Fiber To Any Antenna - (FTAA)

Competency Requirements

The Fiber To Any Antenna Stand-Alone certification is for individuals trained in the practice of installing fiber optic cabling at wireless and cellular facilities. These disciplines are applicable to all the functions required to safely and competently install pre-terminated fiber optic transmission cable assemblies and connection devices onto equipment and antenna(s), wherever the antenna system is located. Included are how to inspect, clean and test the fiber after installation along with how to identify problems during and after installation.

A special course, fee and hands-on exam from an ETA approved school are the required pre-requisites before sitting for the knowledge exam.

The following knowledge competency identifies the individual subject topics a person is expected to have prior knowledge of or to learn in preparation for the Fiber To Any Antenna (FTAA) certification written examination:

1.0 PRINCIPLES OF FIBER OPTIC TRANSMISSION

- 1.1 Describe the basic parts of a fiber-optic link
- 1.2 Describe the basic operation of a fiber-optic transmitter
- 1.3 Describe the basic operation of a fiber-optic receiver
- 1.4 Explain how to express gain, loss and reflectance using the decibel (dB)
- 1.5 Explain how to express optical power in dBm

2.0 BASIC PRINCIPLES OF LIGHT

- 2.1 Describe light as electromagnetic energy
- 2.2 Describe light as particles and waves
- 2.3 Describe electromagnetic spectrum communication frequencies to include:
  - 2.3.1 Fiber Optic
  - 2.3.2 Radio (RF)
  - 2.3.3 Microwave
- 2.4 Describe the refraction of light
- 2.5 Explain Fresnel reflections and how they can impact the performance of a fiber optic communication system

3.0 OPTICAL FIBER CONSTRUCTION AND THEORY

- 3.1 Describe the basic parts of an optical fiber
- 3.2 Describe the tensile strength of an optical fiber
- 3.3 Describe mode in an optical fiber
- 3.4 Describe the difference between a multimode and a single-mode fiber
- 3.5 Describe the refractive index profiles commonly found in optical fiber
- 3.6 Explain the propagation of light through a multimode step index optical fiber
- 3.7 Explain the propagation of light through a multimode graded index optical fiber
- 3.8 Explain the propagation of light through a single-mode optical fiber
- 3.9 Describe the location and function of an optical trench in an ITU-T base G.657 bend insensitive fiber

4.0 OPTICAL FIBER CHARACTERISTICS

- 4.1 Describe the causes of attenuation in an optical fiber
- 4.2 Describe attenuation versus wavelength in an optical fiber
- 4.3 Describe a microbend in an optical fiber
- 4.4 Describe a macrobend in an optical fiber
- 4.5 Differentiate between a bend sensitive and bend insensitive single-mode optical fiber.
- 4.6 Explain how optical fibers are designated in IEC 11801
- 4.7 Explain how optical fibers are designated in IEC 60793-2-10 and IEC 60793-2-50.
- 4.8 Describe how optical fibers are designated in the current TIA-568- standard.
- 4.9 Describe how the International Telecommunications Union (ITU) designates optical fibers.

5.0 FTAA SAFETY

- 5.1 Describe personal protection equipment (PPE) used in communications
- 5.2 Define the following fiber optic safety parameters to include:
  - 5.2.1 citing the government agency that publishes and enforces regulations on safety in the workplace
  - 5.2.2 explaining how to safely handle and dispose of fiber optic cable and bare optical fiber
  - 5.2.3 listing the laser hazard classifications of fiber optic light sources and describe the dangers associated with each
  - 5.2.4 describing potential chemical hazards in the fiber optic environment and explain the purpose of the material safety data sheet (MSDS)
  - 5.2.5 describing potential electrical hazards in the fiber optic installation environment
  - 5.2.6 describing typical work place hazards in the FTAA environment
- 5.3 Describe Radio Frequency (RF) safety parameters
- 5.4 Describe Antenna safety parameters
- 5.5 Define the following tower and elevated surfaces safety parameters including:
  - 5.5.1 basic building safety protocols per industry standards to include:
    - 5.5.1.1 falling object mitigation
    - 5.5.1.2 fire prevention and suppression
    - 5.5.1.3 Lock Out / Tag Out rules
    - 5.5.1.4 a confined space workplace
  - 5.5.2 climbing safety procedures and equipment

