Certified Fiber Optics Designer (FOD)
Competency Requirements

Fiber Optics Designers (**FOD**) are expected to obtain knowledge of basic concepts of fiber optics design and installation which are applicable to all the functions required to safely and competently plan and install fiber optical communications cabling in a LAN/WAN environment. This **FOD** certification covers all aspects of a successful fiber optic system design from network protocols, network configurations, optical cabling, industry communications standards, determination of fiber count, hardware selection, splicing/termination methods, and cable system testing and documentation. All that is learned in class is put into practice through multiple and intensive case studies. Prior knowledge, skill, experience with and aspects of optical fiber Installation found in the ETA Fiber Optics Installer (FOI) and/or one of the Fiber Optics Technician (FOT) certifications is highly suggested, but not required.
Once an **FOD** has acquired these skills, abilities and knowledge through a special course, fee and hands-on skills exam from an ETA approved school are the required pre-requisites before sitting for the knowledge exam; he or she should be able to enter employment in the telecommunications cabling field with minimal training in areas unique to the special requirements of individual products or systems designs.

Fiber Optics Designers must be knowledgeable and have abilities in the following technical areas:

1.0 THEORY AND PRINCIPLES OF FIBER OPTICS

- 1.1 Outline the basic structure of optical fiber
- 1.2 Describe the terms:
  - 1.2.1 Core
  - 1.2.2 Cladding
  - 1.2.3 Coating
- 1.3 Describe the principles of operation as the light travels down the fiber
- 1.4 Define the term index of refraction
- 1.5 Describe the angles of incidence and refraction
- 1.6 Describe the principle of total internal reflection
- 1.7 Describe numerical aperture
- 1.8 Describe the system parameters that affect the transmission system's operation
- 1.9 Discuss the properties of electromagnetic signals
- 1.10 Distinguish between the transmitter power and receiver sensitivity ranges
- 1.11 Examine the two key characteristics attenuation and dispersion
- 1.12 Define attenuation
- 1.13 Describe intrinsic attenuation factors controlled by manufacturer
- 1.14 Describe extrinsic factors controlled by fiber optics cable installer
- 1.15 Relate the term microbend loss to extrinsic attenuation
- 1.16 Relate the term macrobend loss to extrinsic attenuation
- 1.17 Discuss the term dispersion and the affect it has on the pulse as it travels down the fiber
- 1.18 Define and describe the three main types of dispersion to include:
  - 1.18.1 Modal dispersion
  - 1.18.2 Chromatic dispersion
    - 1.18.2.1 Material dispersion
    - 1.18.2.2 Waveguide dispersion
  - 1.18.3 Polarization mode dispersion
- 1.19 Define the term bandwidth

2.0 OPTICAL SOURCES

- 2.1 Recall the typical operational wavelengths for communication systems
- 2.2 Compare the output pattern (sometimes referred to as spot size) of the LED and laser light sources
- 2.3 Distinguish the main difference between an LED and a laser regarding emission
- 2.4 Describe the attributes of the laser and how they differ from the LED
- 2.5 Name and describe the different types of LED sources
- 2.6 Name and describe the different types of Laser sources
- 2.7 Define the term 'chirp' that occurs in directly-modulated lasers
- 2.8 Describe the different modulation techniques used with optical sources to include:
  - 2.8.1 Direct modulation
  - 2.8.2 Integrated modulation
  - 2.8.3 External modulation

3.0 FIBER TYPES

3.1 Outline the types and basic construction of optical fiber
3.2 Associate the differences between multimode and single-mode core and cladding diameters
3.3 List the common classifications for optical fibers
3.4 Describe the four different types of optical fiber material makeup to include:
  3.4.1 Multimode step index
  3.4.2 Multimode graded index
  3.4.3 Single-mode step index
  3.4.4 Single-mode segmented core
3.5 Describe the differences between over filled launch (OFL) and restricted mode launch (RML) bandwidth measurement specifications
3.6 Define differential mode delay effects on conventional 50 µm and 62.5 µm optical fibers
3.7 Associate the need for a mode conditioning patch cord on gigabit or higher equipment
3.8 Summarize the fiber types that correspond to the referenced fiber designations OM1, OM2, OM3, OM4 and OM5 in accordance with ISO/IEC (the International Organization for Standardization/International Electrotechnical Commission) requirements
3.9 Point out that the mode field diameter is a measure of the spot size or beam width of light propagation in a single-mode fiber
3.10 Summarize the fiber types that correspond to the referenced fiber designations OS1, and OS2 in accordance with ISO/IEC (the International Organization for Standardization/International Electrotechnical Commission) requirements

