Electronics Technicians Association, International
COMPETENCY REQUIREMENTS

FIBER OPTICS INSTALLER
2009

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 ANSI/TIA-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 ANSI/TIA-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 ANSI/TIA-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 ANSI/TIA-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 ANSI/TIA-455-57B
9.15 List the ANSI/TIA-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:

Fiber Optics Installer and Technician Guide; 1st Ed; Bill Woodward, Emile Husson; Sybex; ISBN 0-7821-4390-3; May 2005; hardcover; 457 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)
Cabling - The Complete Guide to Network Wiring; 3rd Ed; David Barnett, David Groth and Jim McBee; Sybex; ISBN 0-7821-4331-8; July 2004; 720 ppg; 800-288-3824 (ETA-I)
National Electrical Code; National Fire Protection Assn., 2008; www.nfpa.org
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; 3rd Ed; Jim Hayes; Delmar Learning; ISBN 1-4018-9699-5; 2006; paperback; 268 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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