

22263VIC
Certificate IV in Integrated Technologies
Version 2
May 2018

This course has been accredited under Part 4.4 of the Education and Training Reform Act 2006.

Accredited for the period: 1 January 2014 to 31 December 2018

Extension Granted by VRQA: 1 January 2019 to 31 December 2019



Education
and Training



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Modification History Version 3

22263VIC Certificate IV in Integrated Technologies

December 2018

Extension Granted by VRQA: 1 January 2019 to 31 December 2019

Modification History Version 2

22263VIC Certificate IV in Integrated Technologies

May 2018

The following Victorian units of competency have been developed and included in this qualification to address Version 6 in the CISCO environment.

VU22324	Build a simple network and establish end to end connectivity
VU22325	Configure and troubleshoot network switches and routers
VU22326	Apply network scaling tools and techniques
VU22327	Establish connectivity to a wide area network (WAN)

The following units which were developed to address Version 5 in the CISCO environment have been retained in this qualification and will be removed when the qualification is re-credited.

VU21561	Build a simple network and establish end to end connectivity
VU21562	Configure and troubleshoot network switches and routers
VU21563	Scale an existing network
VU21564	Establish connectivity to a wide area network (WAN)

Modification History Version 1

22263VIC Certificate IV in Integrated Technologies

January 2014

Initial release

Section A: Copyright and course classification information

- 1. Copyright owner of the course** Copyright of this document is held by the Department of Education and Early Childhood Development, Victoria.
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- 2. Address** Department of Education and Early Childhood Development Executive Director,
Market Facilitation and Information,
GPO Box 266
Melbourne 3001.
- Organisational Contact:**
Manager Training Products
Higher Education and Skills Group
Telephone: (03) 9637 3092
Email: course.enquiry@edmail.vic.gov.au
- Day to day contact:**
Mr. George Adda
Executive Officer
CMM Engineering Industries
Box Hill Institute
853 Whitehorse Road
Box Hill 3128
Telephone: (03) 9286 9934
Facsimile: (03) 9286 9800
Email: g.adda@bhtafe.edu.au
- 3. Type of submission** Re-accreditation. This course replaces, but is not equivalent to, the accredited course:
21915VIC - Certificate IV in Shared Technology
- 4. Copyright acknowledgement** Endorsed units of competency have been imported into this course from the following nationally endorsed Training Packages, which are administered by the Commonwealth of Australia.
© Commonwealth of Australia
BSB07 Business Services
CPP07 Property Services

CUF07 Screen and Media
 CUS09 Music
 ICA11 Information and Communications Technology
 ICT10 Integrated Telecommunications
 MEM05 Metal and Engineering
 PSP12 Public Sector
 UEE11 Electrotechnology
 UEP12 Electricity Supply Industry – Generation Sector

Training Package units can be accessed from the web site [here](#)

Copyright of units of competency imported from the following State accredited curricula is held by the Higher Education and Skills Group, Department of Education and Training (DET), Victoria

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22209VIC - Certificate II in Engineering Studies

22228VIC - Advanced Diploma of Engineering Technology

For a detailed listing of these units of competency refer to Section C Table of Contents in this submission.

5. Licensing and franchise

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Executive Director

Industry Engagement and VET Systems

Higher Education and Skills Group

Department of Education and Training (DET)

Email: course.enquiry@edumail.vic.gov.au

Copies of this publication can be downloaded free of charge from the DET website [here](#).

6. Course accrediting body

Victorian Registration and Qualifications Authority

**7. AVETMISS
information**

Classification codes for:

ANZSCO code: 313199 ICT Support Technicians nec

ASCED code – 4 digit 0313 Electrical and Electronic Engineering
and Technology

National course codes 22263VIC

**8. Period of
accreditation**

1 January 2014 – 31 December 2018

Extended: 1 January 2019 to 31 December 2019

Section B: Course information

1. Nomenclature <i>Standard 1 AQTF Standards for Accredited Courses</i>	
1.1 Name of the qualification	Certificate IV in Integrated Technologies
1.2 Nominal duration of the course	800 hours
2. Vocational or educational outcomes <i>Standard 1 AQTF Standards for Accredited Courses</i>	
2.1 Purpose of the course	The course is mainly targeted for new entrants into the workforce, such as school leavers, who want to gain employment as technicians. There is no single source of employment for graduates from this proposed course. Rather, skills developed in the course will prepare graduates to undertake work across a wide range of activities in technology fields which are merging and for which presently no formal qualifications are available. Typical job roles are: • leading tradesperson • service technician • systems manager • facilities manager • small team leader. A diverse range of industries will employ graduates from this course, such as small and large enterprises involved with manufacturing, medical equipment servicing, telecommunications infrastructure, building automation, computer networking, process control or blends of these technologies.
3. Development of the course <i>Standards 1 and 2 AQTF Standards for Accredited Courses</i>	

3.1 Industry /enterprise /community needs	Background and identification of industry need “The Information and Communications Technologies (ICT) Industry and Workforce Development Report” (2012) by Communications and Information Training Limited (CITT) stated that: <i>“The ICT Industry contributes 4.6 percent of Australia’s GDP and 4.9 percent of economic gross value add. It is a complex and comprehensive industry that affects all business activity and is expected to have an increasing impact. With revenue exceeding \$82 billion and investment in research and development at \$5.2 billion, the Australian ICT Industry has a critical place in the Australian economy.</i> <i>The main workforce development challenges faced by the ICT Industry include:</i> • <i>maximising National Broadband Network (NBN) capability – the ICT Industry has a big role to play in its own right but also in supporting other industries and enterprises to be innovative in the development of new products and services made possible with wide-spread access to high speed broadband through the NBN</i> • <i>managing risk associated with network and information security – increased opportunity is often associated with increased risks, both internal and external; the ICT Industry will be challenged to mitigate risks for organisations as they adopt new technology, and</i> • <i>skills convergence – almost every job has an ICT skill associated with it; while not everyone has to be an expert everyone needs digital literacy skills to meet their workplace requirements.”</i> Integrated Technology is the coming together of various technologies that were stand alone, into new integrated applications. The term primarily relates to the transfer of information through electronic means. This technology is changing the nature of work, the way people work and the skills they need. The impact of the application of integrated technology is increasingly felt within the automotive, building and construction, engineering, electrical, electronic, information technology and telecommunications industries. The following examples illustrate occupations that employ integrated technology skills in a diverse range of industries. • Hospitals employing technicians who are involved with installing and maintaining a complex array of medical equipment. This sector has a need for people with skills spanning electronics, microwaves, computer networking, pneumatics, hydraulics and general engineering • Engineering manufacturing companies who employ technologists with skills spanning programmable control, robotics, fabrication together with skills in estimating, quoting and tendering • Telecommunications companies whose employees’ skills span installation and maintenance of sustainable energy systems together with providing technical support such as customer training and post sales helpdesk. The following courses were developed and accredited in 2008 to meet training needs in integrated technology skills. Certificate IV in Shared Technology, Diploma of Shared Technology, and Advanced Diploma of Shared Technology,

	Collectively they were designed to satisfy the vocational outcomes at technician and systems manager levels. However, there have been no enrolments in the Diploma and Advanced Diploma courses, whereas demand in the Certificate IV in Shared Technology has steadily increased. Enrolments in the course have increased from 28 in 2009 to 82 mid-way through 2013. Methodology The Curriculum Maintenance Manager (CMM) for Engineering Industries has consulted with industry and training providers. In particular, consultation has occurred with the industry members of the Steering Committee and the Advanced Diploma of Electronics and Computer Systems teacher network. Consultations have confirmed that: • there is a strong requirement from industry for multi-technology trained people in Integrated technologies; • vendor certification endorsements such as Certified Cisco Networking Associate (CCNA) and the CompTIA A+ computer service technician certification are available. These certifications are in demand and enhance employability; • the majority of units of competency are drawn from current training packages. A small number of new units of competency need to be developed; and • vocational streams and outcomes have been identified and verified through industry surveys, questionnaires and the Steering Committee members. There is a pathway for secondary students who have studied <i>22071VIC Certificate II in Integrated Technologies</i> through VET in Schools programs, but there are no national training package qualifications meeting the needs of integrated technology training. Existing training package qualifications do not provide sufficient flexibility to package units of competency from a range of training packages to provide the necessary cross industry skills training. Vocational outcomes The course is mainly targeted for new entrants into the workforce, such as school leavers, who want to gain employment as technicians or engineering associates. The course may also provide pathways for post-trade workers in electrotechnology, or engineering, wanting to progress to a technician or technical officer occupation. Typical job roles are leading tradesperson, technician and small team leader. Specific skills in an integrated technology context will cover: • installation

	• setting up • maintenance • fault diagnosis and rectification The proposed course does not duplicate any qualifications within existing Training Packages. Membership of the Steering Committee comprised: Noel Pierre (Chair) Siemens Ltd Cathie Usher Chisholm Institute of TAFE Dominic Schipano Communication & Information Technology Training Ltd. Tony Cheers Hydraulics Specialists Australia Alan Bradley Engineers Australia Ian Turnbull Box Hill Institute of TAFE Gabriel Giofre Consultant in Telecommunications and computing <u>In attendance:</u> George Adda CMM - Engineering Industries Sam McCurdy Dewhurst Consultancy Pty Ltd
3.2 Review for re-accreditation	The Certificate IV in Shared Technologies has been monitored throughout its accreditation period by the CMM – Engineering Industries. This has resulted in various versions of the curriculum document to include new industry specialisations and units of competency from endorsed Training Packages and accredited courses. Recent trends have suggested that the course title should be altered to the <i>Certificate IV in Integrated Technologies</i>, as this better reflects what is actually occurring in the industry. This course replaces and is not equivalent to the superseded course <i>21915VIC Certificate IV in Shared Technology</i>. There can be no new enrolments in the 21915VIC Certificate IV in Shared Technology after 30 June 2014. Table 1 identifies the relationship between units from the previous course and current course.

Table 1: Transition arrangements

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
Core units				

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
UEENEEE040B	Identify and select components /accessories/materials for electrotechnology work activities	No corresponding unit		
UEENEEE044B	Apply technologies and concepts to electrotechnology work activities	No corresponding unit		
VBP118	Carry out a shared technology project	VU21535	Implement an integrated technology project	Equivalent
VPAU479	Perform precision measurements	VU21610	Perform precision measurements	Equivalent
VPAU480	Use computer technology	VU21536	Apply computer tools and networking in an integrated technology context	Not Equivalent
VPAU478	Dismantle and assemble engineering components or subassemblies	VU21611	Dismantle and assemble engineering components or subassemblies	Equivalent
No corresponding unit		UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace	No equivalent
No corresponding unit		UEENEEE102A	Fabricate, assemble and dismantle utilities industry components	No equivalent
No corresponding unit		UEENEEE141A	Use of routine equipment /plant/ technologies in an energy sector environment	No equivalent
No corresponding unit		MEM30007A	Select common engineering materials	No equivalent
No corresponding unit		VU21534	Apply mathematics in an integrated technology context	No equivalent
Electives				
BSBDES501A	Implement design solutions	BSBDES501A	Implement design solutions	Same unit
BSBEBU501A	Investigate and design ebusiness solutions	BSBEBU501A	Investigate and design ebusiness solutions	Same unit
BSBITU301A	Create and use databases	BSBITU301A	Create and use databases	Same unit
BSBPUR301B	Purchase goods and services	BSBPUR301B	Purchase goods and services	Same unit
BSBRKG604B	Determine security and access rules and procedures	BSBRKG604B	Determine security and access rules and procedures	Same unit
BSBWRT401A	Write complex documents	BSBWRT401A	Write complex documents	Same unit
CPPSIS4008A	Organise equipment and supplies	No corresponding unit		
CPPSIS4010A	Operate surveying equipment	No corresponding unit		
CPPSIS4011A	Perform surveying computations	No corresponding unit		
CPPSIS4014A	Maintain spatial data	No corresponding unit		
CPPSIS5002A	Capture new spatial data	No corresponding unit		
CPPSIS5009A	Produce spatial project deliverables	No corresponding unit		
CPPSIS5021A	Apply land and planning law to surveying	No corresponding unit		
CPPSIS5023A	Manage advanced surveying Computations	No corresponding unit		

