Competency Requirements - 2005 - ETA International
Certified Fiber Optics Installer - CFOI - 2005

Fiber optics installers are expected to obtain knowledge of basic concepts of fiber optics installation and service that are applicable to all the functions required to safely and competently install fiber optics communications cabling. Once a CFOI has acquired these skills, abilities and knowledge, 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, the Fiber Optics Installer should become a profitable and efficient part of the workforce.

1.0 HISTORY OF FIBER OPTIC CABLING

1.1 List a chronology of events leading to today's fiber optics technology

2.0 PRINCIPLES OF FIBER OPTIC TRANSMISSION

2.1 Describe the four 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 Explain the purpose of decibels (dB's) and convert power levels to and from decibel equivalents
2.5 Explain how optical power is measured (dBm), express optical power levels in dBm

3.0 FIBER OPTIC CABLING SAFETY

3.1 Explain the health risks when working with LED and laser light sources
3.2 List all of the safety procedures pertaining to fiber optic cable handling and disposal
3.3 Describe hazards pertaining to chemicals as defined by the manufacturer's material safety data sheet (MSDS)
3.4 List different types of environmental work place hazards cable workers may face (ladders, high voltage, confined spaces, underground)

4.0 BASIC PRINCIPLES OF LIGHT

4.1 Describe the electromagnetic spectrum and locate light frequencies within the spectrum in relation to other communications frequencies
4.2 Describe how the index of refraction is used
4.3 Define Fresnel reflection loss
4.4 Explain the effects of refraction and Snell's Law

5.0 OPTICAL FIBER CONSTRUCTION AND THEORY

5.1 Name the two common materials out of which the optical fiber is manufactured
5.2 List common classifications for fiber optics cable
5.3 Describe the purpose of the optical fiber coating
5.4 Describe refractive index profiles and their purpose
5.5 Define mode

6.0 OPTICAL FIBER CHARACTERISTICS

6.1 Explain modal dispersion and its importance to fiber optics
6.2 Define material dispersion
6.3 Demonstrate the effects of excessive bending on an optical fiber
6.4 Explain how the cone of acceptance defines the maximum angle of light acceptance in an optical fiber

7.0 ADVANTAGES OF FIBER OVER COPPER

7.1 Compare twisted pair bandwidth performance with multi mode and single-mode optical fiber
7.2 Describe attenuation in copper and optical fiber
7.3 Explain why electromagnetic immunity is superior in optical fiber
7.4 Describe the weight saving advantages of fiber optic cable over copper cable
7.5 Describe the size advantage of fiber optic cable over copper cable.
7.6 Compare the safety advantages of fiber optic cables over copper cables.
7.7 Compare the security advantages of optical fiber over copper

8.0 OPTICAL CABLES

8.1 Draw a cross section of a fiber optic cable and explain the purposes of each segment
8.2 Explain why and where loose tube fiber optic cable is used
8.3 Describe tight buffered fiber optic cable
8.4 Identify the strength member in a fiber optic cable
8.5 Specify the cable jacket material used in common types of fiber optic cables
8.6 Explain the difference between Installation specifications and environmental specifications
8.7 Explain the differences between cordage and cable
8.8 List applications where cordage is preferred
8.9 Explain why and where distribution fiber optic cable is used.
8.10 Explain why and where breakout fiber optic cable is used
8.11 Explain why and where armored fiber optic cable is used
8.12 Explain what a messenger cable is and how it is used
8.13 Describe ribbon fiber optic cable
8.14 Explain what hybrid/composite cables are and where they are ordinarily used
8.15 Explain how the TIA/EIA 598-B color code is used to identify individual fiber optic cables
8.16 Describe cable markings and how they are used
8.17 Define tensile strength of a fiber optic cable and explain the reasons an installer would need to know the strength of various cables

9.0 LIGHT SOURCES

9.1 Explain the safety classifications and types of light sources used in fiber optic communications
9.2 Explain the differences between light emitting diodes and laser diodes
9.3 List the common wavelengths used in fiber optic communications and the advantages and disadvantages of each

