



Electronics Technicians Association, International COMPETENCY REQUIREMENTS

FIBER OPTICS INSTALLER 2010

1.0 HISTORY OF FIBER OPTIC CABLING

- 1.1 Trace the evolution of light in communication
- 1.2 Summarize the evolution of optical fiber manufacturing technology
- 1.3 Track the evolution of optical fiber integration and application

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 fiber optic transmitter
- 2.3 Describe the basic operation of a fiber optic receiver
- 2.4 Demonstrate how to express gain or loss using dB
- 2.5 Demonstrate how to express optical power in dBm

3.0 BASIC PRINCIPLES OF LIGHT

- 3.1.1 Describe the following:
 - 3.1.1. Light as electromagnetic energy
 - 3.1.2 Light as particles and waves
 - 3.1.3 The electromagnetic spectrum and locate light frequencies within the spectrum in relation to radio and microwave communication frequencies
 - 3.1.4 The refraction of light (Snell's Law)
 - 3.1.5 Describe total internal reflection
- 3.2 Explain the following:
 - 3.2.1 How the index of refraction is used to express the speed of light through a transparent medium
 - 3.2.2 Reflection, to include angle of incidence, critical angle, and angle of refraction
 - 3.2.3 Fresnel reflections and how they can impact the performance of a fiber optic communication system

4.0 OPTICAL FIBER CONSTRUCTION AND THEORY

- 4.1 Describe the following:
 - 4.1.1 The basic parts of an optical fiber
 - 4.1.2 The different materials that can be used to construct an optical fiber
 - 4.1.3 Optical fiber manufacturing techniques
 - 4.1.4 The tensile strength of an optical fiber
 - 4.1.5 A mode in an optical fiber
 - 4.1.6 The three refractive index profiles commonly found in optical fiber

- 4.2 Explain the propagation of light through:
 - 4.2.1 Multimode step index optical fiber
 - 4.2.2 Multimode graded index optical fiber
 - 4.2.3 Legacy 62.5/125 multimode optical fiber
 - 4.2.4 Laser optimized 50/125 multimode optical fiber
 - 4.2.5 Single-mode optical fiber
- 4.3 Describe the TIA/EIA-568-C.3 recognized:
 - 4.3.1 Multimode optical fibers
 - 4.3.2 Single-mode optical fibers
- 4.4 Describe the ITU-T-G.652 recognized single-mode optical fibers
- 4.5 Define the ITU-T-G.655 recognized single-mode optical fibers
- 4.6 Cite commercially available:
 - 4.6.1 PCS and HCS optical fiber
 - 4.6.2 Plastic optical fiber

5.0 OPTICAL FIBER CHARACTERISTICS

- 5.1 Explain dispersion in an optical fiber
 - 5.1.1 Define modal dispersion and its effects on the bandwidth of an optical fiber
 - 5.1.2 Describe material dispersion and its effects on the bandwidth of an optical fiber
- 5.2 Outline the causes of attenuation in an optical fiber
 - 5.2.1 Compare attenuation versus wavelength in a multimode optical fiber
 - 5.2.2 Compare attenuation versus wavelength in a single-mode optical fiber
- 5.3 Explain the numerical aperture of an optical fiber
- 5.4 Relate how the number of modes in an optical fiber is defined by core diameter and wavelength
- 5.5 Describe microbends in an optical fiber
- 5.6 Explain macrobends in an optical fiber

6.0 FIBER OPTIC CABLING SAFETY

- 6.1 Explain how to safely handle and dispose of fiber optic cable, optical fiber chips, and debris
- 6.2 List the safety classifications of fiber optic light sources
- 6.3 Discuss the potential chemical hazards in the fiber optic environment and the purpose of the material safety data sheet (MSDS)
- 6.4 Cite potential electrical hazards in the fiber optic installation environment
- 6.5 Outline typical workplace hazards in the fiber optic environment

7.0 FIBER OPTIC CABLES

- 7.1 Draw a cross section of a fiber optic cable and explain the purposes of each segment
- 7.2 Identify why and where loose tube fiber optic cable is used