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
CUFBRT401A	Install or upgrade broadcast equipment and facilities	CUFBRT401A	Install or upgrade broadcast equipment and facilities	Same unit
CUFBRT402A	Maintain broadcast equipment and facilities	CUFBRT402A	Maintain broadcast equipment and facilities	Same unit
CUFBRT403A	Ensure quality of broadcast output	CUFBRT403A	Ensure quality of broadcast output	Same unit
CUFBRT501A	Collaborate on the design of broadcasting facilities	CUFBRT501A	Collaborate on the design of broadcasting facilities	Same unit
CUFDIG201A	Maintain interactive content	CUFDIG201A	Maintain interactive content	Same unit
CUFDIG302A	Author interactive sequences	CUFDIG302A	Author interactive sequences	Same unit
CUFDIG501A	Coordinate the testing of interactive media products	CUFDIG501A	Coordinate the testing of interactive media products	Same unit
CUSSOU05A	Install, align and test sound equipment	No equivalent		
ICAA5045B	Produce network architecture design	ICTTEN6206A	Produce an ICT network architecture design	Equivalent
ICAD3218B	Create user documentation	ICAICT301A	Create user documentation	Equivalent
ICAD4217B	Create technical documentation	ICAICT408A	Create technical documentation	Equivalent
ICAI3020B	Install and optimise operating system software	ICAICT302A	Install and optimise operating system software	Equivalent
ICAI3101B	Install and manage network protocols	ICANWK305A	Install and manage network protocols	Equivalent
ICAI4030B	Install software to networked computers	ICANWK411A	Deploy software to networked computers	Equivalent
ICAI4097B	Install and configure a network	ICAI4097C	Install and configure a network	Equivalent
ICAS3024B	Provide basic system administration	ICASAS304A	Provide basic system administration	Equivalent
ICAS3031B	Provide advice to clients	ICASAS305A	Provide IT advice to clients	Equivalent
ICAS3032B	Provide network systems administration	ICANWK301A	Provide network systems administration	Equivalent
ICAS3120B	Configure and administer a network operating system	ICAS3120C	Configure and administer a network operating system	Equivalent
ICAS4022B	Determine and action client computing problems	No equivalent		
ICAS4023B	Provide one-to-one instruction	ICAICT415A	Provide one-to-one instruction	Equivalent
ICAS4106B	Action and complete change requests	ICASAS412A	Action change requests	Equivalent
ICAS4127B	Support system software	ICASAS419A	Support system software	Equivalent
ICAS5102B	Establish and maintain client user liaison	ICASAS502A	Establish and maintain client user liaison	Equivalent
ICAS5104B	Determine maintenance strategy	ICASAS510A	Review and develop IT maintenance strategy	Equivalent
ICAS5122B	Identify and resolve network problems	ICAS5122C	Identify and resolve network problems	Equivalent
ICAS5123B	Manage network security	ICAS5123C	Manage network security	Equivalent
ICAT3025B	Run standard diagnostic tests	ICASAS301A	Run standard diagnostic tests	Equivalent
ICAU1128B	Operate a personal computer	ICAICT101A	Operate a personal computer	Equivalent
ICAU2005B	Operate computer hardware	ICAICT201A	Use computer operating systems and hardware	Equivalent

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
ICAU2006B	Operate computing packages	ICAICT203A	Operate application software packages	Equivalent
ICAU3126A	Use advanced features of computer applications	No equivalent		
ICAU4205B	Select and employ software and hardware tools	ICAICT411A	Select and employ software and hardware testing tools	Equivalent
ICTCC100A	Follow Occupational Health and Safety policy and procedures	No equivalent		
ICTTC005C	Install cable support systems	ICTCBL2005A	Install customer cable support systems	Equivalent
ICTTC006C	Place and secure cable	ICTCBL2006A	Place and secure customer cable	Equivalent
		ICTTEN2007A	Use electrical skills in telecommunications work	New unit
ICTTC008C	Terminate metallic conductor cable	ICTCBL2008A	Terminate metallic conductor customer cable	Equivalent
ICTTC010C	Place, secure and terminate optical fibre cable	ICTCBL3010A	Install and terminate optical fibre cable on customer premises	Equivalent
ICTTC012C	Install functional and protective telecommunications earthing system	ICTCBL2012A	Install functional and protective telecommunications earthing system	Equivalent
ICTTC016C	Joint copper cable	No equivalent		
ICTTC017C	Alter services to existing cable system	ICTCBL2017A	Alter services to existing cable system	Equivalent
ICTTC022C	Organise and monitor cabling to ensure compliance with regulatory and industry standards	ICTCMP2022A	Organise and monitor cabling to ensure compliance with regulatory and industry standards	Equivalent
ICTTC035C	Organise material supply	ICTWOR3035A	Organise material supply	Equivalent
ICTTC051C	Install PC based customer premises equipment system programs	ICTTEN4051A	Install configuration programs on PC based customer equipment	Equivalent
ICTTC053C	Train customers	ICTEDU3053A	Train customers in new technology	Equivalent
ICTTC055C	Install an antenna/wave guide	ICTRFN3055A	Install a radio communications antenna and feedline	Equivalent
ICTTC064C	Haul underground cable	ICTCBL2064A	Haul underground cable	Equivalent
ICTTC065C	Splice optic fibre cable	ICTCBL2065A	Splice and terminate optical fibre cable for carriers and service providers	Equivalent
ICTTC066C	Joint and terminate co-axial cable	ICTCBL2066A	Joint and terminate co-axial cable	Equivalent
ICTTC068C	Install telecommunications service to a building	ICTCBL2068A	Install a telecommunications service to a building	Not equivalent
ICTTC071C	Install Pay TV set top unit	No equivalent		
ICTTC076C	Complete equipment/software upgrades	ICTTEN4076A	Complete equipment and software upgrades	Equivalent
ICTTC095C	Conduct radio frequency Measurements	ICTRFN4095A	Conduct radio frequency measurements	Equivalent
ICTTC106C	Locate and rectify Pay TV set top unit faults	No equivalent		
ICTTC130B	Prepare site for support Installation	ICTPMG2130A	Prepare site for support installation	Equivalent

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
ICTTC131B	Install an above ground equipment enclosure	ICTCBL2131A	Install an above ground equipment enclosure	Equivalent
ICTTC132B	Erect cable supports	ICTCBL2132A	Erect aerial cable supports	Equivalent
ICTTC133B	Construct underground telecommunications infrastructure	ICTCBL2133A	Construct underground Telecommunications infrastructure	Equivalent
ICTTC134B	Fix aerial cable	ICTCBL2134A	Fix aerial cable	Equivalent
ICTTC135B	Joint metallic cable	ICTCBL2135A	Joint metallic conductor cable in access network	Equivalent
ICTTC136B	Install, maintain and modify customer premises communications cabling: ACA Restricted Rule	ICTCBL2136A	Install, maintain and modify customer premises communications cabling: ACMA Restricted Rule	Equivalent
ICTTC137B	Install, maintain and modify customer premises communications cabling: ACA Open Rule	ICTCBL2137C	Install, maintain and modify customer premises communications cabling: ACMA Open Rule	Equivalent
No equivalent unit		ICTCBL2139A	Apply safe technical work practices for cabling registration	New unit
ICTTC140A	Use hand and power tools	ICTTEN2140A	Use hand and power tools	Equivalent
ICTTC141A	Work effectively in a telecommunications technology team	ICTWOR2141A	Work effectively in a telecommunications technology team	Equivalent
ICTTC142A	Use photonics devices	Unit superseded		
ICTTC143A	Integrate specialised photonics devices into telecommunications systems	ICTOPN5123A	Analyse and integrate specialised optical devices in the network	Not equivalent
ICTTC144A	Use a virtual instrument	ICTITU5144A	Test telecommunications network using virtual instruments	Not equivalent
ICTTC145A	Perform photonics device laboratory techniques	ICTOPN5122A	Test the performance of specialised optical devices	Not equivalent
ICTTC146A	Test and manipulate WDM devices and systems	ICTOPN5121A	Test and commission a dense wavelength division multiplexing transmission system	Not equivalent
MEM07005B	Perform general machining	Unit removed		
MEM07006B	Perform lathe operations	Unit removed		
MEM07007B	Perform milling operations	Unit removed		
MEM07008B	Perform grinding operations	Unit removed		
MEM09002B	Interpret technical drawing	MEM09002B	Interpret technical drawing	Same unit
MEM09003B	Prepare basic engineering drawing	MEM09003B	Prepare basic engineering drawing	Same unit
MEM10004B	Enter and change programmable controller operational parameters	MEM10004B	Enter and change programmable controller operational parameters	Same unit
MEM10005B	Commission programmable controller programs	MEM10005B	Commission programmable controller programs	Same unit
MEM10007C	Modify control systems	MEM10007C	Modify control systems	Same unit
MEM11012B	Purchase materials	MEM11012B	Purchase materials	Same unit

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
MEM13014A	Apply principles of occupational health and safety in the work environment	MEM13014A	Apply principles of occupational health and safety in the work environment	Same unit
MEM16009A	Research and analyse engineering information	MEM16009A	Research and analyse engineering information	Same unit
MEM16010A	Write reports	MEM16010A	Write reports	Same unit
MEM16011A	Communicate with individuals and small groups	MEM16011A	Communicate with individuals and small groups	Same unit
MEM16014A	Report technical information	MEM16014A	Report technical information	Same unit
MEM18001C	Use hand tools	MEM18001C	Use hand tools	Same unit
MEM18002B	Use power tools/hand held Operations	MEM18002B	Use power tools/hand held operations	Same unit
MEM18020B	Maintain hydraulic system components	MEM18020B	Maintain hydraulic system components	Same unit
MEM18021B	Maintain hydraulic systems	MEM18021B	Maintain hydraulic systems	Same unit
MEM22006A	Source and estimate materials	MEM22015A	Source and estimate engineering materials	Not equivalent
MEM23041A	Apply basic scientific principles and techniques in mechanical engineering situations	MEM23041A	Apply basic scientific principles and techniques in mechanical engineering situations	Same unit
MEM23062A	Select and test mechatronic engineering materials	MEM23064A	Select and test mechatronic engineering materials	Not equivalent
MEM30012A	Apply mathematical techniques in a manufacturing engineering or related environment	MEM30012A	Apply mathematical techniques in a manufacturing engineering or related environment	Same unit
MEM30023A	Prepare a simple cost estimate for a manufactured product	MEM30023A	Prepare a simple cost estimate for a manufactured product	Same unit
PRSTS301A	Identify technical security requirements	CPPSEC3035A	Identify technical security requirements	Not equivalent
PRSTS302A	Program security equipment/system	CPPSEC3036A	Program security equipment and system	Not equivalent
PRSTS303A	Test installed security equipment/system	CPPSEC3037A	Test installed security equipment and system	Not equivalent
PRSTS304A	Commission/decommission security equipment/system	CPPSEC3038A	Commission and decommission security equipment and system	Not equivalent
PRSTS305A	Identify and diagnose electronic security equipment/ system fault	CPPSEC3039A	Identify and diagnose electronic security equipment and system fault	Not equivalent
PRSTS306A	Plan and co-ordinate installation	CPPSEC3040A	Plan and co-ordinate installation of security equipment and system	Not equivalent
PRSTS307A	Maintain and service security equipment/system	CPPSEC3041A	Maintain and service security equipment and system	Not equivalent
PRSTS316A	Configure a security system	CPPSEC3046C	Configure a security system	Not equivalent
PSPGOV603B	Develop a tender submission response	PSPGOV603B	Develop a tender submission Response	Same unit
UEENEEC004B	Prepare specifications for the supply of materials and equipment for electrotechnology projects	UEENEEC004B	Prepare specifications for the supply of materials and equipment for electrotechnology projects	Same unit
UEENEEC005B	Estimate electrotechnology	UEENEEC005B	Estimate electrotechnology	Same unit

