

FOC: Optical fibre installation and testing

Online course specification

Course aim:

This online course introduces the use of optical fibre in the access network, the role of the components of optical access networks, and the practical aspects of installing and testing fibre-based broadband access systems

Target audience:

Those involved in implementing, installing and maintaining optical access networks. This course, along with its companion courses "Telecommunications access networks" and "Telecoms testing and fault-finding" delivers many of the knowledge requirements of the Telecoms field operative apprenticeship standard.

Course level: Introductory

An explanation of PTT course levels is given at the end of this document

Pre-requisites:

An understanding of the basic principles of optical fibre transmission would assist in understanding the content of this course. The PTT online course "Optical fibre principles" covers this topic.

Course structure:

The course consists of the following 5 modules:

1. Passive optical networks
2. Optical cables
3. Cable preparation and installation
4. Fibre management
5. Optical testing

Module 1: Passive optical networks

Module aim: To describe the structure and components of a passive optical network (PON) and describe ways of ensuring the PON provides the highest possible performance for its users.

After completing this module, a trainee will be able to:

- describe the role of an optical splitter in a passive optical network (PON).
- compare the benefits of employing a single optical splitter in a PON with those where two splitters are included.
- describe the role of an optical line terminal (OLT) and optical distribution shelf in the access node of a PON.
- describe the physical structure of a PON in terms of feeder cable, distribution cables, drop cables, and the various external splice and splitter enclosures.
- describe and compare the use of demountable connectors and fusion splicing as methods of connecting optical fibres.
- describe the role of the ferrule in an optical connector and compare the ways employed by various types of connector to fasten the connector in place.
- explain the importance of cleanliness when making optical connections.

- describe the various causes of loss in a PON with reference to the factors that affect the magnitude of those losses.
- explain the factors that determine whether a fibre broadband service will provide an acceptable performance in the long term with reference to launched power, receiver sensitivity, system margin, and optical loss contributors.
- explain that precautions should be taken against exposing optical fibre to excessive tensile stress, abrasions, crushing, excessive bending. And exposure to moisture.
- describe the safety precautions that should be taken when working with optical systems.

Module 2: Optical cables

Module aim: To describe how the structure of, and the materials used in, optical cables depends on the environment in which they are to be installed.

After completing this module, a trainee will be able to:

- describe the role of the various protection layers in optical cables.
- describe the various types of cable component that prevent the ingress of water.
- describe the typical structure and role of the components of cables employed within buildings.
- explain that certain sheath materials are not suitable for cables installed in enclosed public areas.
- explain that cables with metallic components may need to be avoided in certain situations.
- describe how all-dielectric cables avoid the use of metals by using aramid yarn and/or fibreglass re-enforced plastic strength members.
- state that metallic components of cables should be connected to ground at the termination point.
- compare the structure of cables designed for direct burial, those designed for installation in ducts and those designed to be suspended by poles or pylons.
- describe and compare the structure of ADSS and "figure of 8" aerial cables.
- describe the structure of, and advantages of using, ribbon cables.
- describe the advantages of installing fibres into microducts using air blowing.
- explain that different standards for colour coding optical fibres and loose tubes in cables for identification purposes exist.
- describe the typical structure of drop cables used to connect customers to a fibre-based broadband service.
- explain that cables with a small minimum bending radius are necessary for installation with buildings as part of an FTTH or FTTP installation.

Module 3: Cable preparation and installation

Module aim: To describe the techniques and equipment used to prepare and install optical cables in ducts and suspended from poles.

After completing this module, a trainee will be able to:

- describe the removal of the protection layers of both internal and external cables in preparation for pulling and termination with reference to the use of specialist tools.
- describe the various ways in which cable ends can be gripped for pulling while minimising the tensile stress on the optical fibres.
- describe how optical fibres are prepared for splicing.
- describe the operation and facilities of modern cleavers and fusion splicers.
- compare the role and operation of fusion splicers using core alignment and those using cladding alignment.
- explain the importance of using a swivel and a mechanical fuse when pulling optical cable.
- describe the techniques and equipment for pulling cable into ducts with reference to maintaining a suitable bending radius and limiting the tensile stress on the cable.