- 7.3 Describe tight buffer fiber optic cable
- 7.4 Relate common strength members found in fiber optic cables
- 7.5 Name common jacket materials found in fiber optic cables
- 7.6 Describe simplex and duplex cordage and explain the difference between cordage and cable
- 7.7 Describe:
 - 7.7.1 Distribution cable
 - 7.7.2 Breakout cable
 - 7.7.3 Armored cable
 - 7.7.4 Messenger cable
 - 7.7.5 Ribbon cable
 - 7.7.6 Submarine cable
 - 7.7.7 Hybrid cable
 - 7.7.8 Composite cable
- 7.8 Discuss fiber optic cable duty specifications
- 7.9 Review how and when a fan-out kit is used
- 7.10 Identify how and when a breakout kit is used
- 7.11 List the National Electrical Code (NEC) optical fiber cable types
- 7.12 Describe the NEC listing requirements for:
 - 7.12.1 Optical fiber cables
 - 7.12.2 Optical fiber raceways
- 7.13 Outline the TIA/EIA-598-C color code and cable markings
- 7.14 List the TIA/EIA-568-C.3 bend radius specifications for inside and outside plant fiber optic cables
- 7.15 Cite the ITU-T G.657 and the Telcordia GR-20 bend radius specification for outside plant fiber optic cables

8.0 SPLICING

- 8.1 Explain the intrinsic factors that affect splice performance
- 8.2 Relate the extrinsic factors that affect splice performance
- 8.3 Recall the basic parts of a mechanical splicer
- 8.4 Discuss how to perform a mechanical splice
- 8.5 Specify the operation of a fusion splicer
- 8.6 Indicate how to perform a fusion splice
- 8.7 List TIA/EIA-568-C.3 inside plant splice performance requirements
- 8.8 Cite TIA/EIA-758 outside plant splice performance requirements

9.0 CONNECTORS

- 9.1 Indicate the basic parts of a fiber optic connector
- 9.2 Discuss these connectors:
 - 9.2.1 Flat finish connectors
 - 9.2.2 PC finish connectors
 - 9.2.3 APC finish connectors
- 9.3 Distinguish between:
 - 9.3.1 TIA/EIA-568-C.3 recognized connectors
 - 9.3.2 Small form factor (SFF) connectors

- 9.3.3 Multi-fiber connectors
- 9.3.4 An optical fiber pigtail
- 9.4 Review common connector ferrule materials
- 9.5 Specify the intrinsic factors that affect connector performance
- 9.6 Explain the extrinsic factors that affect connector performance
- 9.7 Describe return reflections in an interconnection
- 9.8 Identify the steps involved in an anaerobic epoxy connector termination and polish
- 9.9 Cite the steps involved in a UV epoxy connector termination and polish
- 9.10 List the steps involved in an oven cured epoxy connector termination and polish
- 9.11 Relate the steps involved in a pre-load epoxy connector termination and polish
- 9.12 Describe how to construct a no-polish, no-epoxy connector termination
- 9.13 Explain how to properly clean a connector
- 9.14 Relate how to examine the endface of a connector per TIA/EIA-455-57B
- 9.15 List the TIA/EIA-568-C.3 connector performance requirements

10.0 FIBER OPTIC LIGHT SOURCES

- 10.1 Explain why an LED is best used for multimode fiber applications
- 10.2 Identify why a VCSEL light source is used with multimode optical fiber as opposed to an LED for gigabit or higher transmission rates
- 10.3 Specify the benefit of using a laser light source in fiber optic communication systems
- 10.4 Identify which fiber type is best used for communications systems with VCSEL light sources
- 10.5 Explain the differences between an overfilled launch condition and a restricted mode launch

11.0 FIBER OPTIC DETECTORS AND RECEIVERS

- 11.1 Summarize the basic operation of a photodiode
- 11.2 Explain why an optical attenuator is occasionally used in a communication system

12.0 CABLE INSTALLATION AND HARDWARE

- 12.1 Cite manufacturer installation cable specifications
- 12.2 Explain the static and dynamic loading on a fiber optic cable during installation
- 12.3 List commonly used installation hardware
- 12.4 Describe these types of installation:
 - 12.4.1 Tray and duct installation
 - 12.4.2 Conduit installation
 - 12.4.3 Direct burial installation