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
	projects		projects	
UEENEEC006B	Prepare tender submissions for electrotechnology projects	UEENEEC006B	Prepare tender submissions for electrotechnology projects	Same unit
UEENEED002B	Assemble, set up and test personal computers	UEENEED102A	Assemble, set-up and test computing devices	Equivalent
UEENEED004B	Use engineering applications software	UEENEED104A	Use engineering applications software on personal computers	Equivalent
UEENEED007B	Develop, enter and verify programs for programmable logic controllers using ladder instruction set	Unit removed		
UEENEED012B	Support computer hardware and software	UEENEED112A	Support computer hardware and software for engineering applications	Equivalent
UEENEED015B	Administer user networks	UEENEED115A	Administer computer networks	Equivalent
UEENEED017B	Install and configure Internetworking systems	UEENEED117A	Install and configure network systems for internetworking	Equivalent
UEENEED024B	Integrate multiple computer operating systems on a client server network	UEENEED124A	Integrate multiple computer operating systems on a client server local area network	Equivalent
UEENEED027B	Develop structured programs to control external devices	UEENEEI155A	Develop structured programs to control external devices	Not Equivalent
UEENEED031B	Develop and validate basic integrated systems	Unit removed		
UEENEED032B	Design integrated systems	Unit removed		
UEENEED033B	Design complex integrated systems	Unit removed		
UEENEED046B	Set up and configure basic local area network	UEENEED146A	Set up and configure basic local area network (LAN)	Equivalent
UEENEEE001B	Apply OHS practices in the workplace	UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace	Equivalent
UEENEEE002B	Dismantle, assemble and fabricate electrotechnology components	UEENEEE102A	Fabricate, assemble and dismantle utilities industry components	Equivalent
UEENEEE003B	Solve problems in extra-low voltage single path circuits	UEENEEE103A	Solve problems in ELV single path circuits	Equivalent
UEENEEE004B	Solve problems in multiple path d.c. circuits	UEENEEE104A	Solve problems in d.c. circuits	Equivalent
UEENEEE005B	Fix and secure equipment	UEENEEE105A	Fix and secure electrotechnology equipment	Equivalent
UEENEEE007B	Use drawings, diagrams, schedules and manuals	UEENEEE107A	Use drawings, diagrams, <i>schedules, standards, codes and specifications</i>	Equivalent
UEENEEE008B	Lay wiring/cabling and terminate accessories for extra-low voltage circuits	UEENEEE108A	Lay wiring cabling and terminate accessories for extra-low voltage (ELV) circuits	Equivalent
UEENEEE023B	Solve basic problems in electronic and digital equipment	UEENEEE123A	Solve basic problems electronic and digital equipment and circuits	Equivalent
UEENEEH001B	Carry out basic repairs to computer equipment by replacement of modules/sub-assemblies	UEENEEH101A	Repair basic computer equipment faults by replacement of modules/sub-assemblies	Equivalent
UEENEEH002B	Carry out basic repairs to electronic apparatus by replacement of components	UEENEEH102A	Repairs basic electronic apparatus faults by replacement of components	Equivalent
UEENEEH012B	Troubleshoot digital subsystems	UEENEEH112A	Troubleshoot digital sub-systems	Equivalent
UEENEEH014B	Troubleshoot frequency dependent circuits	UEENEEH114A	Troubleshoot resonance circuits in an electronic apparatus	Equivalent

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
UEENEEH015B	Develop software solutions in microcontroller based systems	UEENEEH115A	Develop software solutions for microcontroller based systems	Equivalent
UEENEEH039B	Troubleshoot basic amplifiers	UEENEEH139A	Troubleshoot basic amplifier circuits	Equivalent
UEENEEH066B	Fault find micro-controller based hardware	UEENEEH166A	Troubleshoot microcontroller based hardware systems	Equivalent
UEENEEK001B	Maintain safety and tidiness of remote area power supply(RAPS) systems	UEENEEK101A	Maintain safety and tidiness of remote area power supply systems	Equivalent
UEENEEK002B	Work safely with remote area power supply (RAPS) systems	UEENEEK102A	Work safely with remote area power supply systems	Equivalent
UEENEEK003B	Conduct periodic maintenance of remote area power supply (RAPS) battery banks	UEENEEK103A	Conduct periodic maintenance of remote area power supply battery banks	Equivalent
UEENEEK004B	Conduct periodic maintenance of remote area power supply (RAPS) generator sets	UEENEEK104A	Conduct periodic maintenance of remote area power supply generator sets	Equivalent
UEENEEK005B	Conduct periodic maintenance of remote area power supply (RAPS) photo voltaic arrays	UEENEEK105A	Conduct periodic maintenance of remote area power supply photo voltaic arrays	Equivalent
UEENEEK006B	Conduct periodic maintenance of remote area power supply (RAPS) wind generators	UEENEEK106A	Conduct periodic maintenance of remote area power supply wind generators	Equivalent
UEENEEK007B	Conduct audits in the demand side use of remote area power supplies	UEENEEK107A	Conduct checks in the demand side use of remote area power supplies (RAPS)	Equivalent
UEENEEK008B	Plan periodic maintenance schedules of remote area power supplies	UEENEEK108A	Plan periodic maintenance schedules of remote area power supplies (RAPS)	Equivalent
UEENEEK009B	Attend to breakdowns in remote area power supplies	UEENEEK109A	Attend to breakdowns in remote area power supplies (RAPS)	Equivalent
UEENEEK010B	Coordinate maintenance of renewable energy apparatus and systems	UEENEEK110A	Co-ordinate maintenance of renewable energy (RE) apparatus and systems	Equivalent
UEENEEK011B	Assemble and connect remote area power supplies	UEENEEK111A	Assemble and connect remote area power supplies	Equivalent
UEENEEK012B	Provide basic sustainable energy solutions for energy reduction in domestic premises	UEENEEK112A	Provide basic sustainable energy solutions for energy reduction in residential premises	Equivalent
UEENEEK013B	Apply sustainable energy practice in daily activities	Superseded		
UEENEEK014B	Promote sustainable energy practice in the community	UEENEEK114A	Promote sustainable energy practices in the community	Equivalent
		UEENEEK116A	Maintain and repair remote area power generation facilities	New Unit
UEENEEK017B	Maintain and repair facilities associated with remote area essential services operation	UEENEEK117A	Maintain and repair facilities associated with remote area essential service operations	Equivalent
UEENEEK018B	Maintain operation of remote area water facilities	No equivalent		
UEENEEK019B	Maintain operation of remote area waste water facilities	No equivalent		
UEENEEK020B	Maintain operation of remote area power plant	UEENEEK120A	Maintain operation of remote area power generation plant	Equivalent

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
UEENEEK023B	Carry out basic repairs to renewable energy apparatus by replacement of components	UEENEEK123A	Carry out basic repairs to renewable energy apparatus	Equivalent
UEENEEK024B	Assemble and set up photovoltaic apparatus in domestic dwellings	No equivalent		
UEENEEK025B	Solve basic problems in photovoltaic energy apparatus	UEENEEK125A	Solve basic problems in photovoltaic energy apparatus and systems	Equivalent
UEENEEK026B	Install and set up grid connected photovoltaic power systems	No equivalent		
UEENEEK027B	Diagnose faults in renewable energy control systems	UEENEEK127A	Diagnose and rectify faults in renewable energy control systems	Equivalent
UEENEEK028B	Solve problems in stand-alone renewable energy systems	UEENEEK128A	Solve problems in stand-alone renewable energy systems	Equivalent
UEENEEK030B	Solve problems in wind energy conversion systems	UEENEEK130A	Solve problems in wind energy conversion systems rated up to 10kW	Equivalent
UEENEEK032B	Develop strategies to address sustainability issues	UEENEEK132A	Develop strategies to address environmental and sustainability issues in the energy sector	Equivalent
UEENEEK037B	Install and set up micro-hydro systems	UEENEEK137A	Install, set up and maintain ELV micro-hydro systems rated up to 6.4 kW	Equivalent
UEENEEK038B	Design micro-hydro systems	UEENEEK138A	Design micro-hydro systems rated to 6.4 kW	Equivalent
UEPMNT349A	Diagnose and Repair Faults in Electrical Equipment	No equivalent		
UEPMNT410A	Diagnose and Repair Faults in Electronic Equipment	UEPMNT410B	Diagnose and repair faults in electronic equipment	Equivalent
UEPMNT411A	Diagnose and Repair Faults in Complex Electrical Equipment	UEPMNT411B	Diagnose and repair faults in complex electrical equipment	Equivalent
UEPMNT418A	Perform Mechanical and Fabrication Drafting	No equivalent		
UEPMNT420A	Perform Electrical/Electronic Drafting	UEPMNT420A	Perform Electrical/Electronic Drafting	Same unit
UEPMNT433A	Conduct Routine Generator Electrical Maintenance	UEPMNT433B	Conduct routine generator electrical maintenance	Equivalent
UEPOPS238A	Maintain battery banks and cells	UEPOPS238B	Maintain battery banks and cells	Equivalent
UEPOPS343A	Operate Hydro-Electric Generating Plant and Auxiliary Equipment	UEPOPS343B	Operate hydro-electric generating plant and auxiliary equipment	Equivalent
UEPOPS347A	Operate and Monitor Supervisory, Control and Data Acquisition Systems	UEPOPS347B	Operate and Monitor Supervisory, Control and Data Acquisition Systems	Equivalent
VBN768	Develop an individual career plan for the engineering industry	VU20909	Develop an individual career plan for the engineering industry	Equivalent
VBN769	Perform basic machining processes	VU20912	Perform basic machining Processes	Equivalent
VBN770	Apply basic fabrication techniques	VU20913	Apply basic fabrication techniques	Equivalent
VBN771	Apply electrotechnology principles in an engineering work environment	VU21095	Apply electrotechnology principles in an engineering work environment	Equivalent
VBN772	Use computers for engineering related work activities	VU21537	Use computers for engineering related work activities	Equivalent
VBN773	Produce basic engineering	VU20910	Produce basic engineering	Equivalent