- describe the techniques, components and equipment involved in blowing optical fibre cable.
- describe the techniques, components and equipment involved in installing aerial cables with particular reference to necessary safety precautions.

Module 4: Fibre management

Module aim: To describe the role and features of the closures employed in a passive optical network.

After completing this module, a trainee will be able to:

- describe the role of internal and external closures with reference to fibre management and protection.
- describe the role and typical layout of an optical distribution shelf with reference to the importance of avoiding sharp bends in fibre and protecting exposed fibre and optical splices.
- describe the role, features, and typical layout of the closures holding connections between feeder cables and distribution cables.
- describe the role, features, and typical layout of the closures holding connections between distribution cables and drop cables.
- describe alternative ways of sealing the cable entry points of external closures against moisture ingress.
- explain the advantages of employing connectorised drop cables
- describe the role, typical locations, and features of the customer service point closures employed when providing a fibre to the home service to a single occupancy building.
- describe the role, typical locations, and features of the in-building closures employed when providing a fibre to the premises service to multifloored and multi-occupancy buildings.

Module 5: Optical testing

Module aim: To describe the use of test equipment during the commissioning of a passive optical network (PON) and as part of a fault-finding procedure.

After completing this module, a trainee will be able to:

- describe the purpose of testing with reference to pre-installation, verification, and characterisation testing, and fault-finding.
- explain that loss measurements should be made at each wavelength used by a PON.
- explain that bidirectional loss measurements are necessary giving reasons.
- describe the roles and typical facilities of an optical loss test set (OLTS).
- describe the tasks necessary to prepare for an OLTS test.
- explain the particular characteristics necessary for an optical power meter designed to measure the optical signal transmitted by PON equipment.
- state typical applications of an OTDR measurement.
- describe how backscattered and reflected energy is used by an OTDR to locate and measure the loss of optical connections on a link and measure fibre loss.
- describe the significance of the OTDR characteristics dynamic range, resolution and deadzone, and explain the factors that affect the value of those characteristics.
- describe the factors that affect the choice of pulse width, range, and acquisition time in an OTDR test.
- describe how the position of a splice, demountable connection, macrobend, optical splitter, and fibre end can be identified on an OTDR trace.
- describe the facilities of a modern OTDR including automatic selection of test parameters and automatic identification of events on a fibre trace.
- describe the particular issues that affect the identification of events on an OTDR test on a PON with reference to splitter loss and the direction of the test.

Course access requirements:

To access the course, a computer/tablet running a browser such as Chrome, Safari, Edge etc is required. The device should have an active Internet connection and a screen resolution of at least 1024x768.

Learning facilities:

This online course employs interactive simulations, video clips, hypertext links to an online glossary, and multiple-choice question sessions to fully involve the trainee in the learning experience. Each module provides revision links to previously studied, relevant topics. A record of progress and level of achievement is recorded for each trainee. Once studied as a structured, assessed course, the content can be browsed for revision or reference.

PTT course levels:

PTT online courses are categorised by one of three levels according to the depth of treatment they provide:

1. Introductory:

PTT Introductory courses are designed for those with no previous experience or knowledge of telecommunications. These courses provide an overview of telecommunications or discuss the fundamentals of electronic communications. The study of general science at secondary (high) school is a typical pre-requisite for PTT Introductory courses.

PTT Introductory courses are suitable for those joining the telecommunications or ICT sector particularly those in an apprenticeship programme.

2. Intermediate:

PTT Intermediate courses are designed for technicians and engineers requiring an understanding of a certain aspect of information communications technology (ICT). Those planning to study an Intermediate course should understand the basic principles of electronic communications.

The depth of treatment provided by Intermediate courses is typically equivalent to level 3 of a UK national vocational qualification (NVQ). PTT Intermediate courses can be used to support level 3 digital apprenticeships.

3. Advanced:

PTT Advanced courses are designed for those who require an in-depth treatment of a certain aspect of ICT or telecommunications. Such courses are suitable for system designers as well as those who will be responsible for the maintenance of the system described in the course.

Those planning to study a PTT Advanced course should have a background in telecommunications or ICT, and an understanding of ICT fundamentals and the basic principles of the type of telecommunications or ICT system described in the course.

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