6.0 FIBER OPTIC LIGHT SOURCES, DETECTORS AND RECEIVERS

- 6.1 Describe the basic operation and types of laser light sources used in fiber optic communications
- 6.2 Describe laser performance characteristics
- 6.3 Describe the performance characteristics of a laser transmitter
- 6.4 Describe the basic operation of a photodiode
- 6.5 Describe the basic components in a fiber optic receiver
- 6.6 Explain dynamic range and operating wavelength
- 6.7 Explain why an optical attenuator may be used in a communication system

7.0 FIBER OPTIC AND ANTENNA CABLES

- 7.1 Explain the purpose of each component displayed in a cross section view of a fiber optic cable
- 7.2 Explain why and where loose buffer fiber optic cable is used
- 7.3 Describe the various loose tube fiber optic cable designs to prevent moisture intrusion
- 7.4 Describe tight buffer fiber optic cable
- 7.5 Compare common strength members found in fiber optic cables
- 7.6 Name common jacket materials found in fiber optic cables
- 7.7 Describe simplex and duplex cordage and explain the difference between cordage and cable
- 7.8 Describe the characteristics of the following:
  - 7.8.1 Distribution cable
  - 7.8.2 Breakout cable
  - 7.8.3 Armored cable
  - 7.8.4 Ribbon cable
  - 7.8.5 Hybrid cable
  - 7.8.6 Composite cable
- 7.9 Describe the National Electrical Code (NEC®) indoor fiber-optic cable types
- 7.10 Describe the NEC® listing requirements for fiber-optic cables
- 7.11 Explain the difference between a listed and ‘nonlisted’ fiber-optic cable
- 7.12 List the types of markings typically found on the jacket of a fiber-optic cable
- 7.13 Describe the TIA-598- color-coding scheme for:
  - 7.13.1 premises cable jackets
  - 7.13.2 individual fibers bundled in a fiber-optic cable
- 7.14 Explain how numbering is used to identify the individual fibers bundled in a fiber-optic cable

7.15 Describe how to use sequential markings to determine fiber-optic cable length
7.16 Describe how cabling for power is used in FTAA to include:
  7.16.1 home run cables
  7.16.2 hybrid cabling

8.0 CONNECTORS

8.1 Describe the basic components of a fiber optic connector
8.2 Describe common connector ferrule materials
8.3 Describe the following physical contact endface geometries:
  8.3.1 Spherical (Ultra PC)
  8.3.2 Angled (APC)
8.4 Describe return or back reflections, return loss, and reflectance in an interconnection
8.5 Explain how endface geometry affects return loss and reflectance
8.6 Describe the TIA-568- recognized connectors
8.7 Explain how to use the TIA-568- color code to identify multimode and single-mode connectors and adapters
8.8 Describe small form factor connectors including:
  8.8.1 loopback connectors (SFF LCs) used for top of tower testing
8.9 Explain how to properly clean a connector endface using dry cleaning techniques
8.10 Explain how to properly clean a connector endface using wet-dry cleaning techniques
8.11 Explain how to examine the endface of a connector per TIA-455-57-B and IEC 61300-3-35
8.12 List the ITU-T G.671 maximum insertion loss and reflectance values for single-mode single-fiber mated connector pairs
8.13 Describe connectors used for:
  8.13.1 bulk heads / patch panel
  8.13.2 base band unit (BBU)
  8.13.3 remote radio units (RRU)
  8.13.4 MIMO (multiple in-multiple out) antennas

9.0 CABLE INSTALLATION AND HARDWARE

9.1 Explain manufacturer installation cable specifications and method of procedures (MOP)
9.2 Describe the TIA-568- physical performance specifications for the optical fiber cables recognized in premises cabling standards to include:
  9.2.1 inside plant cable
  9.2.2 indoor-outdoor cable
  9.2.3 outside plant cable
  9.2.4 Drop cable
9.3 Explain static and dynamic loading on a fiber optic cable during installation
9.4 Describe the following types of installations:
  9.4.1 Tray and duct
  9.4.2 Conduit
  9.4.3 Direct burial
  9.4.4 Aerial
  9.4.5 Backbone
  9.4.6 Main Cross Connect
  9.4.7 Telecommunications Room
9.5 Describe the permitted locations defined in NEC® Article 770 for the following cables:
  9.5.1 Plenum
  9.5.2 Riser
  9.5.3 General-purpose
  9.5.4 Unlisted conductive and nonconductive outside plant cables
9.6 Describe the NEC® fiber-optic cable types that might require grounding or isolation
9.7 Explain entrance cable bonding and grounding per NEC® Articles 250, 770.93, and 770.100
9.8 Explain why proper polarity is required to ensure the operation of duplex fiber optic communication systems