- 12.4.4 Aerial installation
- 12.4.5 Blown fiber installation
- 12.4.6 Wall outlet installation
- 12.5 Explain cable grounding and bonding per NEC Article 250
- 12.6 Summarize these types of preparation:
 - 12.6.1 Patch panel
 - 12.6.2 Racks and cable
 - 12.6.3 Splice enclosure
- 12.7 Describe the process of labeling a cable in accordance with TIA/EIA- 606A

13.0 FIBER OPTIC SYSTEM DESIGN CONSIDERATIONS

- 13.1 Compare the following advantages of optical fiber over twisted pair and coaxial cables:
 - 13.1.1 Weigh the bandwidth advantages of optical fiber over twisted pair and coaxial copper cables
 - 13.1.2 Relate the attenuation advantages of optical fiber over twisted pair and coaxial copper cables
 - 13.1.3 Explain the electromagnetic immunity advantages of fiber optic cable over copper cable
 - 13.1.4 Compare the weight saving advantages of fiber optic cable over copper cable
 - 13.1.5 Describe the size advantages of fiber optic cable over copper cable
 - 13.1.6 Identify the security advantages of fiber optic cable over copper cable
 - 13.1.7 Define the safety advantages of fiber optic cables over copper cables

14.0 TEST EQUIPMENT & LINK/CABLE TESTING

- 14.1 Describe the types of fiber optic test equipment that can be used to test for continuity
- 14.2 Explain the limitations of a visual laser when troubleshooting a fiber span
- 14.3 Describe the basic operation of a single-mode and multimode light source and optical power meter
- 14.4 Review the difference between a test jumper and a patch cord
- 14.5 Define the purpose of a mode filter
- 14.6 Describe how to measure the optical loss in a patch cord with a light source and optical power meter
- 14.7 Summarize the basic operation of an optical time domain reflectometer (OTDR)

Suggested Study Materials For ETA Fiber Optics Installer Certification:

Cabling: The Complete Guide to Copper and Fiber-Optic Networking; 4th Ed; Andrew Oliviero, Bill Woodward; Sybex; ISBN 978-0470477076; July 2009; paperback; 1144 ppg.
Troubleshooting Optical Fiber Networks; 2nd Ed; Duwayne Anderson, Larry Johnson, Florian Bell; Elsevier Academic Press; ISBN 0-12-058661-4; 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; 4th Ed; Donald J. Sterling; Delmar Learning; ISBN 1-4018-1270-8; Dec 2003; hardcover; 384 ppg; 800-288-3824 (ETA-I)
National Electrical Code; National Fire Protection Assn., 2008; www.nfpa.org (NEC 2011, release date Nov 2010)
Fiber Optic Installer's Field Manual; Bob Chomycz; McGraw-Hill; ISBN 0-07-135604-5; Jun 2000; softcover; 368 ppg; 800-288-3824 (ETA-I)
Understanding Fiber Optics; 5th Ed; Jeff Hecht; Prentice-Hall; ; ISBN: 0-13-117429-0; Apr 2005; hardcover; 800 ppg
Introduction to Fiber Optics; 3rd Ed; John Crisp; Newnes; ISBN 0-7506-6756-7; Dec 2005; paperback; 245 ppg
Data, Voice, and Video Cabling; 3rd Ed.; Jim Hayes and Paul Rosenburg; Delmar Learning; ISBN 1-4283-3472-6; July 2008; paperback; 352 ppg; 800-288-3824 (ETA-I)
Fiber Optic Theory & Applications; Jeffrey Dominique; 1993; FNT Publishing; paperback
Fiber Optics Technician's Manual; 4th Ed. Ed; Jim Hayes; Delmar Learning; ISBN 978-1435499652; March 2010; paperback; 288 ppg; 800-288-3824 (ETA-I)
Designers Guide to Fiber Optics; AMP Corp., Harrisburg, PA 17105; ASIN B000IU64O; 1982; paperback; 209 ppg

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