# FIBER OPTICS TECHNICIAN – INSIDE PLANT (FOT-ISP)
## Competency Requirements

This competency listing is the syllabus or objective of each individual subject item in which a Fiber Optics Technician – Inside Plant **(FOT-ISP)** must be knowledgeable and skilled to prepare for the hands-on course training and the ETA® International **FOT-ISP** certification knowledge examination. The competency includes concepts and techniques of installing, servicing, troubleshooting, splicing, testing and repairing fiber optic transmission cable, connection devices, links and spans; diagnostically ranging from the intermediate installation for Enterprise Networks, LANs, WANs and Data Centers up to rudimentary project aspects to assure Ultra-Reliable Low-Latency Communication (URLLC).

Prior experience in optical fiber cabling as well as a working knowledge of optical fiber transmissions is recommended before attempting a Fiber Optic Technician – Inside Plant course.

An **FOT-ISP** technician, in addition to completing a special course, fee and hands-on skills exam from an ETA approved school must also be knowledgeable in the following technical areas:

### 1.0 BASIC PRINCIPLES OF LIGHT

- 1.1 Describe the Electromagnetic Spectrum and locate light frequencies within the spectrum in relation to communications frequencies
- 1.2 Describe how the Index of Refraction (IOR) is calculated
- 1.3 Describe the phenomenon of total internal reflection (TIR) that makes fiber optic transmission possible
- 1.4 Define Fresnel Reflection Loss
- 1.5 Explain the effects of refraction
  - 1.5.1 Explain Snell's Law

### 2.0 PRINCIPLES OF FIBER OPTIC TRANSMISSION

- 2.1 Describe the basic parts of a fiber optic link
- 2.2 Describe the basic operation of a transmitter
- 2.3 Describe the basic operation of a receiver
- 2.4 List the benefits of Multiplexing optical signals
- 2.5 Explain the purpose of decibels (dB)
  - 2.5.1 Explain how to express gain, loss and reflectance using dB
- 2.6 Explain how Optical Power is measured (dBm)
  - 2.6.1 Express optical power levels in dBm's
  - 2.6.2 Compare power gains and losses
  - 2.6.3 Identify common wavelengths used in multimode systems
  - 2.6.4 Identify common wavelengths used in single-mode systems
  - 2.6.5 Explain the relationship between dBm and Watts

### 3.0 OPTICAL FIBER CONSTRUCTION AND THEORY

- 3.1 Describe the materials out of which optical fiber is manufactured
- 3.2 Discuss why the core and the cladding have different compositions of glass
- 3.3 Define the performance of optical fibers used in the telecommunications industry in accordance with Telecommunications Industry Association (TIA®), Telcordia, International Electrotechnical Committee (IEC) and the International Telecommunications Union (ITU®)
- 3.4 Summarize the fiber types that correspond to the referenced fiber designations OM1, OM2, OM3, OM4, OM5, OS1, and OS2 in accordance with IEC requirements
  - 3.4.1 Explain the various bandwidth values of OM 1, 2, 3, 4 &5 multimode (MM) and OS 1 & 2 single-mode (S-M) fiber types
  - 3.4.2 Explain the various attenuation values of OM 1, 2, 3, 4 &5 multimode (MM) and OS 1 & 2 single-mode (S-M) fiber types

 

3.5 Describe single-mode (S-M) fiber and how it differs from multimode (MM) fiber
- 3.5.1 Explain why multimode fiber may be selected over single-mode fiber
- 3.5.2 Describe the mode field diameter (MFD) of a single-mode fiber and how it differs from the fiber's core

3.6 Point out how the number of potential paths (modes) of light is one of the most important characteristics used to distinguish types of fiber

3.7 Distinguish the relationship and purpose between the different refractive index profiles

## 4.0 OPTICAL FIBER CHARACTERISTICS

4.1 Define dispersion in an optical fiber

4.2 Explain how modal dispersion causes pulses to spread out as they travel along the fiber
- 4.2.1 List the methods for overcoming modal dispersion