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
	sketches and drawings		sketches and drawings	
VBN774	Perform basic computational principles in engineering work activities	VU21538	Perform basic computational principles in engineering work activities	Equivalent
VBN776	Use basic engineering concepts to plan the manufacture of engineering components	VU21096	Use basic engineering concepts to plan the manufacture of engineering components	Equivalent
VBN777	Handle engineering materials	VU20911	Handle engineering materials	Equivalent
VBN778	Produce basic engineering components and products using fabrication and machining	VU20903	Produce basic engineering components and products using fabrication and machining	Equivalent
VBN779	Perform cutting, grinding and turning operations	VU20904	Perform cutting, grinding and turning operations	Equivalent
VBN780	Form, bend and shape engineering materials	VU20914	Form, bend and shape engineering materials	Equivalent
VBN781	Use fundamental refrigeration principles and processes to make refrigeration and/or air conditioning equipment operational	VU21539	Use fundamental refrigeration principles and processes to make refrigeration and/or air conditioning equipment operational	Equivalent
VBN782	Perform basic welding and thermal cutting processes to fabricate engineering structures	VU20915	Perform basic welding and thermal cutting processes to fabricate engineering structures	Equivalent
VBN783	Create engineering drawings using computer aided systems	VU20916	Create engineering drawings using computer aided systems	Equivalent
VBN785	Assemble and test electronic engineering equipment and make it operational	VU21540	Assemble and test electronic engineering equipment and make it operational	Equivalent
VBP119	Perform basic network and computer assembly	VU21554	Perform basic network and computer assembly	Equivalent
VBP120	Perform basic network and computer maintenance	VU21555	Perform basic network and computer maintenance	Equivalent
VBP121	Install and configure basic network and computer operating systems	VU21556	Install and configure basic network and computer operating systems	Equivalent
VBP122	Install and test a home entertainment system	VU21565	Install and test a home entertainment system	Equivalent
VBP123	Build a small wireless LAN	VU21581	Build a small wireless LAN	Equivalent
VBP124	Install and test a wireless intercom system	VU21566	Install and test a wireless intercom system	Equivalent
VBP125	Conduct a site survey for a wireless network	VU21567	Conduct a site survey for a wireless network	Equivalent
VBP126	Set up and operate a wireless communications link	VU21568	Set up and operate a wireless communications link	Equivalent
VBP127	Install communications antennae	VU21569	Install communications antennae	Equivalent
VBP128	Set up and test an embedded control system	VU21388	Set up and test an embedded control system	Equivalent
VBP129	Test and verify correct operation of a “by-wire” control system	VU21387	Test and verify correct operation of a “by-wire” control system	Equivalent
VBP130	Implement a digital circuit using a programmable logic devices (PLD)	VU21352	Implement a digital circuit using a programmable logic devices (PLD)	Equivalent

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
VBP132	Program a basic robotic system	VU21340	Program a basic robotic system	Equivalent
VBP133	Plan and build a system using photonic equipment	VU20177	Plan and build a system using fibre optic equipment	Equivalent
VBP134	Use photonic equipment in engineering technology	VU20178	Use fibre optic equipment in engineering technology	Equivalent
VBP135	Use photonic equipment in communications technology	VU20179	Use fibre optic equipment in communications technology	Equivalent
VBP136	Operate a small power supply system	VU21552	Operate a small power supply system	Equivalent
VBP137	Assemble and connect an extra low voltage battery power source	VU21553	Assemble and connect an extra low voltage battery power source	Equivalent
VBP138	Maintain rechargeable battery systems	VU21541	Maintain rechargeable battery systems	Equivalent
VBP139	Identify and locate building blocks of a centralised power generation system	VU21542	Identify and locate building blocks of a centralised power generation system	Equivalent
VBP140	Set up an extra low voltage emergency power supply system (not exceeding 32V)	VU21543	Set up an extra low voltage emergency power supply system (not exceeding 32V)	Equivalent
VBP141	Install a sustainable extra low voltage energy power system	VU21544	Install a sustainable extra low voltage energy power system	Equivalent
VBP247	Set up advanced manufacturing systems (AMS)	VU21207	Set up advanced manufacturing systems (AMS)	Equivalent
VBP258	Apply safe working practice when operating vacuum systems	VU21239	Apply safe working practice when operating vacuum systems	Equivalent
VBP259	Apply vacuum principles to advanced manufacturing	VU21240	Apply vacuum principles to advanced manufacturing	Equivalent
VBP260	Identify & select vacuum components & materials	VU21241	Identify & select vacuum components & materials	Equivalent
VBP261	Operate vacuum components and systems	VU21242	Operate vacuum components and systems	Equivalent
VBP262	Maintain & repair vacuum systems	VU21243	Maintain & repair vacuum systems	Equivalent
VBP269	Apply hydraulic principles in engineering	VU21203	Apply hydraulic principles in engineering	Equivalent
VBP270	Apply pneumatic principles in engineering	VU21204	Apply pneumatic principles in engineering	Equivalent
VBP271	Set up mechatronics engineering systems	VU21219	Set up mechatronics engineering systems	Equivalent
VBP275	Program, operate and select a robotics system	VU21232	Program, operate and select a robotics system	Equivalent
VBP300	Implement control processes using PLCs	VU21270	Implement control processes using PLCs	Equivalent
VBP301	Program control systems	VU21174	Program control systems	Equivalent
VBP302	Interface control systems to industrial processes and analyse data from Data Acquisition Systems (SCADA)	VU21173	Interface control systems to industrial processes and analyse data from Data Acquisition Systems (SCADA)	Equivalent
VBP303	Apply instrumentation principles to industrial control systems	VU21172	Apply instrumentation principles to industrial control systems	Equivalent
VBP305	Implement and maintain control systems for industrial processes	VU21170	Implement and maintain control systems for industrial processes	Equivalent
VBQU260	Utilise digital electronics for control applications	VU21176	Utilise digital electronics for control applications	Equivalent

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
VPAU645	Install and configure a home or small office network	VU21557	Install and configure a home or small office networks	Equivalent
VPAU646	Install and configure a small to medium business network	VU21558	Install and configure a small to medium business network	Equivalent
VPAU808	Implement and troubleshoot enterprise routers and switches	VU21559	Implement and troubleshoot enterprise routers and switches	Equivalent
VPAU809	Design, install and configure an internet	VU21560	Design, install and configure an internet	Equivalent
VPAU810	Build and maintain a fundamental network	VU21561	Build a simple network and establish end to end connectivity	Not Equivalent
VPAU811	Apply advanced routing protocols to network design	VU21562	Configure and troubleshoot network switches and routers	Not Equivalent
VPAU812	Configure and troubleshoot advanced network switching	VU21563	Scale an existing network	Not Equivalent
VPAU813	Install and maintain a WAN	VU21564	Establish connectivity to a wide area network (WAN)	Not Equivalent
VPAU814	Apply electrical principles to route selection of power distribution networks	VU21570	Apply electrical principles to route selection of power distribution networks	Equivalent
VPAU815	Apply electrical considerations to developing the design of power distribution infrastructure	VU21571	Apply electrical considerations to developing the design of power distribution infrastructure	Equivalent
		VU21339	Set up and commission programmable logic controllers	New Unit
		VU21087	Write programs for programmable logic controllers	New Unit
		VU20906	Configure and program a basic robotic system	New Unit
		VU21086	Develop, enter and verify programs for SCADA systems	New Unit
		VU21085	Integrate programmable logic controllers into industrial control processes	New Unit
		VU21572	Install and maintain induction motors	New Unit
		VU21550	Evaluate performance of electrical machines	New Unit
		VU21551	Test and monitor fluid power circuits	New Unit
		VU21609	Install and maintain hydraulic/pneumatic systems	New Unit
		VU21084	Set up electronically controlled robotically operated complex systems	New Unit
		VU21083	Test and commission transducers and sensors	New Unit
		VU21082	Set up electronically controlled mechanically operated complex systems	New Unit
		VU21573	Diagnose and rectify faults in AC. motor drive systems	New Unit
		VU21574	Diagnose and rectify faults in DC. motor drive systems	New Unit
		VU21545	Evaluate proportional and servo controlled fluid power systems	New Unit
		VU21546	Monitor and adjust an integrated fluid power control system	New Unit
		VU21547	Select components for an integrated fluid power design project	New Unit
		VU21548	Install and commission an integrated fluid power system	New Unit

21915VIC Certificate IV in Shared Technology		22263VIC Certificate IV in Integrated Technologies		Comments
Unit code	Unit title	Unit code	Unit title	
		VU21549	Conduct a feasibility study for an integrated fluid power system	New Unit
		VU22324	Build a simple network and establish end to end connectivity	New Unit
		VU22325	Configure and troubleshoot network switches and routers	New Unit
		VU22326	Apply network scaling tools and techniques	New Unit
		VU22327	Establish connectivity to a wide area network (WAN)	New Unit

4. Course outcomes		Standards 1, 2, 3 and 4 AQF Standards for Accredited Courses
4.1 Qualification level	The Certificate IV in Integrated Technologies is aligned to the AQF level 4 descriptor (<i>AQF Implementation Handbook, 2013</i>) in that the competencies gained enable the individuals to fulfil the following:	
	Purpose The Certificate IV qualifies individuals who apply a broad range of specialised knowledge and skills in varied contexts to undertake skilled work, in this case integrating various technologies, as required. Knowledge Graduates will have broad factual, technical and theoretical knowledge in a specialised field of work and learning. <i>For example in applying an in depth knowledge of regulatory and safety requirements relating to integrated technologies.</i> Skills • cognitive skills to identify, analyse, compare and act on information from a range of sources. <i>For example in analysing cabling diagrams, machine drawings, system schematics and appropriated lists for commissioning, testing, maintenance and fault finding purposes;</i> • cognitive, technical and communication skills to apply and communicate technical solutions of a non-routine or contingency nature to a defined range of predictable and unpredictable problems. <i>For example, in methodically solving problems by fault finding a wide range of equipment and associated infrastructure, even in unfamiliar contexts;</i> • specialist technical skills to complete routine and non-routine tasks and functions. <i>For example, in applying integrated technologies to a range of tasks and functions;</i> • communication skills to guide activities and provide technical advice in the area of work or learning. <i>For example in providing technical advice to clients and colleagues on integrated technology solution.</i>	

	Application of knowledge and skills Graduates will demonstrate the application of knowledge and skills: • to specialised tasks and functions, <i>such as the detailed maintenance and repair of a wide range of systems and infrastructure;</i> • with responsibility for own functions and outputs. <i>For example, in commissioning and testing of electrical, mechanical, medical systems, telecommunications or sustainable energy systems equipment and associated infrastructure:</i> • with limited responsibility for organisation of others. <i>For example in supervising small integrated technology work teams and provide technical support.</i> Volume of Learning for a Certificate IV is typically 0.5-2 years. This Certificate IV course is designed to meet the requirements for an integrated technology practitioner and is equivalent to 1 year full time. This consists of approximately 800 nominal hours of structured learning and an equivalent number of hours in self-directed learning, project work and assignments.
4.2 Employability Skills	This course has been mapped to national employability skills, as indicated below:

Employability Skill	Industry/enterprise requirements for this qualification include the following facets:
Communication	• Listening to and understanding given instructions • Speaking clearly and directly • Reading and following written work descriptions • Reporting work completion to appropriate personnel • Completing documentation
Teamwork	• Working cooperatively with other team members • Participating in group discussion of OHS procedures • Organising small team activities • Supervising small work-teams and provide technical support
Problem solving	• Applying standard engineering problem solving techniques to routine problems with respect to integrated technologies • Developing practical solutions by applying combined technologies • Using team methods to solve problems • Using simple mathematical calculations to support problem solving
Initiative and enterprise	• Adapting to new work situations • Improving knowledge with respect to changing technologies • Identifying process improvement opportunities • Showing some creativity in approach to work solutions
Planning and organising	• Collecting, analysing and organising information • Managing and monitoring own and small group time and priorities • Taking initiative and making decisions
Self-management	• Working individually unsupervised • Having confidence in own knowledge to meet goals • Evaluating and monitoring own performance • Taking responsibility for work quality and completion
Learning	• Managing own learning • Using skills in different contexts • Using mentoring and coaching activities
Technology	• Using internet and intranet • Using ICT skills to complete activities • Using industry relevant software, technology and equipment • Using technologies to perform tasks
4.3 Recognition given to the course	Not applicable
4.4 Licensing/regulatory requirements	Not applicable

5. Course rules

Standards 2, 6,7 and 9 AQTF Standards for Accredited Courses

5.1 Course structure

The structure of the *Certificate IV in Integrated Technologies* is based on a core/elective model. The core provides the fundamental knowledge and skills for course graduates to be able to operate effectively across a range of technologies. A large number of elective units, made up of nationally endorsed units of competency and units of competency from Victorian state accredited courses, is provided to further enhance technology specific knowledge and skills development.