10.0 DETECTORS

10.1 Describe the basic operation of a photodiode

11.0 CONNECTORS

11.1 Identify TIA/EIA 568-B.3 standard connector types
11.2 Describe ferrule materials used with fiber optics connectors
11.3 Explain intrinsic factors applicable to optical fiber performance
11.4 Explain extrinsic factors applicable to fiber optic connector performance.
11.5 Define physical contact (PC) finish and how it is used to reduce back reflection.
11.6 Define angled physical contact (APC) finish and how it is used to reduce back reflection
11.7 Describe how and where pigtails are used in fiber optic cabling
11.8 Describe the benefits and applications of anaerobic epoxy in fiber optic connector termination
11.9 Describe the benefits and applications of UV epoxy in fiber optic connector termination
11.10 Describe the benefits and applications of oven-cured epoxy in fiber optic connector termination
11.11 Describe the benefits and applications of epoxy-less fiber optic connector termination
11.12 List steps taken in properly performing a visual Inspection of fiber optic connectors.
11.13 List ways to properly clean and care for fiber optic connectors

12.0 PASSIVE COMPONENTS

12.1 Explain the basic operation of optical couplers
12.2 Describe where a T coupler is used
12.3 Describe where a star coupler is used

13.0 TYPES OF SPLICING

13.1 Mechanical Splicing:

13.1.1 Explain the differences between intrinsic factors and extrinsic factors when splicing fiber optic cables
13.1.2 Describe the use of index matching gel in fiber optic splicing
13.1.3 Describe a cable tray and splice closure and explain the usage of each

13.2 Fusion Splicing:

13.2.1 Describe the performance advantages of a fusion splice over a mechanical splice.

13.2.2 Describe the basic operation of a fusion splice machine

13.2.3 Describe the basic application of a protective sleeve in a fusion splice

14.0 CABLE INSTALLATION AND HARDWARE

14.1 Explain dynamic tensile loading and why it allows for higher loading

14.2 Explain static tensile loading

14.3 Explain dynamic bend radius and the TIA/EIA 568-B.3 guidelines

14.4 Explain static bend radius and the TIA/EIA 568-B.3 guidelines

14.5 Describe the use of pulling tape

14.6 Describe the use of a pulling grip

14.7 Describe plenum and plenum rated fiber optic cable as defined by the National Electric Code (NEC) Article 770

14.8 Describe riser and riser rated fiber optic cable as defined by the NEC

14.9 Describe general purpose and general purpose rated fiber optic cable as defined by the NEC

14.10 Describe conductive fiber optic cable as defined by the NEC

14.11 Describe non-conductive fiber optic cable as defined by the NEC

14.12 Describe composite cable as defined by the NEC

14.13 Explain where conduit should be installed to enclose fiber optic cables

14.14 Describe the requirements for tray and duct installation of fiber optic cabling

15.0 FIBER OPTIC LINK

15.1 List the considerations for basic fiber optics system design

15.2 Prepare a basic optical link power budget and explain its importance

16.0 OPTICAL FIBER TEST EQUIPMENT

16.1 Describe the basic theory and operation of a fiber optic light source

16.2 Describe the basic theory and operation of a fiber optic power meter

16.3 Describe the basic theory and operation of an optical time domain reflectometer (OTDR)

16.4 Describe the basic theory and operation of a visual fault locator

16.5 Describe the basic theory and operation of a fiber identifier

17.0 OPTICAL FIBER MEASUREMENT AND TESTING

17.1 Describe how to measure the loss in a fiber optic cable using a light source and power meter as defined by TIA/EIA 526-14A

17.2 Describe how to use an OTDR to measure loss per unit length, evaluate connectors and splices and locate faults.

17.3 Describe how to use a fiber identifier to locate a fault.

17.4 Describe how to use a visual fault locator to locate breaks in the optical fiber.

17.5 Describe OTDR signatures

17.6 Explain why the index of refraction is important for accurate testing

17.7 Describe the requirements for documenting link performance during acceptance testing

Suggested Study Materials:

Technicians Guide to Fiber Optics; 3rd Ed; Donald Sterling, Jr; Delmar Publishing; hardback 346pp; ISBN 0-7668-0171-3; 800-288-3824 (ETA-I); $60
Fiber Optics Technician's Manual - Jim Hayes;1996; ISBN: 0-7668-1825-x; Delmar Publications; paperback; 800-288-3824 (ETA-I); $40
Cabling - The Complete Guide to Network Wiring; David Groth and Jim McBee; 2000; Sybex; ISBN 0-7821-2645-6; 820+ ppg; 800-288-3824 (ETA-I)
National Electric Code; National Fire Protection Assn., 1998
Fiber Optic Installer's Field Manual, Bob Chomycz; ISBN 0-07-135604-5; McGraw-Hill; 2000; 300+ pages; 800 288 3824 (ETA-I)
Designers Guide to Fiber Optics; AMP Corp., Harrisburg, PA 17105; 1982
Understanding Fiber Optics - Jeff Hecht, 3rd Ed; Prentice-Hall; June '99; 620 ppg; ISBN: 0-13-956145-5
Introduction to Fiber Optics - 2nd Ed; John Crisp; ISBN 0-7506-5030-3; Butterworth-Heinemann. www.newnespress.com;$35.00
Data, Voice, and Video Cabling- 2nd Ed.; Jim Hayes and Paul Rosenburg; ISBN: 1-4018-2761-6; 800-288-3824 (ETA-I); $35

Examination Committee Members, 2004: Bill Woodward, CFOI, Chairman, Virginia Beach, VA

Agard, Richard, FOI, Phila, PA, ragard@aol.com
Alicto, Al, FOI, Barrigada, Guam, coradi@netpci.com
Anders, Jon, FOI/FOT, Williamsburg, VA, joneanders@cox.net
Arndt, David, FOI, Casper, WY, darndt@caspercollege.edu
Banks, Sherman, Decatur, AL, smb@calhoun.edu
Beam, James, Goodfellow AFB, TX, james.beam@goodfellow.af.mil
BenHamida, Seddik, FOI, Arlington, VA, ben_hamida@hotmail.com
Berg, Hans, FO, Virginia Beach, VA, hansb@kitcofo.com
Black, Scarlet, FO, Houston, TX, rov@irov.com
Blevins, Jerry, Sheppard AFB, TX, jerry.blevins@sheppard.af.mil
Boden, David, Conroe, TX, boden@nhmccde.edu
Bowers, Richard, Cleveland, OH, rickcatcwa@hotmail.com
Brittain, Michael, Houston, TX, michael@cricketfiber.com
Casbeer, Jr, Chuck, FOI, Virginia Beach, VA, ccasbeer@ecpi.edu
Casey, Bryan, FOI, Richmond, VA, bcasey@ecpi.edu
Cook, Ronald G., Instr, Sheppard AFB, TX, ronald.cook@sheppard.af.mil
Corey, Anthony, Norfolk, VA, anthony.corey@navy.mil
Dudley, Melody, Albuquerque, NM, melodyd@itc4u.com
Flynn, Dennis, FOI, Alexandria, VA, dennis293@netscape.net
Fraley, Ralph, Latham, NY, rfraley@computeredservices.com
Freidman, Dan, Ph.D, Columbia, MD, dfriedman@howardcc.edu
Fulton, Bill, FOI, Kent, WA, bill@lightbrigade.com
Gagne, Mike, FOI, Woods Hole, MA, mgagne@whoi.edu
Gosnay, Greg, FOI/FO, Hamlin, WV, ggosnay@access.k12.wv.us
Gremler, William, Broken Arrow, OK, gremler@cox.net
Harris, Rickie, Annandale, VA, riharris@nvcc.edu
Herinckx, Sandra L, FOI, Waco, TX, sandra.herinckx@tstc.edu
Janca, Tom, CETsr, FOI, Greenwood Village, CO, trjanca@lucent.com

