



Australian Government

Department of Education, Employment and Workplace Relations

ICTOPN4116A Use advanced optical test equipment

Release: 1

ICTOPN4116A Use advanced optical test equipment

Modification History

Not Applicable

Unit Descriptor

<p>Unit descriptor</p>	<p>This unit describes the performance outcomes, skills and knowledge required to test optical communication systems and components using advanced optical test equipment. It involves using the optical time domain reflectometer (OTDR), optical spectrum analyser (OSA) and optical return loss (ORL) test set for performance testing and link budget calculation.</p> <p>Licensing, legislative, regulatory and certification requirements apply to working at heights. If an elevated work platform (EWP) is required, verify state or territory law requirements for a licence to operate an EWP. Users should confirm requirements with the relevant federal, state or territory authority.</p> <p>If working at heights, achievement of the unit 'CPCPCM2015A Work safely on roofs' from the CPC08 Construction and Plumbing Services Integrated framework training Package fulfils this requirement.</p>
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Application of the Unit

<p>Application of the unit</p>	<p>Installation contractors, technical staff and field officers from telecommunications carriers or other private and public organisations, or regulatory authorities apply the skills and knowledge in this unit.</p> <p>They combine technical skills with organisational and administrative skills to perform specialised testing of complex optical faults, optical network monitoring and link budget calculations on broadband passive optical network (PON), fibre to the x (FTTx) networks, hybrid fibre coaxial (HFC) networks and dense wavelength division multiplexing (DWDM) systems during installation, maintenance, commissioning and troubleshooting phases.</p>
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Licensing/Regulatory Information

Refer to Unit Descriptor

Pre-Requisites

Prerequisite units		

Employability Skills Information

Employability skills	This unit contains employability skills.
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Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Prepare to use advanced optical measuring instruments	1.1. Obtain relevant legislation, codes, regulations and standards for compliance when conducting work 1.2. Notify customer for site access, security arrangements and location details of optical system and test purpose 1.3. Identify site hazards and notify appropriate personnel to make site safe 1.4. Devise and implement risk control measures of hazards with handling of optical fibres and lasers in consultation with appropriate personnel 1.5. Prepare a testing plan indicating the type of measurement , procedures and nominated wavelength and seek approval from customer 1.6. Select the appropriate tools and test instruments according to the required measurement and enterprise practice
2. Evaluate optical performance and link budget using advanced optical test equipment	2.1. Set up test instrument according to manufacturer's instructions and occupational health and safety (OHS) and environmental requirements 2.2. Perform measurement using knowledge of appropriate testing techniques and advanced test equipment in a safe manner to evaluate the performance of optical system and component 2.3. Record test results and compare with standard test specifications from manufacturer's and enterprise guidelines 2.4. Perform end-to-end measurements on an optical link to a customer and record test results and test points 2.5. Calculate the optical losses for a link budget figure of an optical link to determine if within operational margins as specified in manufacturer's manual 2.6. Evaluate the test results and report on the functionality of the optical component or equipment and the performance of the optical link
3. Document measurement results	3.1. Document test results for future reference and make recommendations on optimising component and system performance 3.2. Clean worksite and make safe according to the enterprise requirements and to customer satisfaction 3.3. Notify appropriate personnel of job completion for sign off and present test documentations

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

Required skills

- communication skills to liaise with customers and enterprise staff
- literacy skills to read and interpret work instructions and document work
- numeracy skills to gather and record data from measurements
- planning and organisational skills to plan prioritise and manage own work
- safety awareness skills to:
 - apply precautions and required action to minimise, control or eliminate hazards that may exist during work activities
 - select and use required personal protective equipment conforming to industry and OHS standards
 - work systematically with required attention to detail without injury to self or others, or damage to goods or equipment
- technical skills to:
 - clean an optical connector to an acceptable industry standard
 - safely inspect an optical connector for contamination and determine if cleaning is necessary
 - safely operate:
 - optical loss test set (OLTS)
 - optical time domain reflectometer (OTDR)
 - PON power meter