4.0 CABLE SELECTION IN NETWORK DESIGN

4.1 Discuss both Insulated Cable Engineers Association (ICEA) and ANSI/TIA-568- specifications for the optical fiber cables recognized in premises cabling standards to include:
  4.1.1 Inside plant cable
  4.1.2 Indoor-outdoor cable
  4.1.3 Outside plant cable
  4.1.4 Drop cable
4.2 Describe the different types of buffers used in fiber optic cables
  4.2.1 Tight buffer
  4.2.2 Loose tube
  4.2.3 Single tube
4.3 Describe the temperature effects on loose tube fiber optic cables
4.4 Explain why ribbon cables are typically used in high-density, high fiber count applications
4.5 Describe the design benefits of single tube fiber optic cables
4.6 Recognize the recommended indoor, indoor/outdoor, and outdoor cable types for an application
4.7 Determine and select the proper optical fiber cable given an installation scenario

5.0 NATIONAL ELECTRICAL CODE®

5.1 Distinguish the various environments inside a building in which a fiber optic cable is installed
5.2 Infer that the National Electrical Code (NEC®) is purely advisory and is made available for a wide variety of both public and private uses in the interest of life and property protection
5.3 Identify the point of entrance, NEC® Article 800.2, as the point within the building at which the wire or cable emerges from an external wall
5.4 Explain that the intermediate metal conduit (IMC) must be connected by a bonding conductor or grounding electrode in accordance with NEC® Article 800.100(B)
5.5 List the NEC® optical fiber cable types including:
  5.5.1 Abandoned optical fiber cable
  5.5.2 Nonconductive optical fiber cable
  5.5.3 Composite optical fiber cable
  5.5.4 Conductive optical fiber cable
5.6 Describe the NEC® listing requirements for:
  5.6.1 Optical fiber cables
  5.6.2 Optical fiber raceways
5.7 Define the maximum distance that an unlisted outside plant communications cable shall be permitted to be installed in a building (NEC® Article 800.48)
5.8 Discuss the grounding considerations for fiber optic cable installation inside a building to include NEC® Article 770.100, NEC® Article 250, and ANSI/TIA-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
5.9 Discuss the NEC® Article 645 requirements for cabling information technology equipment

5.10 Describe the possible cabling scenarios and considerations to take into account when developing a cost comparison model

6.0 FIBER OPTIC TERMINATION

- 6.1 Define fiber optic termination
- 6.2 Summarize the anatomy of a fiber optic connector
- 6.3 Compare advantages and disadvantages of termination versus splicing
- 6.4 Explain where connectors are used
- 6.5 Discuss the performance of a multimode fiber optic link using the following sections of the ANSI/TIA-568- Optical Cabling Components Standard
  - 6.5.1 Section 4.2 cable transmission performance
  - 6.5.2 Section 5.3 optical fiber splice
  - 6.5.3 Annex A (Normative) optical fiber connector performance specifications
- 6.6 Discuss the performance of a single-mode fiber optic link using the following sections of the ANSI/TIA-568- 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
  - 6.6.1 ANSI/TIA-568- Section 4.2 cable transmission performance
  - 6.6.2 ANSI/TIA-758 Section 6.3.4.1.2 attenuation
  - 6.6.3 ANSI/TIA-568- Annex A (Normative) optical fiber connector performance specifications
- 6.7 Define physical contact (PC) and angled physical contact (APC) finish
- 6.8 Explain how PC and APC finishes affect both insertion loss and back reflectance
- 6.9 Recall how to properly perform a connector endface cleaning and visual inspection in accordance with ANSI/TIA-455-57B Preparation and Examination of Optical Fiber Endface for Testing Purposes
- 6.10 Associate how physical contact depends on connector end-face geometry to include the Telcordia GR-326 three key parameters for optimal fiber contact:
  - 6.10.1 Radius of curvature
  - 6.10.2 Apex offset
  - 6.10.3 Fiber undercut and protrusion
- 6.11 Name and describe the different single fiber termination connector styles
- 6.12 Name and describe the different multi-fiber termination connector styles
- 6.13 Describe the field installable connector technologies
- 6.14 Describe the heat cured epoxy technology
- 6.15 Describe quick cure terminations
- 6.16 Describe no epoxy, no polish terminations
- 6.17 Define pigtail splicing
- 6.18 Describe preconnectorized assemblies and cables (“Splice-On”)