4.3 Describe the Absorption effects of intrinsic attenuation in an optical fiber

4.4 Describe the Scattering effects of intrinsic attenuation in an optical fiber

4.5 Explain chromatic dispersion in an optical fiber

4.6 Describe how to measure fiber optic link attenuation using the referenced methods specified by TIA-526-14-B for multimode and TIA-526-7 for single-mode fiber optic cables

4.7 Describe how microbends can affect the signal of an optical fiber

4.8 Describe how a macrobend affects the signal attenuation

4.9 Relate how light rays have to fall within a fiber's acceptance angle, measured by the numerical aperture (NA), in order to be guided into the core

4.10 Identify the cone of acceptance as used in optical fiber

4.11 List the ANSI/TIA-568.0-E. and 568.3-D, ISO/IEC 11801, and ITU Series G minimum overfilled modal bandwidth-length product (MHz·km) limitations for common multimode optical fiber and cable types

4.12 Differentiate between the attributes and tolerances for the common types of single-mode optical fibers used inside data centers and local area networks (LANs) as defined in IEC 60793; the ITU-T series G.652, G.655, G.657; ANSI/TIA-568, TIA-758, TIA-942 and Telcordia standards

## 5.0 SAFETY

5.1 Explain how to safely handle and dispose of fiber optic cable and fiber scraps
- 5.1.1 Explain potential electrical hazards in a fiber optic environment
- 5.1.2 Describe typical work place hazards in the fiber optic environment
- 5.1.3 List different types of personal protective equipment and where they are used
- 5.1.4 Explain good work habits

5.2 List the safety classifications of fiber optic light sources as described by the FDA, ANSI (Z136.2), OSHA, and IEC (60825-2) fiber optic communication standards to prevent injuries from laser radiation
- 5.2.1 Describe where Class 1 Lasers are used
- 5.2.2 Describe where Class 2 Lasers are used

5.3 Explain the potential chemical hazards in the fiber optic environment and the purpose of the material safety data sheet (SDS)

## 6.0 FIBER OPTIC CABLES

6.1 In a cross-section of a fiber optic cable explain the purposes of each functional component

6.2 Distinguish between the two buffer type cables:
- 6.2.1 Loose buffer (stranded versus central tube)
- 6.2.2 Tight buffer (distribution versus breakout)

6.3 Identify the different types of strength members used to withstand tensile forces in an optical fiber cable

6.4 Compare the choice of jacket materials and how they play a crucial role in determining characteristics of a cable

 

6.5 List common material classifications for a fiber optic cable

6.6 Describe the following cable types:
- 6.6.1 Simplex cordage
- 6.6.2 Duplex cordage
- 6.6.3 Distribution cable
- 6.6.4 Breakout cable
- 6.6.5 Armored cable
- 6.6.6 Messenger cable
- 6.6.7 Ribbon cable
- 6.6.8 Stranded Loose Tube cable
- 6.6.9 Central Loose Tube cable – Unitube
- 6.6.10 Ultra-High-Density (UHD) cabling
- 6.6.11 Collapsible rollable ribbon fiber – (High-Density (HD) cabling
- 6.6.12 Air blown cable (air-jetted cable)

6.7 Explain what hybrid cables are and where they are ordinarily used in fiber optics in accordance with ANSI/TIA-568.1-E

6.8 Describe a composite cable, as defined by National Electrical Code® (NEC®) Article 770.2

6.9 Distinguish the difference between a fanout kit (sometimes called a furcation kit) and a breakout kit

6.10 Explain how fibers can be blown through microducts instead of being installed underground or in structures.

6.11 List the National Electrical Code® (NEC®) optical fiber cable categories including:
- 6.11.1 Abandoned optical fiber cable
- 6.11.2 Nonconductive optical fiber cable
- 6.11.3 Composite optical fiber cable
- 6.11.4 Conductive optical fiber cable

6.12 Describe the NEC® listing requirements for:
- 6.12.1 Optical fiber cables
- 6.12.2 Optical fiber raceways
- 6.12.3 Listed variants to the NEC® requirements

6.13 Explain where the TIA-598-C color code is used and how the colors are used to identify individual cables
- 6.13.1 Describe the color code for 16-fiber and 32-fiber MPO connectors
- 6.13.2 Describe the color code variants for UHD cables

