



This four-day class has been developed with 16 hours of classroom lecture and 16 hours of hands-on skills labs that provide the practical understanding and skills required to properly design, install, and maintain fiber optic networks. This course is also available in a two-day version with 16 hours of classroom lecture.

This course is applicable to fiber optic communications systems in Telco, Broadband, and Premises (LAN) applications. Students will learn how to splice, connectorize, test, and troubleshoot optical fiber networks in order to increase efficiency, reliability, and on-the-job safety as well as to reduce cost and downtime.

**Prerequisites:** None. Entry level.

**Certifications and Credits:** ETA Fiber Optic Installer (FOI)  
30 BICSI ITS Continuing Education Credits  
Light Brigade Certificate of Completion

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### Chapter 1 — Preface

- Photonics Skills Standard for Technicians

### Chapter 2 — Introduction

- Basic Fiber Optic Terminology
- Three Critical Considerations
- Optical Fiber Transmission System
- Fiber Optic Standards
- Fiber Comparison
- Typical Transmission Rates
- Service Providers of Communications
- Fiber Optics History
- Fiber Optic Symbols
- System Topologies
- Advantages and Disadvantages of Fiber Optics

### Chapter 3 — Theory

- Numerical Aperture
- Refraction
- Optical Reflection
- The Electromagnetic Spectrum
- Lightwave Transmission
- ITU Transmission Bands
- Attenuation
- Intrinsic and Extrinsic Losses
- Termination Attenuation
- Multimode Systems
- Graded-index Lightwave Propagation
- Single-mode Systems
- Mode Field Diameter
- Optical Dispersion

### Chapter 4 — Fiber

- Fiber Characteristics and Specifications
- Multimode Fiber Types
- Multimode Fiber Bandwidth
- Launch Conditions
- Single-mode Fiber Types
- Dispersion-compensating Fiber
- Fiber Optic Color Coding
- Application Areas of Optical Fiber

### Chapter 5 — Cable

- Cable Materials and Structure
- Indoor Optical Cables
- Low Smoke Zero Halogen
- Distribution Cables
- Interlocking Armor Cable
- Breakout Cables
- Fiber Optic Cable Cordage
- Tight Buffered Cable Specifications
- Indoor/Outdoor Cables
- Loose Tube Outside Plant Cables
- Stranded Cables
- Unitube Cables
- Ribbon Cables
- Microduct Cables
- Aerial Fiber Optic Cables
- FTTx Drop Cables
- Typical Optical Cable Specifications
- Composite and Hybrid Cables
- Cable Interconnection Options
- Loose Tube Cable Preparation

### Chapter 6 — Connectors

- Main Connector Components
- What to Look for in a Connector
- Subscriber Connector (SC)
- BFOC/2.5 (ST)
- LC Connector
- Multifiber Connectors
- Older Multimode Connectors
- DWDM Influenced Single-mode Connectors
- Older Single-mode Connector Styles
- Termination Techniques
- Connector Polishing Procedures
- Fiber Optic Connector Inspection
- Cleaning Methods
- Single-mode Field Connectorization Issues
- The Importance of Yield
- Attenuators
- Terminators

### Chapter 7 — Splicing

- Why Do We Need to Splice?
- Good Splice Requirements
- Fiber Cleaving
- Common Fiber Optic Cleavers
- Fusion Splicing
- Ribbon Splicing
- Mechanical Splicing
- Pigtail Splicing
- How Do We Protect the Splice?

### Chapter 8 — Fiber and Cable Management

- Rack Space
- Patch Panels
- Splice Panels
- Optical Entrance Enclosures
- Fiber Distribution Units
- Splice Closures
- Splice Trays
- Fanout and Breakout Kits
- Buildings and Campuses
- Premises Panels
- Fiber Raceway Systems
- Work Area (WA) Media Outlets
- Fiber to the Building Installations
- OSP Fiber and Cable Management
- FTTx Cable Management Products
- Fiber Distribution Hubs
- Fiber Access Terminals
- Multiport Service Terminals
- Fiber Transition Terminals
- Cabling Scenarios
- Vaults and Handholes
- Panel and Closure Issues

### Chapter 9 — Installation

- Optical Cable Installation
- Cable Handling
- Guidelines for Fiber Optic Cable Installation
- Standards, Regulations, and Codes
- Air Blown Fiber
- Cabling Buildings
- Cable Trays and Cable Duct Benefits
- Cable Installation Products