Johnson, Larry, FO, Kent, WA, larry@lightbrigade.com
Keys, Robert, Adrian, PA, rkeys@teksystems.com
Klein, Nancy, Bethpage, NY, nklein@bcl.edu
Kovacs, Michael, Bloomfield, CT, mike@kovacsengineering.com
Limtiaco, John, FOI, Barrigada, Guam, jlimtiaco@guamcc.net
Little, William L., FOI, Slidell, LA, wlittle@theltc.net
Lorentson, Alex, Renton, WA, alorentson@rtc.ctc.edu
Marler, Tom, CETsr, Oxnard, CA, tom.marler@gte.net
McCaleb, Madeline, St. Gabriel, LA
McKlosky, John, Kansas City, MO, jmcklosky@btstraining.com
McLaughlin, Barry, FOI, Wellesley Hills, MA, barry@barrymclaughlin.com
Morris, Dan, FO, Virginia Beach, VA, dmorris@kitcofo.com
Norris, Kent, Fiber Camp, Washington, IN, kent@fibercamp.com
Pappaly, Joseph, FOI, Concord, CA, pappaly@earthlink.net
Parady, Edward, CET, Pitcairn, PA, eepar@aol.com
Parker, Jim, FO, Virginia Beach, VA, jparker@kitcofo.com
Rader, Dave, Columbia, MD, drader@howardcc.edu
Rodriques, John, FOI, Sacramento, CA, jrhugger@aol.com
Roehm, Mark, Virginia Beach, VA, mroehm@cox.net
Seddon, Robert, FOI, Richmond, VA, rseddon@ecpi.edu
Sena, Emory, FOI, Tucson, AZ, unclechicky@cox.net
Siverling, Wayne, MSgt, Sheppard AFB, TX, wayne.siverling@sheppard.af.mil
Smith, Joe D, FOI, College Station, TX, joesmith@tamu.edu
Stover, Robert, FOI, Virginia Beach, VA, rstover@vbcps.k12.va.us
Taha, Khalid, FOI, FOT, FOD, CETsr, CSS, Glen Allen, VA, ktaha@ecpi.edu
Villaman, Jose, El Cajon, CA, tony@advancedtraining.edu
Walters, John, FOI, 29 Palms, CA, waltersja@29palms.usmc.mil
Woodward, Bill, FOI, Virginia Beach, VA, wwoodwar@wrsystems.com
Ziller, Tim, Grand Island, NE, tziller@cccneb.edu

Course Length: Training Courses aimed at producing a fully capable Fiber Optics Installer: 24 to 80 contact hours—50% lab

Fiber Optics Installer ETA-I - 2005 11-05-04
Hands-on Competencies – FOI – 2005 – ETA-I

1. Construct a patch cord using anaerobic epoxy that meets or exceeds TIA/EIA 568 B.3 loss requirements for a mated pair. (.75 dB)
2. Construct a patch cord using oven-cured epoxy that meets or exceeds TIA/EIA 568 B.3 loss requirements for a mated pair. (.75 dB)
3. Construct a mechanical splice that meets or exceeds TIA/EIA 758,6.3.4.1.2 attenuation requirement. (.3 dB)
4. Construct a fusion splice. (.1 dB) (TIA/EIA 758 standard)
5. Measure the bi-directional loss in a fiber optic link with a light source and power meter using one of the TIA/EIA 526-14A methods.
6. Measure the bi-directional loss in a mated pair with a light source and power meter.
7. Measure the bi-directional loss in a splice with a light source and power meter.
8. Locate a mechanical interconnection and the end of fiber in an Optical Time Domain Reflectometer (OTDR) trace.
9. Properly evaluate a connector endface as defined by TIA/EIA-455-57B.
10. Identify a fan out kit.
11. Identify a breakout kit
12. Identify armored cable
13. Identify loose tube gel filled cable
14. Identify breakout cable
15. Identify distribution cable
16. Identify single-mode cordage
17. Identify multi-mode cordage
18. Identify ribbon cable
19. Identify an ST connector
20. Identify an SC connector

FOI HANDS-ON NOTES:

1. The Hands-On competencies for FOI require that the instructor verify each procedure. The instructor should not only see that the procedure was performed, but he should also test and verify that it was done correctly. (Items #1 and 2)

2. #6 and #7 require a light source and power meter and the proper filling out of documentation before and after the tests. This test should also include both 850/1300 nm and or 1310/1550 nm.