6.14 Describe TIA-598-C premises cable jacket colors and exceptions

6.15 Explain how cable markings are used to determine the length of a cable

## 7.0 TYPES OF SPLICING

### 7.1 Mechanical Splicing
- 7.1.1 Explain the extrinsic factors that affect splice performance
- 7.1.2 Summarize the correct fiber preparation scoring method using a cleaver
- 7.1.3 Discuss the mechanical splice assembly process
- 7.1.4 Explain performance characteristics of index matching gel used inside the mechanical splice and splice-on connectors
- 7.1.5 Explain how to perform ANSI/TIA-568.0-E (Annex E.8.3) Optical Time Domain Reflectometer (OTDR) insertion loss procedures for a reflective event mechanical splice

### 7.2 Fusion Splicing
- 7.2.1 Describe the advantages of fusion splicing over mechanical splicing
- 7.2.2 Explain intrinsic factors that affect splice performance
- 7.2.3 Summarize the correct fiber preparation scoring method using a cleaver
- 7.2.4 Discuss the fusion splice assembly process and splice protection

 

- 7.2.5 Explain the key fiber and splice routing in fiber optic splice trays
- 7.2.6 Explain the use of the Splice Closure including:
  - 7.2.6.1 Butt style splice closures
  - 7.2.6.2 In-line splice closures
  - 7.2.6.3 Environmental sealing
  - 7.2.6.4 Bonding to ground requirements and techniques
- 7.2.7 Explain ANSI/TIA-568.0-E (Annex E.8.3) Optical Time Domain Reflectometer (OTDR) insertion loss procedures for a non-reflective fusion splice
- 7.2.8 Explain the locations of single-mode splices in outside plant (OSP) installations

## 8.0 CONNECTORS

- 8.1 Identify the wide variety of fiber optic connector types including:
  - 8.1.1 In-line ferrule based connectors
  - 8.1.2 plug/receptacle connectors
  - 8.1.3 multi-fiber connectors
- 8.2 Describe the most common approaches to align the fibers in fiber optic connector types
- 8.3 Describe the ANSI/TIA-568.3-D section 5.2.2.4 polarity of the two types of array adapters
  - 8.3.1 Type-A MPO and MTP® adapters shall mate two array connectors with connector keys key-up to key-down
  - 8.3.2 Type-B MPO and MTP® adapters shall mate two array connectors with connector keys key-up to key-up
  - 8.3.3 Describe how the MPO 8/16 is prevented from cross mating with the standard MPO 12/24 fiber connectors
- 8.4 Identify the connectors specified in the ANSI/TIA 942- Infrastructure Standard for Data Centers
- 8.5 Describe ferrule materials used with fiber optics connectors
- 8.6 Explain both the intrinsic and extrinsic factors that affect connector performance
- 8.7 Define physical contact (PC), angled physical contact (APC), and ultra physical contact (UPC) finishes
  - 8.7.1 Explain how PC, APC, and UPC finishes affect both insertion loss and back reflectance
- 8.8 Explain how physical contact depends on connector endface geometry to include the Telcordia GR-326 three key parameters for optimal fiber contact:
  - 8.8.1 Radius of curvature
  - 8.8.2 Apex offset
  - 8.8.3 Fiber undercut and protrusion
- 8.9 Describe how and where pigtails are used in fiber cabling
- 8.10 Summarize connector termination methods and tools including:
  - 8.10.1 Thermal cure
  - 8.10.2 Anaerobic adhesive
  - 8.10.3 Splice-on mechanical connectors
  - 8.10.4 Fuse-on mechanical connectors
- 8.11 Compare the differences between field polishing, factory polishing, and no-epoxy/no-polish connector styles
- 8.12 Describe how to properly perform a connector endface cleaning and visual inspection in accordance with ANSI/TIA-455-57 Preparation and Examination of Optical Fiber Endface for Testing Purposes
- 8.13 Explain how to ensure insertion loss and return loss performance in accordance with the IEC 61300-3-35 global common set of requirements for fiber optic connector endface quality
- 8.14 Identify both multimode and single-mode connector strain relief, connector plug body, and adapter housing following ANSI/TIA-568.3-D section 5.2.3
- 8.15 Explain the importance of connectorization yield when installing an optical span

