m
5.0m to < 30-m	+0.3/-0.0m
30-m and greater	+2% of length

3.16 - LC Patchcord Color Coding

Patchcord	Connector Color	Cordage Color*
Multimode, MM	Beige with White Boot	Orange
Multimode, MM, Laser Optimized	Beige *(Aqua trigger)* with White Boot	Aqua
Singlemode, SM	Blue with White Boot	Yellow
Singlemode – for Angled APC	Green with Green Boot	Yellow

* - Cordage colors are typical and may vary. Specific cordage colors are available on request as special order.

3.17 - Patchcord Identification & Part Numbers

When selecting a Patchcord please specifiy the following:

a) **End 1 Connector** -> Connector type (this would be the reference connector for reference jumpers)
b) **End 2 Connector** -> Connector type (this would be "X" (none) for pigtails)
c) **Jumper Family** -> Standard Straight, Right Angle, Reference, Custom assy
d) **Fiber Count** -> 1, 2, 4, etc. fibers
e) **Cable Diameter** -> 2mm, 0.9mm, 2.5 x 3.5mm ribbon, etc.
f) **Fiber Type** -> Single Mode, Multimode 62.5µm, etc.
g+h) **Cable Length w/units** -> 2ft, 20m, 1km, etc.

Part Number format = **OG3 X X X - X X X XXX.X X ***
a b c d e f g h *

* = special variations

(polish to be PC unless specified otherwise)

a **END 1 – CONNECTOR TYPE**

D = E2000, APC
E = E2000
F = FC
G = FC, APC
J = MTRJ
K = LC, APC
L = LC
M =MU
P = MPO (MTP), APC
R = SC, APC
S = SC
T = ST®

b **END 2 - CONNECTOR TYPE**

D = E2000, APC
E = E2000
F = FC
G = FC, APC
J = MTRJ
K = LC, APC
L = LC
M =MU
P = MPO (MTP), APC
R = SC, APC
S = SC
T = ST®
X = None (Pigtail)

c **JUMPER GROUPING**

1 = STANDARD (straight)
2 = CUSTOM REQUEST (part no. format may vary)
3 = REFERENCE (REF, 1st conn. in P/N to be ref.)
4 = RIGHT ANGLE, 90° (R/A)
5 = VARIATION(s) of standard jumpers

d **FIBER COUNT**

1 = SIMPLEX (1f = 1 fiber)
2 = DUPLEX (2f = 2 fiber)
4 = QUAD (4f = 4 fiber)
6 = 6 FIBERS (6f)

e **CABLE DIAMETER**

2 = 2.0 mm
3 = 3.0 mm
9 = 0.9 mm
R = 2.5 x 3.5 mm *(ribbon- 2, 4 fibers)*
B = 2.5 x 4.5 mm *(ribbon- 8 fibers)*
F = 2.5 x 5.0 mm *(ribbon- 12 fibers)*

f **FIBER TYPE**

S = SM, (G.652)
K = MM, 50/125 µm
M = MM, 62.5/125 µm

g+h **LENGTH w/ UNITS**

Examples: 050.0M = 50.0 meters
050.0F = 50.0 feet

(for "h" LENGTH UNITS)

C = CENTIMETER
M = METER
F = FEET
N = INCH

for hundredths place, use 5 digits for the 'g' place holder
i.e. 005.55N = 005.55 inches

Example P/N: OG3LL1-22S010.0M = LC-LC, standard patchcord, Duplex, 2mm, SM, length= 10.0m

OTHER OPTIONS AND CONNECTORS AVAILABLE UPON REQUEST

3.18 - LC Connector Installation and Removal Tool

Quantity	Item	Part Number
1	LC Connector Installation & Removal Tool	OT1LC1-19561

1. **Application:** For installation and removal of LC Patchcord connectors in tight locations.
2. **For LC Connectors:** For use with LC Patchcord connector and LC Unibody Connector. Not for use with LC Duplex connectors or LC BTW Connector.
3. **How to Use, *Installing* Connector:** Insert the connector into Insertion & Removal Tool as shown. Install connector into adapter then rotate tool off of the connector.
4. **How to Use, *Removing* Connector:** Use the fiber-cord as a guide to slide the tool onto the Patchcord boot until the tool "clicks" onto the connector. Pull back on the tool to remove connector.
5. **Material:** Steel. **Weight:** 130 gm.
6. **Cleaning and Care:** Wipe clean with a damp cloth. Do not drop.
7. **Caution:** Do not disassemble.