The elective units are grouped by technology specialisations. To satisfy the requirement for graduates to work in an integrated technology environment, course participants must choose units from at least two specialisations from the table of elective units, in order to complete the qualification.

To attain the *Certificate IV in Integrated Technologies*, participants must complete 800 nominal hours comprising:

- Completion of all seven (7) core units (320 hours)
- Completion of 480 hours of elective units from two or more specialisations comprising:

Specialisation 1:

Minimum of 200 hours of units originally packaged at Certificate IV level or higher;

Specialisation 2:

Minimum of 200 hours of units originally packaged at Certificate IV level or higher;

- The remainder of elective units may be selected from any specialisation, or imported from Training Packages and/or State accredited courses

The imported unit/s of competency must be relevant to the integrated technology job function or the need of the enterprise and meet the packaging rules specified above.

Participants who do not complete the full course will be awarded a Statement of Attainment listing those units that they have successfully completed.

Some electives have pre-requisite units, which must be satisfied in addition to the specific elective.

Specialisations

The following specialisations are available for the Certificate IV in Integrated Technologies course:

Broadcast Engineering

	• radio and television broadcasting equipment and facilities <u>Building Automation and Security</u> • domestic/commercial/industrial automation • multimedia, climate control, lighting • building surveillance-alarms, fire alarm <u>Control Technologies</u> • embedded control, robotics, pneumatics, hydraulics <u>Engineering Business</u> • estimating, quoting, tendering <u>Manufacturing Technology</u> • manufacturing systems, production processes, fabrication, quality concepts • micro-fabrication / nano-technology <u>Fluid power</u> • hydraulic circuits • pneumatic circuits • integrated fluid power systems <u>Photonics</u> • devices, systems, interfacing, control <u>Sustainable Energy Systems</u> • generation, storage, distribution, monitoring • energy management systems <u>Technical Support</u> • vacuum, clean-room, control, microwave pneumatics/hydraulics • network infrastructure, security, access • customer relations/training, sales and post-sales support • installation, configuration, programming • ongoing tech support and maintenance <u>Telecommunications</u> • services, network equipment, customer equipment, cabling, monitoring <u>Wireless Technologies</u> • infrastructure • protocols • installing, commissioning, monitoring/maintaining <u>Electrotechnology</u> • electrical distribution • analogue and digital electronics • amplifiers Providers are advised that in counselling learners on the choice of electives consideration should be given to ensure that a balance between breadth and depth in a particular specialisation is achieved.

Table 2 – Core units

Unit of competency code	Field of Education	Unit of competency title	Hrs	Pre- requisites
MEM30007A		Select common engineering materials	40	None
UEENEEE101A		Apply Occupational Health and Safety regulations, codes and practices in the work-place	20	None
UEENEEE102A		Fabricate, assemble and dismantle utilities industry components	40	UEENEEE101A
UEENEEE141A		Use of routine equipment/plant/technologies in an energy sector environment	60	UEENEEE101A
VU21534	010101	Apply mathematics in an integrated technology context	50	None
VU21535	031399	Implement an integrated technology project	60	None
VU21536	020199	Apply computer tools and networking in an integrated technology context	50	None
Total hours of core units			320	
Electives (Selected from Table 3)			480	
Total course nominal duration			800	

Table 3: Elective Units of Competency

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
Broadcast Engineering Specialisation					
BSBDES501A		Implement design solutions	60	5	None
CUFBRT401A		Install or upgrade broadcast equipment and facilities	100	4	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
CUEBRT402A		Maintain broadcast equipment and facilities	100	4	None
CUEBRT403A		Ensure quality of broadcast output	100	4	None
CUEBRT501A		Collaborate on the design of broadcasting facilities	50	5	CUEBRT402A
ICANWK411A		Deploy software to networked computers	40	3	None
Building Automation and Security Specialisation					
CPPSEC3035A		Identify technical security requirements	8	3	None
CPPSEC3036A		Program security equipment and system	30	3	None
CPPSEC3037A		Test installed security equipment and system	12	3	None
CPPSEC3038A		Commission and decommission security equipment and system	16	3	None
CPPSEC3039A		Identify and diagnose electronic security equipment and system fault	20	3	None
CPPSEC3040A		Plan and co-ordinate installation of security equipment and system	20	3	None
CPPSEC3041A		Maintain and service security equipment and system	24	3	None
CPPSEC3046A		Configure a security system	30	3	None
CUFDIG201A		Maintain interactive content	30	2	None
CUFDIG302A		Author interactive sequences	40	3	None
CUFDIG501A		Coordinate the testing of interactive media products	40	5	None
ICAICT101A		Operate a personal computer	30	1	None
ICAICT201A		Use computer operating systems and hardware	60	2	None
ICAICT203A		Operate application software packages	60	2	None
ICAICT301A		Create user documentation	20	3	None
ICAICT302A		Install and optimise operating system software	20	3	None
ICAICT411A		Select and employ software and hardware testing tools	40	4	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
ICASAS419A		Support system software	50	4	None
ICTCBL2136B		Install, maintain and modify customer premises communications cabling: ACMA Restricted Rule	60	3	None
ICTCMP2239A		Perform restricted customer premises broadband cabling work: ACMA Restricted Rule	20	4	ICTCBL2136B
ICTCBL2137B		Install, maintain and modify customer premises communications cabling: ACMA Open Rule	100	3	None
Control Technologies Specialisation					
UEENEED104A		Use engineering applications software on personal computers	40	3	UEENEEE101A
UEENEEH101A		Repair basic computer equipment faults by replacement of modules/sub-assemblies	40	2	UEENEEE102A UEENEEE107A UEENEEE104A OR UEENEEE123A UEENEEE101A
UEENEEH102A		Repairs basic electronic apparatus faults by replacement of components	40	2	UEENEEE101A UEENEEE102A
UEENEEH112A		Troubleshoot digital sub-systems	80	3	UEENEEE101A UEENEEH102A
UEENEEH115A		Develop software solutions for microcontroller based systems	60	3	UEENEEE101A
UEENEEH166A		Troubleshoot microcontroller based hardware systems	40	3	None
UEENEEI155A		Develop structured programs to control external devices	40	4	UEENEEE101A
VU20906	030101	Configure and program a basic robotic system	60	3	None
VU21610	030101	Perform precision measurements	30	4	None
VU21170	030101	Implement and maintain control systems for industrial processes	120	5	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
VU21172	030199	Apply instrumentation principles to industrial control systems	80	5	None
VU21173	030101	Interface control systems to industrial processes and analyse data from Data Acquisition Systems (SCADA)	120	5	None
VU21174	030101	Program control systems	60	5	None
VU21176	031301	Utilise digital electronics for control applications	60	5	None
VU21232	030701	Program, operate and select a robotics system	60	5	None
VU21203	030703	Apply hydraulic principles in engineering	60	5	None
VU21204	030703	Apply pneumatic principles in engineering	60	5	None
VU21270	030101	Implement control processes using PLCs	80	5	None
VU21219	030703	Set up mechatronics engineering systems	60	5	None
VU21388	031305	Set up and test an embedded control system	30	2	None
VU21387	031303	Test and verify correct operation of a "by-wire" control system	30	2	None
VU21352	031303	Implement a digital circuit using a programmable logic devices (PLD)	30	2	None
VU21340	030703	Program a basic robotic system	30	2	None
VU21339	030703	Set up and commission programmable logic controllers	40	4	None
VU21087	030703	Write programs for programmable logic controllers	60	4	None
VU21086	030703	Develop, enter and verify programs for SCADA systems	60	4	None
VU21085	030703	Integrate programmable logic controllers into industrial control processes	80	4	None
VU21084	031303	Set up electronically controlled robotically operated complex systems	80	4	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
VU21083	030703	Test and commission transducers and sensors	60	4	None
VU21082	031303	Set up electronically controlled mechanically operated complex systems	80	4	None
Engineering Business Specialisation					
BSBEBU501A		Investigate and design ebusiness solutions	50	5	None
BSBITU301A		Create and use databases	30	3	None
BSBPUR301B		Purchase goods and services	60	3	None
BSBWRT401A		Write complex documents	50	4	None
MEM11012B		Purchase materials	60	3	None
MEM16009A		Research and analyse engineering information	20	4	None
MEM16010A		Write reports	20	3	None
MEM16011A		Communicate with individuals and small groups	20	3	None
MEM16014A		Report technical information	20	3	None
MEM22015A		Source and estimate engineering materials required	40	4	None
MEM30023A		Prepare a simple cost estimate for a manufactured product	20	4	None
PSPGOV603B		Develop a tender submission response	50	5	None
UEENEEC004B		Prepare specifications for the supply of materials and equipment for electrotechnology projects	40	4	None
UEENEEC005B		Estimate electrotechnology projects	40	4	None
UEENEEC006B		Prepare tender submissions for electrotechnology projects	60	5	UEENEEC005B
Manufacturing Technology Specialisation					
MEM09002B		Interpret technical drawing	40	3	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
MEM09003B		Prepare basic engineering drawing	80	3	MEM09002B
MEM10004B		Enter and change programmable controller operational parameters	20	3	MEM09002B MEM16008A
MEM10005B		Commission programmable controller programs	40	3	MEM09002B MEM10004B MEM16008A
MEM10007C		Modify control systems	60	4	MEM10007B has eight different pre-requisite pathways. Refer to the MEM05 Metals and Engineering Training Package for details.
MEM13014A		Apply principles of occupational health and safety in the work environment	10	2	None
MEM18001C		Use hand tools	20	2	None
MEM18002B		Use power tools/hand held operations	20	2	None
MEM18020B		Maintain hydraulic system components	40	3	MEM09002B MEM12023A MEM18001C MEM18002B MEM18003C MEM18006B MEM18055B
MEM18021B		Maintain hydraulic systems	40	3	MEM09002B MEM12023A MEM18001C MEM18002B MEM18003C MEM18006B MEM18020B MEM18055B
MEM23041A		Apply basic scientific principles and techniques in mechanical engineering situations	80	5	None
MEM23064A		Select and test mechatronic engineering materials	60	5	None
MEM30012A		Apply mathematical techniques in a manufacturing engineering or related environment	40	3	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
VU21610	030101	Perform precision measurements	30	4	None
VU21611	030101	Dismantle and assemble engineering components or subassemblies	30	2	None
VU20903	030101	Produce basic engineering components and products using fabrication and machining	60	2	VU20910 VU20912 VU20913
VU20904	030707	Perform cutting, grinding and turning operations	60	2	VU20910 VU20912 VU20913
VU20909	030799	Develop an individual career plan for the engineering industry	20	2	None
VU20910	030701	Produce basic engineering sketches and drawings	20	2	None
VU20911	030799	Handle engineering materials	20	2	None
VU20912	030707	Perform basic machining processes	40	2	None
VU20913	030101	Apply basic fabrication techniques	40	2	None
VU20914	030709	Form, bend and shape engineering materials	60	2	VU20913
VU20915	030711	Perform basic welding and thermal cutting processes to fabricate engineering structures	60	2	None
VU20916	030799	Create engineering drawings using computer aided systems	60	2	VU21537 VU20910
VU21095	031399	Apply electrotechnology principles in an engineering work environment	20	2	None
VU21096	030101	Use basic engineering concepts to plan the manufacture of engineering components	20	2	None
VU21207	030101	Set up advanced manufacturing systems (AMS)	60	5	None
VU21232	030701	Program, operate and select a robotics system	60	5	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
VU21239	030101	Apply safe working practice when operating vacuum systems	20	4	None
VU21240	030101	Apply vacuum principles to advanced manufacturing	40	5	None
VU21241	030101	Identify & select vacuum components & materials	40	5	None
VU21242	030101	Operate vacuum components and systems	40	4	None
VU21243	030101	Maintain & repair vacuum systems	60	5	None
VU21537	030799	Use computers for engineering related work activities	20	2	None
VU21538	030799	Perform basic computational principles in engineering work activities	20	2	None
VU21539	031315	Use fundamental refrigeration principles and processes to make refrigeration and/or air conditioning equipment operational	60	2	MEM18001C MEM18002B VU20910 VU21538
VU21540	030101	Assemble and test electronic engineering equipment and make it operational	60	2	MEM18001C MEM18002B VU21538
VU21541	031301	Maintain rechargeable battery systems	30	2	None
VU21542	031301	Identify and locate building blocks of a centralised power generation system	30	2	None
VU21543	031301	Set up an extra low voltage emergency power supply system (not exceeding 32V)	30	2	None
VU21544	031301	Install a sustainable extra low voltage energy power system	30	2	None
Fluid Power Specialisation					
MEM18052B		Maintain fluid power systems for mobile plant	40	3	MEM09002B MEM12023A MEM18001C MEM18002B MEM18055B