7.0 FIBER OPTIC SPLICING

- 7.1 Define a fiber optic splice
- 7.2 Distinguish between a mechanical and fusion splice
- 7.3 Explain where splices are used
- 7.4 List ANSI/TIA-568- inside plant splice performance requirements
- 7.5 Cite ANSI/TIA-758 outside plant splice performance requirements
- 7.6 Explain the intrinsic factors that affect splice performance
- 7.7 Relate the extrinsic factors that affect splice performance
- 7.8 Describe splicing types and methods
- 7.9 Outline mechanical splice technology
- 7.10 Discuss fusion splice technologies to include:
  - 7.10.1 Local injection and detection (LID)
  - 7.10.2 Lens profile alignment system (LPAS)
  - 7.10.3 Profile alignment system (PAS)
  - 7.10.4 Core detection system (CDS)
  - 7.10.5 Fixed V-Groove
- 7.11 Examine the critical steps involved in splicing
  - 7.11.1 Planning
  - 7.11.2 Work area
  - 7.11.3 Preparing the fiber
  - 7.11.4 Splicing
  - 7.11.5 Protection

8.0 HARDWARE

8.1 Discuss the reasons why and where hardware is used
8.2 Compare the differences of hardware designs without cable management and with cable management products
8.3 Define the typical usage areas of rack (frame) mounted patch panel hardware
8.4 Explain how to provide for and install horizontal cable management products
8.5 Explain how to provide for and install vertical cable management products
8.6 Discuss the different styles of hardware adapter (connector) panels
8.7 Define the different types and typical usage areas of wall mountable housing hardware
8.8 Describe work area outlet hardware types
8.8 Define distributed zone architecture
8.9 Describe a fiber zone box (FZB)
8.10 Define other hardware options such as splice closures and splice trays

9.0 CROSS-CONNECT

9.1 Explain that a cross connection is the termination point of a system
9.2 Describe the numerous factors, which will affect how to terminate a cross connection design including:
- 9.2.1 Location
- 9.2.2 Growth
- 9.2.3 Capacity
- 9.2.4 Cable type
- 9.2.5 Fiber count

9.3 Identify the strategy or process used to determine a cross connect fiber termination capacity including:
- 9.3.1 Type of optical connector
- 9.3.2 Number of terminations per connector panel
- 9.3.3 Number of connector panels
- 9.3.4 Patch panel density and size

9.4 Identify the strategy or process used to determine a cross connect splice capacity including:
- 9.4.1 Number of trays a housing can accommodate
- 9.4.2 Number and types of splices a tray can accommodate
- 9.4.3 Number and types of cable a tray may accommodate

9.5 Explain the strategy and factors involved in the process of determining space allocation including:
- 9.5.1 Growth strategy
- 9.5.2 Connectivity scheme (interconnect or cross-connect)
- 9.5.3 Cable routing and jumper management capabilities
- 9.5.4 Hardware dimensions
- 9.5.5 Hardware access requirements

9.6 Explain the strategy and factors involved in the process of determining layout including:
- 9.6.1 Network size
- 9.6.2 Segregation requirements