Required knowledge

- consequences of mating contaminated optical connectors
- decibels, dBm
- downstream and upstream signals
- DWDM metro and long haul system architecture
- measurement of DWDM signals
- measurement of gain and gain flatness of optical amplifier
- measurement of laser spectral stability, drift and unexpected variation in spectral transmission characteristics
- non-linear effects, four-wave mixing
- optical connector types
- optical signal to noise ratio (OSNR)
- optical spectrum limits, wavelengths used in various applications and International

REQUIRED SKILLS AND KNOWLEDGE

- Telecommunications Union (ITU) grid
- optical transmitters and receivers
- ORL
- OTDR dead zones, dynamic range and launch cable
- reflectance
- safe handling procedures with optical fibres
- transmission system line rates:
 - optical Ethernet
 - optical transport network (OTN)
 - synchronous digital hierarchy (SDH)
- wavelength division multiplexing (WDM), coarse wavelength division multiplexing (CWDM) and DWDM principles and optical multiplexers

Evidence Guide

EVIDENCE GUIDE	
<p>The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.</p>	
Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	<p>Evidence of the ability to :</p> <ul style="list-style-type: none"> • use OTDR, OSA and ORL advanced optical test equipment to: <ul style="list-style-type: none"> • measure optical power level • measure insertion loss of optical network • measure end-to-end fibre loss (bi-directional) • test and calculate optical link budget • comply with all related OHS requirements and work practices.
Context of and specific resources for assessment	<p>Assessment must ensure:</p> <ul style="list-style-type: none"> • sites on which optical measurements can be conducted • tools and equipment required for measurements • manufacturer's documentation for test instruments and equipment under test.
Method of assessment	<p>A range of assessment methods should be used to assess practical skills and knowledge. The following examples are appropriate for this unit:</p> <ul style="list-style-type: none"> • direct observation of the candidate performing optical measurements • review of a written report for the OTDR, the OSA and the ORL test set • oral or written questioning to assess required knowledge.
Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended, for example:</p> <ul style="list-style-type: none"> • ICTOPN5118A Plan and configure dense wavelength division multiplexing systems • ICTOPN5119A Perform acceptance and commissioning tests on optical network • ICTOPN5120A Plan for an optical system upgrade

EVIDENCE GUIDE

	<p>and cut over</p> <ul style="list-style-type: none"> • ICTOPN5121A Test and commission a dense wavelength division multiplexing transmission system • ICTOPN5122A Test the performance of specialised optical devices • ICTOPN5123A Analyse and integrate specialised optical devices in the network. <p>Aboriginal people and other people from a non-English speaking background may have second language issues.</p> <p>Access must be provided to appropriate learning and assessment support when required.</p> <p>Assessment processes and techniques must be culturally appropriate, and appropriate to the oral communication skill level, and language and literacy capacity of the candidate and the work being performed.</p> <p>In all cases where practical assessment is used it will be combined with targeted questioning to assess required knowledge. Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.</p> <p>Where applicable, physical resources should include equipment modified for people with special needs.</p>
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Range Statement**RANGE STATEMENT**

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of

RANGE STATEMENT

the item, and local industry and regional contexts) may also be included.

Relevant legislation, codes, regulations and standards may include:

- appropriate licences:
 - crane
 - EWP
 - forklift
 - winch
- Australian Construction Industry Forum (ACIF) standards and codes
- AS Communications Cabling Manual (CCM) Volume 1
- AS/NZS 3000:2007
- AS/NZS 3080:2003
- AS/NZS 3084:2003
- AS/NZS 3085.1:2004
- AS/NZS IEC 61935.1:2006
- AS/NZS IEC 61935.2:2006
- AS/NZS ISO/IEC 14763.3:2007
- AS/NZS ISO/IEC 15018:2005
- AS/NZS ISO/IEC 24702:2007
- cabling security codes and regulations
- Environmental Protection Acts
- OHS
- technical standards AS/ACIF S008:2006 and AS/ACIF S009:2006.