3. In identifying events with the OTDR, the student must show ability to make the Proper set-up adjustments to the OTDR and also to describe the difference between Acceptance testing, splice loss and stress from a Macro or a Micro bend. The student must set markers correctly and verify distance to the event. Student must verify correct index of refraction setting. Student should be able to show the difference between the trace returns for a fusion splice, mechanical splice or stress due to Macro or Micro bend or a pinch.

End of hands-on notes

Suggested FOI training course syllabus items listed on page two

Hands-On Categories – Topics included in fiber installer training course syllabuses

1. Fiber Optic Source and Fiber Optic Meter Preparation and Calibration
2. Fiber Splicing (TIA 758)
3. Installation – Bend Ratios and Loading
4. Installation Tools, Pulling and Stripping
5. Measurements and Testing
6. Visual Light Continuity Testing
7. Measuring Optical Source Output Levels
8. Utilizing Visual Fault Locators
9. Using Optical Fiber Identifiers
10. Using Infrared Detection Card
11. Using Optical Talk Sets
12. Link, Fiber, Transmitter and Receiver Testing
13. End-to-End Attenuation Testing, Channel or Link
14. Patch Cable Testing
15. Fiber Optics Restoration
16. OTDR Testing
17. Acceptance Testing
18. Troubleshooting and Maintenance Records
19. Troubleshooting and Repairs

Classroom Equipment Requirements - Fiber Optics Installer
Training Courses – ETA – 2005 11-05-04

Classroom:

1. Manuals (10)
2. Workbooks (10)
3. Support and resource materials (Videos, Catalogs, Books)
4. Slide or video presentations
5. Samples

Lab:

1. Combination hotmelt/epoxy oven (1)
2. No-nik 203 (5) strippers
3. Jacket Strippers (5)
4. Carbide Scribe (5)
5. Kevlar Shears (5)
6. Markers (5)
7. Templates for connectors (5)
8. Cleave tool (2) (Fujikura ct-07 and ct-02) (Thomas & Betts)
9. Splice tool (2)
10. 5 micron paper (2 packs)
11. 1 micron paper (2 packs)
12. Alcohol (2 bottles w/pump)
13. Air (2 cans)
14. Connectors
15. Splices
16. Cable
17. Light source/power meter (1 set)
18. Measurement quality jumpers (1 set)
19. Optical time domain reflectometer (1)
20. Fusion Splicer
21. Optical talk set
22. Masking tape (2 rolls)
23. Sharps containers (5)
24. ST Connectors (Epoxy or anaerobic)
25. SC Connectors (Epoxy or anaerobic)
26. ST Crimplok
27. Boxes with splice trays
28. Fiberloks (2/stu)
29. Cam splices (2/stu)
30. Outdoor cable (50'/class)
31. 3M hotmelt kits
32. Buffer tube removal tools
33. 1K reel 250 um single-mode fiber
34. Patch cords FC-FC
35. 6 port Siecor patch panel
36. Multi-mode FO cable - 100' lengths
37. Single-mode FO cable - 50' lengths

Other lab items

a. Long nose pliers
b. Razor knives
c. Pliers (common)
d. Diagonal pliers
e. Miller strippers
f. Punch down tool
g. Screwdrivers
h. Hand-towels (box)
i. Drop cloths (2/class)
j. Wipes (box)
k. Fish tape

The above items are intended to serve a 10 student class

Listing origination courtesy of Kitco, Inc., Virginia Beach, VA