9.7 Define the basic rules of fiber jumper management

10.0 ANSI/TIA-568 CODE COMPLIANCE

10.1 Identify the major telecommunication standards and governing bodies
10.2 Interpret ANSI/TIA-568.0-D Generic Telecommunications Cabling for Customer Premises to include:
- 10.2.1 Telecommunications cabling system structure
- 10.2.2 Cabling installation requirements
- 10.2.3 Cabling transmission performance and test requirements

10.3 Understand ANSI/TIA-568.1-D Commercial Building Telecommunications Cabling Standard to include:
- 10.3.1 Entrance facilities
- 10.3.2 Equipment rooms
- 10.3.3 Telecommunications rooms and telecommunications enclosures
- 10.3.4 Backbone cabling (cabling subsystem 2 and cabling subsystem 3)
- 10.3.5 Horizontal cabling (cabling subsystem 1)
- 10.3.6 Work area
- 10.3.7 Cabling installation requirements

10.4 Interpret ANSI/TIA-568.3-D Optical Fiber Cabling Components Standard including:

- 10.4.1 Optical fiber cable transmission performance and physical requirements
- 10.4.2 Connecting hardware
- 10.4.3 Optical fiber patch cords and optical fiber transitions

10.5 Define structured optical fiber cabling distances
10.6 Describe structured cabling architecture
10.7 Define open office design practices using multi-user telecommunications outlet assemblies (MUTOAs)

11.0 LOGICAL NETWORKS AND INTERNETWORKING

11.1 Define a logical topology
- 11.1.1 Describe logical bus network topology
- 11.1.2 Describe logical ring network topology
- 11.1.3 Describe logical star network topology
- 11.1.4 Describe logical mesh network topology

11.2 Compare and contrast characteristics of internetworking physical media to include:
- 11.2.1 Physical media
- 11.2.2 Logical architectures
- 11.2.3 Communication technologies

11.3 In the network describe the role of a:
- 11.3.1 Repeater
- 11.3.2 Hub
- 11.3.3 Bridge
- 11.3.4 Switch
- 11.3.5 Router

11.4 Identify differences between switched and routed network design considerations

12.0 ETHERNET

12.1 Describe the genesis of Ethernet (IEEE 802.3)
12.2 Explain Carrier Sense Multiple Access/Collision Detection (CSMA/CD) technology
12.3 Describe the various Physical Layer Medium Dependent (PMD) speeds at which a standards-based implementation of Ethernet operates
12.4 Describe the features, functions and components of the 1000 Mbps “Gigabit” Ethernet
12.5 Describe the features, functions and components of the 10 Gigabit Ethernet
12.6 Define “differential mode delay” and the purpose of a Mode Conditioning Patch Cord
12.7 Differentiate between the operating ranges for Ethernet IEEE 802.3 series to include:
- 12.7.1 Physical Medium Dependent (PMD) options
- 12.7.2 Nominal speed
- 12.7.3 Light source and wavelength
- 12.7.4 Overfilled Launch Bandwidth (OFL)
- 12.7.5 Effective Modal Bandwidth (EMB)
- 12.7.6 Maximum supportable distances

13.0 FIBRE CHANNEL

13.1 Explain Fibre Channel technology as a computer communications protocol in accordance with the ANSI/International Committee for Information Technology Standards (INCITS)
13.2 Define the different applications and technologies that Fibre Channel supports
13.3 Describe the different physical cabling topologies of a Fibre Channel network to include:
- 13.3.1 Point-to-Point (FC-P2P)
- 13.3.2 Arbitrated Loop (FC-AL)
- 13.3.3 Switched Fabric (FC-SW)

13.4 Describe the various Physical Interfaces (PI) speeds at which a standards-based implementation of Fibre Channel operates
13.5 Differentiate between the operating ranges for ANSI/INCITS Fibre Channel series to include:
- 13.5.1 Fibre Channel Physical Interface (FC-PI) options
- 13.5.2 Nominal speed
- 13.5.3 Light source and wavelength
- 13.5.4 Overfilled Launch Bandwidth (OFL)
- 13.5.5 Effective Modal Bandwidth (EMB)
- 13.5.6 Maximum supportable distances