### Chapter 10 — OSP Installation

- Underground Installation Techniques
- Proper Route Planning and Engineering
- Conduit and Duct Installation
- Cable Pulling Methods
- Tension Monitoring
- High Air Speed Blown
- Aerial Installation
- Utility Applications of Fiber Optics
- Mid-span (Express) Entries
- Slack Storage Methods
- Underground Cable Storage
- Aerial Cable Storage Products
- Sequential Markings

### Chapter 11 — Test Equipment

- Optical Loss Test Sets
- The OTDR
- Key Issues for All OTDRs
- Fiber Identifiers
- Visual Tracers
- Visual Inspection
- Optical Dispersion Testers
- Testing Documentation
- Elements of an Effective Maintenance Posture

### Chapter 12 — Optical Testing

- TIA-568 Testing Terminology
- Test Methods
- Multimode Launch Conditions
- Optical Loss Testing with a Mandrel
- Reference Test Methods
- Insertion Loss Method
- “Not to Exceed” Charts
- Testing Transmitter and Receiver Power
- Transmitter and Receiver Documentation
- OTDR Deadzone
- OTDR Signatures
- Optical Gain
- Fiber Roll-off
- Testing Fiber Optic Splitters
- Key Points to Understanding IOR
- Documentation Issues

### Chapter 13 — Restoration

- Identify ... Locate ... Resolve
- Typical Causes of Failure
- Types of Fiber Optic Damage
- Failure Rates of Fiber Optic Systems
- Pre-Emergency Planning Activities
- Equipment Used in the Restoration Role
- Troubleshooting Flow Chart
- Emergency Restoration Jump Kit
- Aerial Restorations
- OSP Restorations
- OSP Emergency Restoration
- Fiber Optic Restoration for Premises
- Proactive Planning vs. Reactive Restorations
- Premises Restorations
- LAN Restorations
- The Need for Slack Cable
- Post-restoration Recommendations

### Chapter 14 — Safety

- Fiber Optic Safety Concerns
- Visual Safety Using Fiber Optic Sources
- Wavelength and the Eye
- Laser Classifications
- Working with Lasers
- Safety Eyewear
- Working with Optical Fibers
- Personal Protective Equipment
- Chemicals
- Safety Data Sheets (SDS)
- The Work Area
- Installation Practices

### Chapter 15 — Communication System Basics

- Fiber Optic Transmitters
- Laser Light Sources
- Lasers in Single-mode Systems
- Light Sources in Multimode Systems
- Laser and LED Spectral Width
- Reflection Issues
- Fiber Optic Receivers
- Photo Diodes
- Typical Span Distances
- Repeaters, Regenerators, and Amplifiers
- Factors for Regenerator Usage
- Basic Components for Optical Transmission
- Point to Point
- Point to Multipoint
- Passive Devices
- Optical Splitters
- WDMs and Bidi Devices
- Coarse Wavelength Division Multiplexing
- Dense WDM

### Chapter 16 — Loss Budgets

- Loss Budget Basics
- Design Options for Fiber Optic Networks
- Safety Margin
- Multimode System Budgets
- Multimode Wavelength Optimization
- 10/40/100 Gigabit Networks
- Single-mode Wavelength Optimization
- Single-mode System Budgets
- Loss Budgets for FTTx Networks
- PON Architectures
- P2MP System Budgets

### Appendix A — Worksheets

- Fiber Selection
- Cabling Options
- Cable Management Products
- Test Equipment Selection
- Placement Technique
- Fiber Installation Inspection Report
- OTDR Acceptance Test Form
- Splice Loss Record

### Appendix B — Miscellaneous

- National and Canadian Electrical Codes
- TIA-569

## Hands-on Skills Learning

### Station #1 – Splicing

- Fusion / mechanical / pigtail
- Fiber handling and cleaving

### Station #2 – Connectorization

- Multiple bonding methods
- Visual inspection / cleaning
- Cable assembly testing

### Station #3 – Cable Preparation

- Loose tube cable preparation
- Breakout and distribution cable preparation
- Patch panel and splice closure preparation
- Mid-entry practices

### Station #4 – OTDR Operation

- Acceptance testing
- Reflection testing
- Span testing and splice loss
- Emergency restoration
- Troubleshooting

### Station #5 – Optical Loss Testing

- Link loss measurement
- Transmit and receive power
- Reflection testing
- Variable and fixed attenuators