 

## 9.0 SOURCES

- 9.1 Describe the two primary types of light sources including the light emitting diode (LED) and semiconductor laser (also called a laser diode)
- 9.2 Explain the basic concept, operation and address launch conditions of an LED light source
- 9.3 Explain the basic concept and operation of a laser diode light source
- 9.4 List the differences between the Fabry-Perot (FP), distributed feedback (DFB), and vertical-cavity surface-emitting laser (VCSEL), commonly used in fiber optic communication systems
  - 9.4.1 Explain the impact of Fresnel reflections on Fabry-Perot and distributed feedback (DFB) lasers and their signal quality
- 9.5 Recall the typical operational wavelengths for communication systems
- 9.6 Compare the performance characteristics of the LED and laser light sources to include:
  - 9.6.1 Output pattern (sometimes referred to as spot size)
  - 9.6.2 Source spectral width
  - 9.6.3 Source output power
- 9.7 Identify standards and federal regulations that classify the light sources used in fiber optic transmitters
- 9.8 Explain the relationship between launch conditions and the Overfill versus Effective Modal Bandwidth (EMB) / Bandwidth Length (BWL) product performance specifications of MM fibers
- 9.9 Explain Encircled Flux and its importance when it should be used for testing multimode spans

## 10.0 DETECTORS AND RECEIVERS

- 10.1 Explain the function of photodiodes in receivers
- 10.2 Compare the factors in photodiode performance characteristics including:
  - 10.2.1 responsivity
  - 10.2.2 switching speed
- 10.3 Discuss how fiber optic receivers are typically packaged with the transmitter and how together, the receiver and transmitter form a transceiver
  - 10.3.1 Review an SFP module (small form-factor pluggable transceiver, et.al.)
- 10.4 Examine a block diagram of a typical receiver that is divided into three subassemblies:
  - 10.4.1 Electrical subassembly
  - 10.4.2 Optical subassembly
  - 10.4.3 Receptacle
- 10.5 Describe the key characteristics of a fiber optic receiver:
  - 10.5.1 Dynamic Range
  - 10.5.2 Sensitivity
  - 10.5.3 Wavelength (almost always broadband)

## 11.0 PASSIVE COMPONENTS AND MULTIPLEXERS

- 11.1 Discuss the different passive devices and the common parameters of each device:
  - 11.1.1 Optical fiber and connector types
  - 11.1.2 Insertion loss
  - 11.1.3 Return loss
- 11.2 Explain how optical splitters work
- 11.3 Explain that an optical attenuator is a passive device used to reduce an optical signal’s power level
- 11.4 Explain how wavelength division multiplexing (WDM) combines different optical wavelengths from two or more optical fibers into just one optical fiber
  - 11.4.1 Describe short wavelength division multiplexing (SWDM) including how the OM5 multimode fiber uses WDM for increasing transmission data rates
  - 11.4.2 Explain coarse wavelength division multiplexing (CWDM)
  - 11.4.3 Explain dense wavelength division multiplexing (DWDM)

11.5 Point out that an optical filter is a device that selectively permits transmission or blocks a range of wavelengths

## 12.0 PASSIVE OPTICAL NETWORKS (PON)

12.1 Define the passive and active individual optical network categories
12.2 Describe the technologies used in passive optical local area networks (POLANs)
12.3 Explain that Fiber to the X (FTTX) is used to describe any optical fiber network that links the end user directly to the service provider
12.4 Discuss the major inside plant components for an FTTX passive optical network (PON)
12.5 Explain the maximum span length of a passive optical local area network (POLAN)
12.6 Explain the types of single-mode fibers used in POLAN installations