14.0 DATA CENTER – CABLE DESIGNS

14.1 Define a data center
14.2 Recognize the different types of data centers to include:
- 14.2.1 Co-location Hosting Services

- 14.2.2 Managed Hosting Services
- 14.2.3 Enterprise

14.3 Describe the various functional areas of data centers to include the following:
- 14.3.1 Main Distribution Area (MDA)
- 14.3.2 Server Area
- 14.3.3 Storage Area Network (SAN) Area

14.4 Compare and contrast the functionality and major differences between the data center cabling requirements and considerations

14.5 Recognize ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers provides information on the factors to consider when planning and preparing the installation of a data center or computer room

14.6 Identify ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers telecommunication spaces to include:
- 14.6.1 Entrance Room
- 14.6.2 Main Distribution Area (MDA)
- 14.6.3 Horizontal Distribution Area (HDA)
- 14.6.4 Zone Distribution Area (ZDA)
- 14.6.5 Equipment Distribution Area (EDA)

14.7 Identify ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers telecommunication cabling to include:
- 14.7.1 Horizontal cabling
- 14.7.2 Backbone cabling
- 14.7.3 Centralized cabling

14.8 Explain the difference between Structured versus Un-structured cabling solutions

14.9 Outline the zone distribution data center layout utilizing a Zone Distribution Area (ZDA) with star topology to include the following:
- 14.9.1 In-cabinet Zone Distribution
- 14.9.2 Sub-floor Zone Distribution
- 14.9.3 Overhead Zone Distribution

14.10 Discuss the importance of maintaining proper system polarity in the data center design so that the optical fibers connected to a transmitter on one end of an optical fiber link connects to a receiver on the other end

15.0 DATA CENTER – CABLING SOLUTIONS

15.1 Define plug and play

15.2 Explain and breakdown the major benefits of designing a plug and play system in the data center

15.3 Compare the alternatives to a standard plug and play design to include:
- 15.3.1 Star topology with Main Distribution Area (MDA)
- 15.3.2 High density truck cables from the Main Distribution Area (MDA) to the Zone Distribution Area (ZDA)

15.4 Describe the ANSI/TIA-942 recommended compliant design (star topology) for the Storage Area Network (SAN)

16.0 VOICE NETWORKS

16.1 Describe the evolution and components of voice networks

16.2 Delineate the transmission process involved in voice communication, both analog and digital

16.3 Describe the different multiplexing techniques used in a voice network

16.4 Define the basic design rules of voice technologies that apply to a voice network design

16.5 Explain Voice over Internet Protocol (VoIP) design considerations

17.0 SECURITY VIDEO

17.1 Differentiate between a distributed backbone and centralized cabling security video networking design

17.2 Describe the distributed backbone security video network design to include:
- 17.2.1 Reduces fiber count
- 17.2.2 Increases electronics
- 17.2.3 Works well with large networks
- 17.2.4 Placement of video multiplexers will affect fiber allocation

17.3 Describe the centralized cabling security video network design to include:
- 17.3.1 Increases fiber count
- 17.3.2 Decreases electronics
- 17.3.3 Works well with small networks

18.0 FIBER TYPES AND COUNTS

18.1 Describe how to design the cabling infrastructure in accordance with ANSI/TIA-568- to include:
- 18.1.1 Location of the main cross-connect (MC), intermediate cross-connects (IC) and horizontal cross-connects (HC)
- 18.1.2 Determine cable routes
- 18.1.3 Determine the fiber distances, including helical lay

18.2 Describe how to choose the cable routes and physical topology when designing the cabling infrastructure to include the following:
- 18.2.1 Ring
- 18.2.2 Star
- 18.2.3 Special configurations

18.3 Describe how to determine fiber types and fiber counts when designing the cabling infrastructure

18.4 Outline the considerations for Gigabit Ethernet (GigE) and 10 Gigabit Ethernet (10 GigE) to include the following:
- 18.4.1 Length restrictions for Gigabit Ethernet and 10 Gigabit Ethernet
- 18.4.2 Redundancy requirements
- 18.4.3 Trunking requirements