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
MEM23006A		Apply fluid and thermodynamics principles in engineering	80	5	MEM23004A
MEM23114A		Evaluate thermodynamic systems and components	60	4	MEM23004A MEM23006A
MEM23115A		Evaluate fluid power systems	60	4	MEM23004A MEM23006A
MEM234007A		Design fluid power systems	40	5	None
MEM30010A		Set up basic hydraulic circuits	40	4	None
MEM30011A		Set up basic pneumatic circuits	40	4	None
VU21610	030101	Perform precision measurements	30	4	None
VU21609	030703	Install and maintain hydraulic/pneumatic systems	60	4	None
VU21545	030703	Evaluate proportional and servo controlled fluid power systems	80	5	VU21546 VU21547 VU21548 MEM23006A VU21270
VU21546	030703	Monitor and adjust an integrated fluid power control system	60	4	VU21547 MEM23006A VU21270
VU21547	030703	Select components for an integrated fluid power design project	40	4	MEM23006A VU21546
VU21548	030703	Install and commission an integrated fluid power system	80	5	VU21546 MEM23006A VU21270
VU21549	030703	Conduct a feasibility study for an integrated fluid power system	80	5	VU21546 VU21547 VU21548 MEM23006A VU21270
VU21550	030703	Evaluate performance of electrical machines	40	4	None
VU21551	030703	Test and monitor fluid power circuits	60	4	None
Fibre Optics Specialisation					
ICTITU5144A		Test telecommunications network using virtual instruments	60	5	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
ICTOPN5121A		Test and commission a dense wavelength division multiplexing transmission system	50	5	None
ICTOPN5122A		Test the performance of specialised optical devices	45	5	None
ICTOPN5123A		Analyse and integrate specialised optical devices in the network	60	5	None
VU20177	031303	Plan and build a system using fibre optic equipment	30	2	None
VU20178	030703	Use fibre optic equipment in engineering technology	30	2	None
VU20179	031307	Use fibre optic equipment in communications technology	30	2	None
Sustainable Energy Systems Specialisation					
UEENEEE104A		Solve problems in multiple path d.c. circuits	80	2	UEENEEE101A
UEENEEE105A		Fix and secure electrotechnology equipment	20	2	UEENEEE101A
UEENEEE107A		Use drawings, diagrams, schedules, standards, codes and specifications	40	2	UEENEEE101A
UEENEEE108A		Lay wiring cabling and terminate accessories for extra-low voltage (ELV) circuits	40	2	UEENEEE101A UEENEEE102A UEENEEE105A UEENEEE107A
UEENEEK101A		Maintain safety and tidiness of remote area power supply systems	20	2	UEENEEE101A UEENEEK102A
UEENEEK102A		Work safely with remote area power supply systems	20	2	UEENEEE101A
UEENEEK103A		Conduct periodic maintenance of remote area power supply battery banks	40	2	UEENEEE101A UEENEEE102A UEENEEE107A UEENEEE131A UEENEEK101A UEENEEK102A OR UEENEEE104A

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
UEENEEK104A		Conduct periodic maintenance of remote area power supply generator sets	40	2	UEENEEE101A UEENEEE102A UEENEEE107A UEENEEE131A UEENEEK101A UEENEEK102A OR UEENEEE104A
UEENEEK105A		Conduct periodic maintenance of remote area power supply photo voltaic arrays	40	2	UEENEEE101A UEENEEE102A UEENEEE107A UEENEEE131A UEENEEK101A UEENEEK102A OR UEENEEE104A
UEENEEK106A		Conduct periodic maintenance of remote area power supply wind generators	40	2	UEENEEE101A UEENEEE102A UEENEEE003B UEENEEK101A UEENEEE107A UEENEEK102A UEENEEE131A OR UEENEEE104A
UEENEEK107A		Conduct checks in the demand side use of remote area power supplies (RAPS)	40	2	UEENEEE101A UEENEEE102A UEENEEE003B UEENEEK101A UEENEEK102A UEENEEK103A UEENEEK104A UEENEEK105A UEENEEK106A
UEENEEK108A		Plan periodic maintenance schedules of remote area power supplies (RAPS)	40	2	UEENEEE101A UEENEEE033B UEENEEE137A UEENEEK102A UEENEEK103A UEENEEK104A
UEENEEK109A		Attend to breakdowns in remote area power supplies (RAPS)	20	3	UEENEEE101A UEENEEE102A UEENEEE003B UEENEEE103A UEENEEK101A

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
UEENEEK110A		Co-ordinate maintenance of renewable energy (RE) apparatus and systems	20	4	UEENEEE101A UEENEEE102A UEENEEE003B UEENEEE103A UEENEEK101A
UEENEEK111A		Assemble and connect remote area power supplies	60	2	UEENEEE101A UEENEEE102A UEENEEE003B UEENEEE107A UEENEEE108A UEENEEE131A OR UEENEEE104A
UEENEEK112A		Provide basic sustainable energy solutions for energy reduction in residential premises	40	2	None
UEENEEK114A		Promote sustainable energy practice in the community	40	2	None
UEENEEK116A		Maintain and repair remote area power generation facilities	120	2	UEENEEE102A UEENEEE107A UEENEEK101A UEENEEK102A UEENEEK104A OR UEENEEE104A OR UEENEEE131A
UEENEEK117A		Maintain and repair facilities associated with remote area essential services operation	120	2	UEENEEE101A UEENEEE102A UEENEEE003B UEENEEE103A UEENEEE131A OR UEENEEE104A
UEENEEK120A		Maintain operation of remote area power generation plant	120	2	UEENEEK117A UEENEEK116A
UEENEEK123A		Carry out basic repairs to renewable energy apparatus	80	2	UEENEEE104A UEENEEE108A OR UEENEEG106A

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
UEENEEK125A		Solve basic problems in photovoltaic energy apparatus and systems	40	2	UEENEEK123A UEENEEE104A UEENEEE137A UEENEEE108A OR UEENEEG106A
UEENEEK127A		Diagnose and rectify faults in renewable energy control systems	60	4	UEENEEK025C UEENEEK125A
UEENEEK128A		Solve problems in stand-alone renewable energy systems	60	4	UEENEEK123A
UEENEEK130A		Solve problems in wind energy conversion systems rated up to 10 kW	60	4	UEENEEK123A UEENEEG101A UEENEEE104A UEENEEE101A
UEENEEK132A		Develop strategies to address environmental and sustainability issues in the energy sector	20	4	None
UEENEEK137A		Install, set up and maintain ELV micro-hydro systems rated up to 6.4 kW	20	3	UEENEEK123A UEENEEK124A
UEENEEK138A		Design micro-hydro systems rated to 6.4 kW	60	4	UEENEEK128A UEENEEK124A
UEPMNT410B		Diagnose and repair faults in electronic equipment	40	4	None
UEPMNT411B		Diagnose and repair faults in complex electrical equipment	40	4	None
UEPMNT420A		Perform Electrical/Electronic Drafting	80	4	None
UEPMNT433B		Conduct Routine Generator Electrical Maintenance	80	4	None
UEPOPS238B		Maintain battery banks and cells	20	2	None
UEPOPS343B		Operate Hydro-Electric Generating Plant and Auxiliary Equipment	30	3	None
UEPOPS347B		Operate and Monitor Supervisory, Control and Data Acquisition Systems	30	3	None
VU21552	031301	Operate a small power supply system	30	2	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
VU21553	031301	Assemble and connect an extra low voltage battery power source	30	2	None
VU21541	031301	Maintain rechargeable battery systems	30	2	None
VU21542	031301	Identify and locate building blocks of a centralised power generation system	30	2	None
VU21543	031301	Set up an extra low voltage emergency power supply system (not exceeding 32V)	30	2	None
VU21544	031301	Install a sustainable extra low voltage energy power system	30	2	None
Technical Support Specialisation					
ICAWEB408A		Ensure basic website security	20	4	None
ICAICT302A		Install and optimise operating system software	20	3	None
ICAICT305A		Identify and use current industry-specific technologies	60	3	None
ICAICT401A		Determine and confirm client business requirements	40	4	None
ICAICT407A		Maintain website information standards	30	4	None
ICAICT409A		Develop macros and templates for clients using standard products	60	4	None
ICAICT410A		Conduct post-implementation IT system reviews	30	4	None
ICAICT411A		Select and employ software and hardware testing tools	40	4	None
ICAICT415A		Provide one-to-one instruction	20	4	None
ICAICT417A		Identify, evaluate and apply current industry-specific technologies to meet industry standards	60	4	None
ICAICT501A		Research and review hardware technology options for organisations	20	5	None
ICANWK301A		Provide network systems administration	60	2	None
ICANWK303A		Configure and administer a network operating system	70	3	None
ICANWK305A		Install and manage network protocols	40	3	None
ICANWK401A		Install and manage a server	40	4	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
ICANWK402A		Install and configure virtual machines for sustainable ICT	50	4	None
ICANWK403A		Manage network and data integrity	40	4	None
ICANWK404A		Install, operate and troubleshoot a small enterprise branch network	60	4	None
ICANWK406A		Install, configure and test network security	50	4	None
ICANWK407A		Install and configure client-server applications and services	40	4	None
ICANWK408A		Configure a desktop environment	40	4	None
ICANWK409A		Create scripts for networking	60	4	None
ICANWK410A		Install hardware to a network	40	4	None
ICANWK411A		Deploy software to networked computers	40	4	None
ICANWK416A		Build security into virtual private networks	20	4	None
ICANWK511A		Manage network security	80	5	None
ICANWK532A		Identify and resolve network problems	50	5	None
ICAPRG405A		Automate processes	40	4	None
ICAPRG407A		Write script for software applications	40	4	None
ICAPRG409A		Develop mobile applications	50	4	None
ICAPRG412A		Configure and maintain databases	50	4	None
ICAPRG414A		Apply introductory programming skills in another language	60	4	None
ICAPRG415A		Apply skills in object-oriented design	40	4	None
ICAPRG425A		Use structured query language	60	4	None
ICASAS301A		Run standard diagnostic tests	20	3	None
ICASAS304A		Provide basic system administration	20	3	None
ICASAS305A		Provide IT advice to clients	40	3	None
ICASAS406A		Implement and hand over system components	20	4	None
ICASAS408A		Complete data transition in data migration process	20	4	None
ICASAS409A		Manage risks involving ICT systems and technology	20	4	None
ICASAS410A		Identify and resolve client IT problems	40	4	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
ICASAS411A		Assist with policy development for client support procedures	20	4	None
ICASAS412A		Action change requests	40	4	None
ICASAS414A		Evaluate system status	20	4	None
ICASAS415A		Optimise IT system performance	30	4	None
ICASAS416A		Implement maintenance procedures	10	4	None
ICASAS417A		Undertake IT system capacity planning	50	4	None
ICASAS418A		Monitor and administer security of an IT system	30	4	None
ICASAS419A		Support system software	50	4	None
ICASAS420A		Provide first-level remote help-desk support	30	4	None
ICASAS421A		Support users and troubleshoot desktop applications	20	4	None
ICASAS425A		Configure and troubleshoot operating system software	40	4	None
ICASAS426A		Locate and troubleshoot IT equipment, system and software faults	40	4	None
ICASAS502A		Establish and maintain client user liaison	20	5	None
ICASAS510A		Review and develop IT maintenance strategy	30	5	None
ICAWEB404A		Maintain website performance	30	4	None
ICAWEB405A		Monitor traffic and compile website traffic reports	15	4	None
ICAWEB413A		Optimise search engines	50	4	None
ICTCBL2136A		Install, maintain and modify customer premises communications cabling: ACMA Restricted Rule	60	2	None
ICTCBL2139A		Apply safe technical work practices for cabling registration	40	2	None
ICTEDU3053A		Train customers in new technology	40	3	None
ICTTEN4051A		Install configuration programs on PC based customer equipment	50	4	None
ICTTEN4199A		Install, configure and test a router	60	4	None
UEENEED102A		Assemble, set-up and test computing devices	80	2	UEENEEE101A
UEENEED112A		Support computer hardware and software for engineering applications	120	3	UEENEED102A UEENEEE101A