## 13.0 CABLE INSTALLATION AND HARDWARE

13.1 Define the physical and tensile strength requirements for optical fiber cables recognized in ANSI/TIA-568.3-D, section 4.3 to include:
  13.1.1 Inside plant cables
  13.1.2 Indoor-outdoor cables
  13.1.3 Outside plant cable
  13.1.4 Drop cables
13.2 Compare the bend radius and pull strength tensile ratings of the four common optical fiber cables recognized in ANSI/TIA-568.3-D, section 4.3
13.3 Identify ANSI/TIA-568-hardware commonly used in fiber optic installation to include:
  13.3.1 Pulling grips, pulling tape and pulling eyes
  13.3.2 Pull boxes
  13.3.3 Splice enclosures
  13.3.4 Patch panels
  13.3.5 Indoor fiber distribution hubs
  13.3.6 Multi-user telecommunications outlet assembly (MUTOA)
13.4 Compare the variety of installation methods used to install a fiber optic cable such as:
  13.4.1 Tray and duct
  13.4.2 Conduit and microduct
  13.4.3 Direct burial
  13.4.4 Aerial
  13.4.5 Blown optical fiber (BOF)
13.5 Describe the National Electrical Code (NEC®) Article 770 and Article 250 requirements on fiber optic cables and their installation within buildings to include:
  13.5.1 Fire resistance
  13.5.2 Grounding
  13.5.3 Transition point between listed and unlisted cables
    13.5.3.1 Optical Cable Entrance Facility (OCEF)
13.6 Discuss the documentation and labeling requirements in order to follow a consistent and easily readable format as described in ANSI/TIA-606- “Administration Standard for the Commercial Telecommunications Infrastructure”
13.7 Describe hardware management applications
13.8 Describe Top of Rack (TOR) and End of Row (EOR) specified in the ANSI/TIA 942-Infrastructure Standard for Data Centers

## 14.0 FIBER OPTIC SYSTEM CONSIDERATIONS

14.1 List the considerations for a basic fiber optic system design
14.2 Compare the different characteristic performance areas within a system of optical fiber and copper including:
  14.2.1 Bandwidth

 

- 14.2.2 Attenuation
- 14.2.3 Electromagnetic immunity
- 14.2.4 Size
- 14.2.5 Weight
- 14.2.6 Security
- 14.2.7 Safety

14.3 Describe the performance of a multimode fiber optic link using the following sections of the ANSI/TIA-568.3-D Optical Cabling Components Standard

- 14.3.1 Section 4.2 cable transmission performance
- 14.3.2 Section 5.3 optical fiber splice
- 14.3.3 Annex A (Normative) optical fiber connector performance specifications

14.4 Explain how to prepare a fiber optical link power budget as defined in IEEE 802.3

- 14.4.1 Calculate a multimode optical link power budget
- 14.4.2 Calculate a single-mode optical link power budget

14.5 Analyze the performance of a single-mode fiber optic link using the following sections of the ANSI/TIA-568.3-D Optical Cabling Components Standard, ANSI/TIA-758 Customer–Owned Outside Plant Telecommunications Cabling Standard, and Telcordia GR-326 Core Generic Requirements for Single-mode Optical Connectors and Jumper Assemblies

- 14.5.1 ANSI/TIA-568.3-D Section 4.2 cable transmission performance
- 14.5.2 ANSI/TIA-758 Section 6.3.4.1.2 attenuation
- 14.5.3 ANSI/TIA-568.3-D Annex A (Normative) optical fiber connector performance specifications

14.6 Explain Data Center Links defined in TIA-568., TIA-942- and IEEE 802.3, Clause 78-95:

- 14.6.1 Describe the significance of data link transceiver specifications including:
  - 14.6.1.1 form-factors described in 10.4.1 and Multi-user Agreements
  - 14.6.1.2 number of fibers (or optical lanes) defined in 802.3 (clause 86.10 & 95.11) on 40GBASE-SR4 and 100GBASE-SR4 and 100GBASE-SR10
  - 14.6.1.3 number of wavelengths described in MEF (Mfg's Ethernet Forum)
  - 14.6.1.4 "reach" - application supported distances, i.e. point-to-point (86.1, 95.1))
  - 14.6.1.5 connector type (TIA 568.3-D, Section 5)
  - 14.6.1.6 fiber type (TIA 568.3-D, Section 4, et.al.)
- 14.6.2 Explain how to perform a reach calculation including penalties using Effective Modal Bandwidth (EMB) / Bandwidth Length (BWL) product (TIA-3.D, 4.2, Table 1; Table 86-14, Table 95-8)
- 14.6.3 Describe various configurations of multichannel MPO/MTP links(86.10, 95.11)