19.0 TESTING AND MEASUREMENTS

19.1 Describe the reasons for testing

19.2 Identify the optical testing procedures to include:
- 19.2.1 Connector and splice loss testing
- 19.2.2 Attenuation testing
- 19.2.3 Optical Time Domain Reflectometer (OTDR) testing

19.3 Outline the ANSI/TIA-568- and Telcordia testing standards component requirements to include:
- 19.3.1 Connector pair loss
- 19.3.2 Splice loss
- 19.3.3 Connector reflectance
- 19.3.4 Optical fiber attenuation

19.4 Describe the purpose and procedures of end-to-end attenuation testing

19.5 Explain the purpose of five small-radius nonoverlapping loops around a mandrel may be required on the transmit jumper when measuring multimode link attenuation in accordance with ANSI/TIA-526-14-A during reference and system test

19.6 Determine proper ANSI/TIA-568- (1, 2, or 3 jumper) reference based on the optical fiber link architecture

19.7 Explain the required Tier 1 Testing tasks and equipment

19.8 Explain the required Tier 2 Testing tasks and equipment

19.9 Explain why the encircled flux requirement was developed for multimode link attenuation measurements

19.10 Describe the purpose of Optical Time Domain Reflectometer (OTDR) testing

19.11 Describe the purpose of chromatic dispersion testing

19.12 Describe “polarization mode dispersion” testing

19.13 Breakdown a Link Loss Budget Calculation to include:
- 19.13.1 Determine fiber loss at operating wavelength
- 19.13.2 Determine connection loss
- 19.13.3 Determine splice loss
- 19.13.4 Determine total system budget loss

End of Fiber Optics Designer Competencies Listings:
(with 19 major knowledge categories)

Find an ETA-Approved Training Organizations and approved test sites: http://www.eta-i.org/test_sites.html

Suggested optional/additional Study Materials and Resources for ETA Fiber Optics Designer Certification:

Fiber Optics Installer (FOI) Certification Exam Guide, Bill Woodward; ISBN 978-1119011507; Sybex, Inc.; November 2014; softcover; 560 ppg**.** Available through ETA 800-288-3824, www.eta-i.org

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; softcover; 1284 ppg**.** Available through ETA 800-288-3824, www.eta-i.org

Four Years of Broadband Growth; The White House; June 2013; 28 ppg; http://www.whitehouse.gov/sites/default/files/broadband_report_final.pdf

2018 Broadband Deployment Report; Federal Communications Commission; Feb.2,2018; 89 ppg; https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2018-broadband-deployment-report

Troubleshooting Optical Fiber Networks: Understanding and Using Optical Time-Domain Reflectometers, 2E; Duwayne Anderson, Larry Johnson, Florian Bell; ISBN 978- 0387098470; 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

FNT Fiber Optic Installer, Rev.2; Jeffrey Dominique, FOT; 2005; FNT Publ.; $45, Available: www.f-n-t.com; (formerly Fiber Optic Theory & Applications; the FNT Fiber Optic Installer,Rev.3 will be available 2016);

How We Do & Should Not, Should & May Not, Clean & Inspect a Fiber Optic Connection; Edward J. Forrest, Jr; ISBN: 978-1517210113; RMS; Sept 2015; softcover; 92 ppg; —Available through Ed's website: **www.fiberopticprecisioncleaning.com** or use code FVCFR80DX for a 20% discount on all **www.createspace.com** orders; **Video Postings: https://www.youtube.com/channel/UC1a552-2i620UP6mM9WhwRg**

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.eta-i.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.eta-i.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

Fiber Optic Communications; James N. Downing; ISBN 978-1401866358; Delmar Cengage Learning; September 2004; softcover; 378 ppg; Available through ETA 800-288-3824, www.eta-i.org

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

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

National Electrical Code, 2020; National Fire Protection Assn., Sept.,2019; www.nfpa.org

Also contact ETA at www.eta-i,org or 1-800-288-3824 for more information, numerous links, locations for training sites, additional white papers, articles and the latest Fiber updates. Additionally, please review internet search engines for other inquiries and your local Authority Having Jurisdiction (AHJ) materials and guidelines.

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