10.0 TEST EQUIPMENT AND LINK/CABLE TESTING

10.1 Explain what test equipment calibration is required to meet the National Institute of Standards and Technology (NIST) standards
10.2 Describe the types of fiber optic test equipment that can be used to test for continuity
10.3 Explain the use of a visual fault locator (VFL) when troubleshooting a fiber span
10.4 Describe the basic operation of a single-mode optical loss test set (OLTS)
10.5 Explain the difference between a patch cord and a measurement quality jumper (MQJ)
10.6 Explain why a single turn 30mm in diameter loop must be applied to the transmit jumper when measuring single-mode link attenuation in accordance with TIA-526-7
10.7 Describe Tier 1 Testing as defined in TIA-568- Annex E to include:
- 10.7.1 Link attenuation (insertion loss) measurement
- 10.7.2 Fiber length verification
- 10.7.3 Polarity verification

10.8 Explain why it is important to document OLTS test results
10.9 List the minimum information required for OLTS testing documentation
10.10 Summarize the basic operation of an optical time domain reflectometer (OTDR)
10.11 Describe the different OTDR setup parameters to include:
- 10.11.1 Optical fiber type
- 10.11.2 Wavelength
- 10.11.3 Range and resolution
- 10.11.4 Pulse width
- 10.11.5 Averages
- 10.11.6 Refractive index
- 10.11.7 Thresholds
- 10.11.8 Backscatter coefficient

10.12 Explain the role of launch and receive cables when testing the cable plant with an OTDR
10.13 Explain how to determine the minimum length for launch and receive cables
10.14 Describe how to measure transmit and receive power levels using an optical power meter
10.15 Describe how to measure the following using an OTDR:
- 10.15.1 The attenuation of a partial length of optical fiber
- 10.15.2 The distance to the end of the optical fiber
- 10.15.3 The length of a cable segment
- 10.15.4 The loss of an interconnection
- 10.15.5 The loss using a loopback connection
- 10.15.6 The loss of a macrobend
- 10.15.7 The loss of a cable segment and interconnections

10.16 Describe Tier 2 Testing as defined in TIA-568- Annex E to include:
- 10.16.1 Fiber segment length
- 10.16.2 Attenuation uniformity and attenuation rate
- 10.16.3 Interconnection loss
- 10.16.4 Insertion loss
- 10.16.5 Macrobends

10.17 Explain why it is important to document OTDR test results.
10.18 Describe how to use power circuit testing equipment
10.19 Discuss PIM (Passive Intermodulation) testing
10.20 Explain why Optical Return Loss (ORL) testing is important in fiber optic communication systems

End of Fiber To Any Antenna Competencies Listing:
(10 Major Knowledge Categories)

Find An ETA Approved School and Test Site: **http://www.eta-i.org/test_sites.html**

Suggested Additional Study Materials and Resources for ETA® Fiber To Any Antenna Certification:

Fiber-to-the-Antenna - Fiber Optics Workshop Manual; Tom Dover; ISBN 978-19040429823 or in e-book as e-978-1940429182; October 2013; 108 ppg; available through DTS, Inc., (800) 360-1425, www.doverts.com
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
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.eta-i.org
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
Fiber Optics Installer (FOI) Certification Exam Guide, Bill Woodward; ISBN 978-1119011507; Sybex, Inc.; November 2014; Paperback; 560 ppg. Available through ETA 800-288-3824, www.eta-i.org
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
Understanding Fiber Optics, 5E; Jeff Hecht; ISBN: 978-0131174290; Prentice-Hall; Apr 2005; hardcover; 800 ppg
Fiber Optic Theory & Applications, 2E; Jeffrey Dominique; 2016; FNT Publ.; paperback www.f-n-t.com
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
National Electrical Code, 2017; National Fire Protection Assn., Nov. 2016; www.nfpa.org

See the many webpages filled with information concerning FTAA equipment and deployment.

ETA® Fiber To Any Antenna Certification Program Committee

Tommy Bonner, PhD	KnT Consulting	
Phil Shoemaker, FOI, FOT-OSP	Light Brigade	
Larry Johnson	Light Brigade	
Bill Woodward, FOD, PE	Geodesicx	william.woodward@geodesicx.com
Paul Neukam, FOI, FOT-OSP, RCDD	SiteWise Systems (BTS)	paul@sitewisesystems.com
Tom Dover	Dover Telecom (DTS)	
Dane Brockmiller, FOI, LAS, PIM	dBc, LLC	
Richard W. Booth, FOT	Empire HS (ETA)	richard.w.booth@gmail.com

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