## 15.0 TEST EQUIPMENT AND LINK/CABLE TESTING

15.1 Compare and contrast the functional use of the following pieces of test equipment:

- 15.1.1 Continuity tester
- 15.1.2 Visual fault locator (VFL)
- 15.1.3 Fiber optic light source (FOS) and fiber optic power meter (FOM)
- 15.1.4 Optical loss test set (OLTS)

15.2 Explain the proper use of the following pieces of test equipment:

- 15.2.1 Continuity tester
- 15.2.2 Visual fault locator (VFL)
- 15.2.3 Optical return loss test set (ORL)
- 15.2.4 Fiber optic light source (FOS) and fiber optic power meter (FOM)
- 15.2.5 Optical loss test set (OLTS)

15.3 Explain the role and types of tests performed in a TIA-568 Tier 1 test

- 15.3.1 Define a transposition

15.4 Describe the importance of the TIA-455 standard and its fiber optic test procedures (FOTP)

15.5 Compare the difference between an optical fiber patch cord and measurement quality test jumpers (MQJ) known as test reference cables (TRC)

15.6 Describe the use of a mandrel wrap or mode filter on both a multimode and single-mode source measurement quality reference jumper

- 15.6.1 Describe the diameters of mandrel wraps for OM1, OM2 and OS2 fibers

15.7 Explain the ANSI/TIA-526-14- Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant procedures to include:

- 15.7.1 Method A: Two Jumper Reference
- 15.7.2 Method B: One Jumper Reference
- 15.7.3 Method C: Three Jumper Reference

15.8 Describe the testing launch conditions of the following:

- 15.8.1 Overfilled
- 15.8.2 Restricted mode launch
- 15.8.3 Encircled flux

15.9 Explain the role and types of tests performed in a TIA-568 Tier 2 test

15.10 Describe the proper setup and cable preparation for an Optical Time Domain Reflectometer (OTDR) measurement including to:

- 15.10.1 Measure fiber length
- 15.10.2 Compensate the index of refraction (IOR) to match the cable's sheath markings
- 15.10.3 Evaluate connectors for attenuation and reflectance
- 15.10.4 Evaluate splices for attenuation and reflectance
- 15.10.5 Locate faults
- 15.10.6 Rayleigh backscatter
- 15.10.7 Identify Fresnel reflections
- 15.10.8 Explain why launch and receive cables are used to measure attenuation and reflectance on optical spans, (or a deadzone box is used)
- 15.10.9 Describe the vertical and horizontal axes on an OTDR's display
- 15.10.10 Identify the OTDR's signatures and causes for reflective, nonreflective, ghosts and "roll-offs"

## 16.0 TROUBLESHOOTING AND RESTORATION – (knowledge part of Hands-On Skills)

16.1 Perform Fiber Optic Source (FOS) and Fiber Optic Meter (FOM) fiber optic link testing

16.2 Perform Fiber Optic Source (FOS) and Fiber Optic Meter (FOM) patch cable testing

16.3 Perform Optical Time Domain Reflectometer (OTDR) unit length testing:

- 16.3.1 dB/km
- 16.3.2 Wavelengths
- 16.3.3 Bi-directional averaging of out of specification splices

16.4 Perform Optical Time Domain Reflectometer (OTDR) connector and splice evaluation

16.5 Perform Optical Time Domain Reflectometer (OTDR) fault location

16.6 Demonstrate and prepare acceptance testing documentation

16.7 Perform a not to exceed attenuation budget for a span of replacement fiber with a splice at each end

**End of Fiber Optics Technician – Inside Plant Competencies Listing:**
**(16 Major Knowledge Categories)**

**Find an ETA approved school and approved test site: http://www.etai.org/test_sites.html**

 