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
UEENEED115A		Administer computer networks	80	4	UEENEED124A UEENEEE101A
UEENEED117A		Install and configure network systems for internetworking	120	4	UEENEEE101A
UEENEED124A		Integrate multiple computer operating systems on a client server local area network	80	4	UEENEEE101A
UEENEED146A		Set up and configure basic local area network (LAN)	40	2	UEENEED102A UEENEEE101A
VU21239	030101	Apply safe working practice when operating vacuum systems	20	4	None
VU21240	030101	Apply vacuum principles to advanced manufacturing	40	5	None
VU21241	030101	Identify & select vacuum components & materials	40	5	None
VU21242	030101	Operate vacuum components and systems	40	4	None
VU21243	030101	Maintain & repair vacuum systems	60	5	None
VU21554	031305	Perform basic network and computer assembly	30	2	None
VU21555	031305	Perform basic network and computer maintenance	30	2	None
VU21556	020117	Install and configure basic network and computer operating systems	40	2	None
VU21557	020113	Install and configure a home or small office network	60	2	None
VU21558	020113	Install and configure a small to medium business network	60	2	VU21557
VU21559	020113	Implement and troubleshoot enterprise routers and switches	100	4	None
VU21560	020113	Design, install and configure an internet	100	4	None
VU21561	020113	Build a simple network and establish end to end connectivity	80	2	None
VU21562	020113	Configure and troubleshoot network switches and routers	80	2	None
VU21563	020113	Scale an existing network	80	4	None
VU21564	020113	Establish connectivity to a wide area network (WAN)	80	4	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
VU21565	031317	Install and test a home entertainment system	30	2	None
VU22324	020113	Build a simple network and establish end to end connectivity	90	2	None
VU22325	020113	Configure and troubleshoot network switches and routers	100	2	None
VU22326	020113	Apply network scaling tools and techniques	90	4	None
VU22327	020113	Establish connectivity to a wide area network (WAN)	100	4	None
Telecommunications Specialisation					
ICAA5045C		Produce network architecture design	30	5	ICAD4127A
ICAD4217B		Create technical documentation	20	4	None
ICTCBL2005A		Install customer cable support systems	50	2	None
ICTCBL2006A		Place and secure customer cable	45	2	None
ICTCBL2008A		Terminate metallic conductor customer cable	30	2	None
ICTCBL2012A		Install functional and protective telecommunications earthing system	30	2	None
ICTCBL2017A		Alter services to existing cable system	50	2	None
ICTCBL2064A		Haul underground cable	40	2	None
ICTCBL2066A		Joint and terminate co-axial cable	30	2	None
ICTCBL2068A		Install a telecommunications service to a building	50	2	None
ICTCBL2131A		Install an above ground equipment enclosure	45	2	None
ICTCBL2132A		Erect aerial cable supports	40	2	None
ICTCBL2133A		Construct underground telecommunications infrastructure	50	2	None
ICTCBL2134A		Fix aerial cable	50	2	None
ICTCMP2022A		Organise and monitor cabling to ensure compliance with regulatory and industry standards	40	2	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
ICTPMG2130A		Prepare site for support installation	45	2	None
ICTRFN3055A		Install a radio communications antenna and feedline	40	3	None
ICTRFN4095A		Conduct radio frequency measurements	40	4	None
ICTTEN2140A		Use hand and power tools	40	2	None
ICTTEN3250A		Provide infrastructure for telecommunications customer equipment	60	3	None
ICTWOR2141A		Work effectively in a telecommunications technology team	20	2	None
ICTWOR3035A		Organise material supply	20	4	None
Wireless Technologies Specialisation					
ICANWK405A		Build a small wireless local area network	20	4	None
ICANWK417A		Build an enterprise wireless network	80	4	None
ICASAS406A		Implement and hand over system components	20	4	None
CASAS409A		Manage risks involving ICT systems and technology	20	4	None
ICASAS410A		Identify and resolve client IT problems	40	4	None
ICASAS411A		Assist with policy development for client support procedures	20	4	None
ICASAS413A		Manage resolution of system faults on a live system	40	4	None
ICASAS414A		Evaluate system status	20	4	None
ICASAS415A		Optimise IT system performance	30	4	None
ICASAS416A		Implement maintenance procedures	10	4	None
ICASAS417A		Undertake IT system capacity planning	50	4	None
ICASAS418A		Monitor and administer security of an IT system	30	4	None

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
ICASAS419A		Support system software	50	4	None
ICASAS420A		Provide first-level remote help-desk support	30	4	None
ICASAS421A		Support users and troubleshoot desktop applications	20	4	None
ICASAS424A		Support different operating systems	40	4	None
ICASAS425A		Configure and troubleshoot operating system software	40	4	None
ICASAS426A		Locate and troubleshoot IT equipment, system and software faults	40	4	None
ICAWEB405A		Monitor traffic and compile website traffic reports	15	4	None
ICAWEB408A		Ensure basic website security	20	4	None
ICAWEB413A		Optimise search engines	50	4	None
ICAICT401A		Determine and confirm client business requirements	40	4	None
ICAICT407A		Create technical documentation	30	4	None
ICAICT409A		Develop macros and templates for clients using standard products	60	4	None
ICAICT411A		Select and employ software and hardware testing tools	40	4	None
ICAICT420A		Develop client user interface	40	4	None
ICANWK407A		Install and configure client-server applications and services	40	4	None
ICANWK416A		Build security into virtual private networks	20	4	None
ICANWK411A		Deploy software to networked computers	40	4	None
ICANWK402A		Install and configure virtual machines for sustainable ICT	50	4	None
VU21581	020113	Build a small wireless LAN	30	2	None
VU21566	031309	Install and test a wireless intercom system	30	2	None
VU21567	031307	Conduct a site survey for a wireless network	30	2	None
VU21568	031309	Set up and operate a wireless communications link	30	2	None
VU21569	031309	Install communications antennae	30	2	None
Electrotechnology					

Unit of Competency Code	Field of Education	Unit of Competency Title	Hours	AQF Packaging	Pre-Requisites
UEENEEE123A		Solve basic problems electronic and digital equipment and circuits	80	2	UEENEEE101A UEENEEE104A
UEENEEH114A		Troubleshoot resonance circuits in an electronic apparatus	80	3	UEENEEE101A UEENEEE104A; OR UEENEEH169A; UEENEEE003B
UEENEEH139A		Troubleshoot basic amplifier circuits	40	3	UEENEEH102A; UEENEEH114A; OR UEENEEG102A UEENEEE102A; UEENEEE104A; UEENEEE107A AND UEENEEE104A; UEENEEE003B
VU21610	030101	Perform precision measurements	30	4	None
VU21611	030101	Dismantle and assemble engineering components or subassemblies	30	2	None
VU21570	031301	Apply electrical principles to route selection of power distribution networks	50	4	None
VU21571	031301	Apply electrical considerations to developing the design of power distribution infrastructure	50	4	None
VU21572	031301	Install and maintain induction motors	60	4	None
VU21550	031301	Evaluate performance of electrical machines	40	4	None
VU21573	031301	Diagnose and rectify faults in AC. motor drive systems	60	4	None
VU21574	031301	Diagnose and rectify faults in DC. motor drive systems	60	4	None

5.2 Entry requirements	<i>Standard 9 AQTF Standards for Accredited Courses</i> There are no specific entry requirements for the course. However, it is recommended that participants have communication, literacy and numeracy skills sufficiently well developed for them to participate effectively in the training. This would equate to level 3 of the Australian Core Skills Framework (ACSF). Details may be found on the web site: here Participants should be able to demonstrate that they are able to: - understand, reference, interpret and summarise technical texts in English from text books, manuals, standards and catalogues; - document events, write short reports and fill out forms;

	• use mathematical concepts to calculate parameters from technical data or measurements; • extract data and meaning from graphs and diagrams; • communicate with others effectively on interpersonal and basic technical levels Learners with language, literacy and numeracy skills at lower levels than those suggested will require additional support to successfully undertake the qualification.
6. Assessment	Standards 10 and 12 AQTF Standards for Accredited Courses
6.1 Assessment strategy	<i>Standard 10 AQTF Standards for Accredited Courses</i> All assessment, including RPL, must be consistent with the requirements of Standard 1.5 of the <i>AQTF: Essential Standards for Registration</i> and Standard SNR15.5 of the <i>Standards for NVR Registered Training Organisations</i> For the imported units of competency, the evidence gathering and assessment must be in accordance with the assessment guidelines incorporated in the endorsed component of the relevant Training Package and/or State accredited course Course providers will be required to adopt an assessment strategy that: ▪ incorporates continual feedback of individual progress toward, and achievement of competencies; ▪ addresses skills, attitudes and knowledge underpinning performance; ▪ gathers sufficient evidence to judge achievement of progress towards determining competence; ▪ recognises achievement of elements/competencies regardless of where the enabling learning took place; ▪ fosters a collaborative and co-operative relationship between the learner and assessor; ▪ is flexible in regard to the range and type of evidence provided by the learner; ▪ provides opportunity for the learner to challenge assessment provisions and participate in re-assessment; ▪ is equitable and fair to all learners; ▪ does not unnecessarily restrict the progress of a learner through the course; ▪ comprises a clear statement of both the criteria and assessment process;

	▪ selects assessment tools to suit the needs of particular clients or client groups (e.g. clients with special needs) or to suit the needs of an enterprise; ▪ incorporates employability skills within industry specific competencies. Practical work may be assessed in the work place or under conditions, which simulate the normal work environment. The opportunity for learners to negotiate the form of assessment is also possible in many cases, e.g. alternative assessments for learners with special needs.
6.2 Assessor competencies	<i>Standard 12 AQTF Standards for Accredited Courses</i> The National Skills Standard Council (NSSC) is responsible for determining the competencies to be held by assessors, in accordance with Standard 1.4 of the AQTF Essential Conditions and Standards for Continuing Registration and SNR 15.4 of the Standards for NVR Registered Training Organisations as set out below. Accordingly, the NSSC has determined that from 1 July 2013, assessors must: - hold the <i>TAESS00001 Assessor Skill Set</i>, or be able to demonstrate equivalence of competencies; and - be able to demonstrate vocational competencies at least to the level being assessed; and - be able to demonstrate how they are continuing to develop their VET knowledge and skills as well as maintaining their industry currency and assessor competence. Note: If a person does not have all the assessment competencies as defined in (i), (ii) and (iii) then one or more persons with the combined expertise in (i), (ii) and (iii) may work together to conduct the assessment.
7. Delivery	Standards 11 and 12 AQTF Standards for Accredited Courses

7.1 Delivery modes	<i>Standard 11 AQTF Standards for Accredited</i> Courses Units of competency for these courses are drawn from many endorsed Training Packages and State accredited courses which are generally industry specific. RTOs should adopt delivery strategies that contextualise these industry specific units of competency for applications in an integrated technology environment, incorporating employability skills and the needs of the learner. Delivery strategies could include: ▪ traditional classroom delivery ▪ practical work ▪ project based learning ▪ problem based learning ▪ workplace projects ▪ self-paced learning ▪ case studies ▪ role-pays ▪ guest speakers ▪ on-the-job training Because integrated technology applications draw on technical concepts across industry sectors, RTOs should consider achieving outcomes for students by utilising: ▪ project based strategies that allow learners to plan, organise and implement activities to achieve a defined outcome; and ▪ problem based strategies that focus on introducing concepts to learners by challenging them to solve a real world problem. Due to the potential for a dispersed distribution of learners, providers may wish to consider non-traditional strategies in the delivery of training. The facilitation of distance learning and the achievement of competencies through workplace activities or on the-job training should be fostered and encouraged where possible.

