Certified Fibre Characterisation Engineer (CFCE)

Characterise fibre infrastructure professionally, to assess its quality & capacity

COURSE DESCRIPTION

As data rates increase and systems become more complex, more factors can impair system performance. This course is designed to enable engineers to master the fibre optic tests required to prove that advanced fibre infrastructures are of good quality and can support direct detection and coherent systems for high data rate applications from 10Gb/s to 400Gb/s and beyond. Participants will also be able to assess support for Raman amplification as well as extended wavelength range operation for DWDM and CWDM systems. Fibre characterisation is typically required when dark fibre contracts are signed, to prove that the fibres will operate satisfactorily for the duration of the contract period.

Participants will learn to apply the full capability of multi-purpose test platforms to carry out these tests, including insertion and return loss measurements, bi-directional OTDR testing, chromatic dispersion, Polarisation Mode Dispersion (PMD) and spectral attenuation. Training covers checking the validity of measurements to avoid costly mistakes and time-consuming re-tests, and processing results swiftly and efficiently using test report software to provide full system documentation. With an understanding of the issues behind the tests, participants will be able to assess link performance intelligently against application support criteria.

PREREQUISITES

This is an advanced course and assumes participants have some previous experience of ILM and OTDR testing.

KEY OUTCOMES

By the end of this course participants will be able to:

- Explain the significance of fibre specifications and performance grades, including all G.65n.x fibre types
- Identify the characteristics of the infrastructure that can impair system performance

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- Design and plan test programmes to meet customer and operational requirements
- Interpret test specifications
- Inspect connector end faces and assess against criteria of IEC61300-3-35
- Perform accurate and reliable insertion loss and return loss measurements
- Describe the purpose of OTDR testing
- Analyse OTDR traces, event tables and link maps
- Explain what chromatic dispersion is and measure it accurately
- Describe PMD and measure it accurately
- Perform full fibre characterisation on installed fibre systems
- Interpret the results of fibre characterisation to report on infrastructure quality and map against application support criteria

FORMAT

5 days.

- Hands-on experience using specially constructed fibre test systems
- Comprehensive course manual
- Supporting online resources
- Successful completion of the assessment confers Certified Fibre Characterisation Engineer (CFCE) status

CONTENT

Becoming a CFCE

- What are optical networks
- What is fibre characterisation
- Why & when it is necessary
- How it is done
- Standards

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Characteristics of Light

- Electromagnetic spectrum
- Wavelengths & frequencies used in fibre optics
- Singlemode fibre as a waveguide
- Speed of light
- Dispersion

Light in Optical Fibres

- How fibres work
- Singlemode fibre
- Launch conditions
- Attenuation
- Dispersion
- Bend loss performance

Optical Fibres

- Optical fibres for telecoms
- Fibre standards

Preparation

Preparing for Fibre Characterisation

- Specification of parameters
- FC characterisation systems & resources checklists
- Management of test results
- Reference procedures
- Measurement procedures

Inspect + Clean Connectors

- Why inspection and cleaning is important
- Inspection standards
- Inspection equipment
- Cleaning equipment
- Connector care

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ILM & Spectral Attenuation

- Continuity checking
- Power & loss budgets
- Insertion loss measurements
- Spectral attenuation
- Live fibre identifiers

Return Loss Measurement

- Definitions
- Performance requirements
- How it is measured

OTDR Testing

OTDR Introduction

- What is OTDR testing
- What it can be used for
- How OTDR testing works

OTDR Capabilities

- Distance measurements
- Fibre loss measurements
- Bending losses
- Splice loss measurement
- Connector losses
- Link return loss (ORL)

OTDR Limitations

- Dynamic range
- Dead zone
- Resolution

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Test Configurations

- Cable on a drum
- Installed cable before termination
- Connectorised systems
- Bi-directional testing

Using the OTDR

- Step by step guide
- Manipulating the trace
- Measurement parameters

OTDR Issues

- Poor launch conditions
- Interfacing with bare fibres
- Ghosts
- Fibre mismatches

OTDR Trace Analysis

- Information obtained from OTDR traces
- Event tables and link maps
- Analysis of a single trace
- Multiple wavelength traces
- Analysis of multiple fibres
- Bi-directional analysis
- OTDR trace comparison

Using OTDR Software

- OTDR viewer software
- Automatic event detection
- Comparing OTDR traces

Dispersion

Intro to Dispersion

- When dispersion measurements are needed

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Chromatic Dispersion

- What is chromatic dispersion
- What causes it
- CD characteristics of common fibre types

CD Measurement Methods

- Standards
- Group delay and dispersion
- Time of flight techniques
- Phase Shift Techniques

Practical Exercises

- G.652 & G.655 systems
- DCMs
- Compensated links
- Amplified links

Polarisation Mode Dispersion

- Polarisation in fibres
- Polarisation in other system components
- PMD & system performance
- Second order PMD
- Dynamics of PMD

Measurement Techniques

- Interferometric technique
- Polarimetric technique
- Fixed analyser technique
- Wavelength scanning
- Interpreting test results

PMD Measurement Issues

- What is being tested & why
- Factors affecting choice of technique

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PMD Measurement Exercises

- Low PMD fibre link
- High PMD fibre link
- Concatenated links
- Amplified links

Reporting

- Measurement validation checklist
- OTDR measurement presentation
- Fibre characterisation reports
- Web based documentation

Link Acceptance Criteria

- Fibre distances
- Cabling losses
- Reflections
- Chromatic dispersion
- PMD
- Extended wavelength requirements
- Support for Raman amplifiers
- Application support:
  - ITU OTN applications
  - Ethernet LR, ER and ZR
  - 128G Fibre Channel
  - OIF IA for 400ZR
  - OpenROADM MSA for OpenZR+
  - Coherent 100G-400G+

CFCE Assessment

- Fibre characterisation practical assignment
- Theory assessment

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