## Suggested Additional Study Materials and Resources for ETA® Fiber Certifications:


**Fiber Optic Design for Multimode and Single-mode Optical Local Area Networks**; Corning Cable Systems LLC; FSD400-R7.M5; 2009. http://catalog2.corning.com/CorningCableSystems/en-US/catalog/DocumentLibrary.aspx

**Cabling: The Complete Guide to Copper and Fiber-Optic Networking, 5E**; Andrew Oliviero, Bill Woodward; ISBN 978-1-118-80732-3; Sybex, Inc.; March 2014; paperback; 1284 ppg**.** —Available through ETA at 800-288-3824, www.etai.org

**Troubleshooting Optical Fiber Networks: Understanding and Using Optical Time-Domain Reflectometers, 2E**; Duwayne Anderson, Larry Johnson, Florian Bell; ISBN 978-0120586615; Elsevier Academic Press; May 2004; hardcover; 437 ppg; 800-545-2522

**Technology Series Videos and CDs**; The Light Brigade, 800-451-7128, www.lightbrigade.com

**Technicians Guide to Fiber Optics, 4E**; Donald J. Sterling; ISBN 1-4018-1270-8; Delmar Learning; Dec 2003; hardcover; 384 ppg; Available through ETA 800-288-3824, www.etai.org

**Fiber Optic Installer's Field Manual**; Bob Chomycz; ISBN 0-07-135604-5; McGraw-Hill; Jun 2000; softcover; 368 ppg; —Available through ETA at 800-288-3824, www.etai.org

**Fiber Optic Installer and Technician Guide**; Bill Woodward, Emile Husson; ISBN 978-0782143904; Sybex, Inc; July 2005; hardcover; 496 ppg; Available through ETA 800-288-3824, www.eta-i.org

**Understanding Fiber Optics, 5E**; Jeff Hecht; ISBN: 978-0131174290; Prentice-Hall; Apr 2005; hardcover; 800 ppg

**Understanding Laser Accidents;**; ed.by Ken Barat; ISBN 978-1138048454; CRC Press; Sept 2018; softcover; 288 ppg;

**Laser Safety: Tools and Training, 2E;**; ed.by Ken Barat; ISBN 978-1138072008; CRC Press; March 2017; softcover; 436 ppg;

**Introduction to Fiber Optics, 3E**; John Crisp, Barry Elliott; ISBN 978-0750667562; Newnes; Dec 2005; paperback; 245 ppg

**Fiber Optic Theory & Applications**; Jeffrey Dominique; 1993; FNT Publ.; paperback

**Guide Design and Implement Local and Wide Area Networks, 3E**; Michael Palmer and Bruce Sinclair, ISBN 978-0619216115; Course Technology; June 2012; paperback; 250 ppg

**Optical Networking Crash Course**; Steven Shepard; ISBN 007-1372083; McGraw-Hill Co.; July 2008; paperback; 288 ppg

**Optical Networking: A Beginner's Guide**; Robert C. Elsenpeter; ISBN 978-0072193985; McGraw-Hill Co.; Dec 2001; paperback; 544 ppg

**Optical Networking & WDM**; Walter J. Goralski; ISBN 978-0072130782; McGraw-Hill Co.; Jan 2001; paperback; 556 ppg

**Designers Guide to Fiber Optics**; AMP Corp., Harrisburg, PA 17105; ASIN B000IU64O; 1982; paperback; 209 ppg

**National Electrical Code®, 2020**; National Fire Protection Assn., Nov., 2019; www.nfpa.org

**National Electrical Safety Code®, 2017**; IEEE Standards Assn.; www.ieee.org


Review other related applicable TIA standards, IEEE 802.3 standards, along with ITU and IEC standards for additional detailed information. Also review many commercial/multi-user agreement Optical Data Links which are not yet standards.

https://www.fiber-story.com/;

Also contact ETA at www.etai.org or 1-800-288-3824 for more information, numerous links, locations for training sites, additional white papers, articles and the latest fiber updates.

**ETA certification programs are accredited through ICAC, complying with the ISO/IEC 17024 standard.**

ICAC International Certification Accreditation Council

 

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