Customer may be:

- asset manager
- installation manager
- maintenance manager
- nominated customer representative
- outage manager
- project manager.

Optical system may contain:

- add-drop multiplexer
- Bragg filters
- DWDM system
- fibre hub
- HFC network
- optical amplifier
- optical line termination (OLT)
- optical links
- optical network termination (ONT)
- optical splitter.

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<i>Hazards</i> may include:	<ul style="list-style-type: none"> • building debris • earth potential rise • glass fibre • live power lines • manual handling • mud and water • natural gas and other gas build up • optical fibre cable may contain hazardous light • radio frequency (RF) equipment emitting radiation • remote power feeding services which operate at above telecommunications network voltage (TNV) • vermin.
<i>Testing plan</i> may include:	<ul style="list-style-type: none"> • correct test set up • recording and evaluation of measurements • test layout • test procedures • test purpose • test sites and location • type of measurements • use of appropriate test equipment.
<i>Type of measurement</i> may include:	<ul style="list-style-type: none"> • dedicated ORL test set: <ul style="list-style-type: none"> • optical power meter ORL • ORL versus wavelength. • OSA and ORL • PON splitter ORL • OSA: <ul style="list-style-type: none"> • bandwidth of a device (multiplexer) • central wavelength and channel spacing • device flatness • DWDM channel uniformity • insertion loss: <ul style="list-style-type: none"> • coupler • filter • optical splitter • WDM • non-linear effects (four-wave mixing) • optical power level: <ul style="list-style-type: none"> • at drop terminal • at optical transmitter

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	<ul style="list-style-type: none"> • at patch panel • at the OLT • at the ONT • optical signal to noise ratio (OSNR) • ripple • spectral purity of a source • spectral stability and drift of a source • OTDR: <ul style="list-style-type: none"> • break and fault location • certification of new cabling • characterisation of events in path • detailed event table • fibre attenuation • fibre attenuation rate • fibre attenuation uniformity • identification of 'gainers' • identification of 'ghost' events • insertion loss of connectors and splices • macro-bend detection • ORL • segment length.
Wavelength may include:	<ul style="list-style-type: none"> • 850 nm • 1310 nm • 1490 nm • 1550 nm.
Tools may include:	<ul style="list-style-type: none"> • alcohol swabs • dry type cleaning cassette for optical connectors hand tools • launch cable for OTDR • lint-free dry wipes • microscope for examining optical connector with: <ul style="list-style-type: none"> • integral safety infra-red filter • video microscope display • optical connector adaptors <ul style="list-style-type: none"> • FC to LC • FC to SC • FC to ST • SC to ST

RANGE STATEMENT	
	<ul style="list-style-type: none"> • optical fibre mandrel (single mode fibre low reflection termination) • optical termination • optical reference cable.
<i>Test instruments</i> may include:	<ul style="list-style-type: none"> • ORL test set • OSA • OTDR multimode • OTDR single mode • PON optimised OTDR.
<i>OHS and environmental requirements</i> may include:	<ul style="list-style-type: none"> • decommissioning and isolating worksite and lines prior to commencement • identifying other services, including power and gas • personal protective equipment: <ul style="list-style-type: none"> • earmuffs • gloves • head protection • masks • protective suits • safety boots • safety glasses • safe working practices, such as the safe use and handling of: <ul style="list-style-type: none"> • chemicals • materials • tools and equipment • work platforms • special access requirements • environmental considerations: <ul style="list-style-type: none"> • clean-up protection • stormwater protection • waste management.

Unit Sector(s)

Unit sector	Telecommunications
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Co-requisite units

Co-requisite units		

Competency field

Competency field	Optical networks
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