7.2 Resources

Standard 12 AQTF Standards for Accredited Courses

The resources that should be available for these courses relate to normal work practice using procedures, information and resources typical of a workplace. This should include access to:

- OH&S policy and work procedures and instructions;
- a simulated integrated technology environment;
- relevant electrical safety acts, service installation rules, standards, and codes of practice;
- relevant codes of practice, regulations, and safety authorisation;
- relevant equipment, tools, materials and consumables;
- relevant plans, drawings and instructions to the level of operation;

Qualifications of Trainers

The National Skills Standard Council (NSSC) is responsible for determining the competencies to be held by trainers, in accordance with Standard 1.4 of the AQTF Essential Conditions and Standards for Continuing Registration and SNR 15.4 of the Standards for NVR Registered Training Organisations.

Accordingly, the NSSC has determined that from 1 July 2013, trainers must:

- i. hold the *TAE40110 Certificate IV in Training and Assessment* from the TAE10 Training and Education Training Package as a minimum qualification, or be able to demonstrate equivalence of competencies; and
- ii. be able to demonstrate vocational competencies at least to the level being delivered and assessed; and
- iii. be able to demonstrate how they are continuing to develop their VET knowledge and skills as well as maintaining their industry currency and trainer/ assessor competence.

Persons delivering training under the supervision of a trainer must:

- i. work under the supervision of a trainer with the *TAE40110 Certificate IV in Training and Assessment*, or of a person who has demonstrated equivalence of competencies; and
- ii. holds either the *TAESS00007 Enterprise Trainer – Presenting Skill Set*, or be able to demonstrate equivalence of competencies, or the *TAESS00008 Enterprise Trainer – Mentoring Skill Set*, or be able to demonstrate equivalence of competencies within two years of commencing to deliver training while under supervision; and
- iii. be able to demonstrate vocational competencies at least to the level being delivered and assessed as well as maintaining their industry currency.

8. Pathways and articulation	<i>Standard 8 AQTF Standards for Accredited Courses</i> Learners who have gained some of the national competencies through previous training will be given credit for the specific units, under the national recognition process. Direct credits into the Certificate IV in Integrated Technologies are available for all the common units of competency already completed in <i>22071VIC Certificate II in Integrated Technologies</i>. Depending on the units of competency chosen participants may get credits into relevant Certificate IVs, Diplomas and Advanced Diplomas from the following endorsed Training Packages: BSB07 Business Services CUF07 Screen and Media CPP07 Property Services CUS09 Music ICA11 Information and Communications Technology ICT10 Integrated Telecommunications MEM05 Metal and Engineering PSP12 Public Sector UEE11 Electrotechnology UEP12 Electricity Supply Industry – Generation Sector Credits may also be available into the following State accredited courses: 21621VIC Diploma of Engineering Technology 21622VIC Advanced Diploma of Engineering Technology The course packaging rules are very flexible and there are many variations in the way technologies in these courses may be mixed and matched by individual RTOs. For this reason no particular higher education qualifications could be identified as aligned for articulation. It is recommended that RTOs negotiate credit transfer arrangements with selected universities
9. Ongoing monitoring and evaluation	<i>Standard 13 AQTF Standards for Accredited Courses</i> Ongoing evaluation and validation of these courses is the responsibility of the Curriculum Maintenance Manager, Engineering Industries and recommendations for any significant changes will be reported through the CMM to the Victorian Registration and Qualification Authority. A course advisory committee will be established for the ongoing monitoring and evaluation of the courses. It will comprise representatives from the following areas: • Curriculum Maintenance Manager, Engineering Industries • Course providers • Industry representatives The advisory committee will:

	• review the implementation of the course; • provide advice on changing course requirements, such as the need to add further elective units to meet defined industry needs; • monitor and evaluate course standards, delivery and assessment. • review the continuing need for the course should an appropriate qualification be incorporated into a nationally endorsed Training Package. Course maintenance and review procedures will monitor developments to inform changes by: • course moderation through the RTO peer evaluation • RTO liaison with industry and feedback to the CMM via RTO networks • Industry sector consultation • Student surveys Changes to the course that will be reported to the VRQA include: • the course structure, by adding or deleting units from the core or electives to reflect local industry needs and to reflect changes to training packages and the availability of new or revised nationally endorsed units of competency; • required pre-requisites and/or co-requisites ; • the nominal duration of the course and of units of competency; • copyright ownership. • articulation and/or credit transfer arrangements • legislation such as OHS/ licensing Changes may also include the addition of further specialisations.

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Core Units

VU21534 Apply mathematics in an integrated technology context

Unit descriptor This unit provides the skills and knowledge required for the application of mathematics to solve problems and/or analyse data in various integrated technology scenarios. It includes a range of mathematical processes associated with various technologies.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the unit This competency would be applied by those working in an integrated technology context. It would include design, implement, test, service and troubleshooting situations. Calculators and computer applications may be used, as required.

ELEMENT

PERFORMANCE CRITERIA

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement.¹ Assessment of performance is to be consistent with the evidence guide.²

1. Determine the mathematics required for integrated technology tasks	1.1 The <i>mathematical requirements</i> of the <i>integrated technology</i> tasks are analysed
	1.2 Relevant data for specific mathematical processing or calculation are collected
	1.3 The <i>materials or devices</i> needed to carry out the required calculations are obtained
2. Apply mathematics to specific integrated technology tasks	2.1 Data is checked for relevance and accuracy for the task
	2.2 Appropriate formulae or <i>mathematical process</i> is used to achieve the required information for each task.
	2.3 Various <i>parameters</i> of the integrated technology tasks are calculated.
	2.4 Ongoing checks of the quality/accuracy of the calculations are undertaken in accordance with established procedures

3. Complete the mathematical activities	3.1 The mathematical calculations are checked against estimates or specifications 3.2 Any errors or discrepancies in the calculations are detected and corrected promptly, in accordance with established procedures 3.3 The results of the calculations are conveyed to the <i>relevant personnel</i> 3.4 Appropriate records of the calculations are compiled and maintained, in accordance with established procedures

Required skills and knowledge

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- *Shapes and representation*
 - Extracting the geometric parameters of lines, curves, shapes and solids and their graphical and/or diagrammatic representations
 - Linear scaling and to achieve enlargement and reduction of area, surface area and volume
- *Number systems*
 - Applying basic mathematical skills in addition, subtraction, multiplication and division
 - Using percentages and decimal fractions in practical contexts
 - Applying approximation strategies, extrapolation and analysis calculations to obtain predictions, estimates and exact values
- *Data presentation and analysis*
 - Utilising graphs and tables of linear and non-linear relations to interpret information
 - Utilising spread-sheet tools as a means of capturing and presenting data with a range of graphical techniques
 - Characterising typical data sets in terms of mean, median, range and other key parameters
 - Qualitative interpretation of features of graphs, including consideration of axis intercepts, slope, asymptotic behaviour, symmetry, local linearity, tangents, gradients and rates of change
 - Interpretation of non-linear graphs representing practical situations, interpolation and extrapolation to predict values, estimation of maximum and minimum values and average rate of change
 - Construction and interpretation of motion graphs – displacement-time and velocity-time
- *Measurement*
 - Conducting linear measurements using the metric system and consideration of required accuracy, tolerances, rounding, truncation and approximations
 - Reading, recording and analysing digital and analogue instrument scales
- *Formulae and algebraic representation*
 - Using appropriate mathematical symbols, formula and basic algebra to obtain information in specific contexts
 - Using algebraic formulae to model and analyse integrated technology phenomena
 - Transforming and solving algebraic formula to determine unknown parameters
- *Geometry and trigonometry*
 - Representing practical problems in two and three dimensional geometric form

- Applying right angle trigonometry and Pythagoras theorem
- Applying trigonometric ratios sine, cosine and tangent, sine and cosine rules and area of triangle formulas to solve problems in two and three dimensions
- Calculating angles and distances using triangulation approaches
- **Random processes**
 - Identifying, characterising and independence of random events, processes and experiments
 - Simulating random events using simple devices, processes and technology and consideration of probability concept
 - Characterising a normal distribution in terms of mean and standard deviation

Required knowledge:

- Relevant workplace health and safety regulations and requirements
- Basis of number systems
- Basis of measurement processes
- Addition, subtraction, multiplication and division processes
- Principles of geometry
- Principles of trigonometry
- Principles of basic algebra and transformation of formulae
- Graphical and tabular approaches to data presentation and analysis
- Principles of non-deterministic data characterisation

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 in the Performance Criteria is detailed below.

Mathematical requirements may include:

- Number systems
- Linear measurements
- Algebraic formulae
- Spatial representation
- Graphical techniques, analysis and representation
- Data presentation, characterisation and analysis
- Geometric and trigonometric analysis
- Statistical representation
- Mathematical modelling

Integrated technology may include:

- Broadcast engineering
- Building automation and security
- Control technologies
- Engineering business
- Robotics and manufacturing technology
- Medical systems engineering
- Photonics
- Sustainable energy systems
- Energy generation
- Technical support
- Telecommunications and wireless communications

- Electrotechnology
- Computer network technology
- Robotics and embedded controller technology
- Photonics technology
- Fluid power

Materials or devices may include:

- Linear measuring devices
- Computer
- Data acquisition, presentation, design and analysis software
- Calculator
- Analogue and digital instruments

Mathematical process may include:

- Addition
- Subtraction
- Multiplication
- Division
- Scaling
- Percentages
- Decimal fractions
- Averages
- Extrapolation and interpolation
- Rate of change
- Approximation
- Geometry
- Trigonometry
- Graphical techniques and graphical interpretation
- Random data, processes and characterisation

Parameters may include, but are not limited to:

- Electrical parameters such as current, voltage, energy and power
- Linear and rotational motion parameters such as distance, velocity, acceleration
- Fluid power parameters such as:
 - Pressure
 - Flow rates
 - Power
 - Cycle times
- Business modelling parameters
- Project planning, costing and management parameters
- Process and system monitoring, control and optimisation parameters
- Design and performance parameters
- Quality assurance parameters

Relevant personnel may include:

- Work supervisor
- Leading hand

- Tradesperson
- Technician
- Technologist
- Project Manager

Evidence Guide:

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines

Critical aspects of evidence required to demonstrate competency in this unit

- To be considered competent in this unit the candidate must be able to demonstrate the achievement of all of the elements of competency to the level defined by their associated performance criteria and incorporating the required skills and knowledge.
- Specifically they must provide evidence that they can:
 - Identify the mathematics required for specific integrated technology work activities
 - Utilise a variety of mathematical processes to achieve required information
 - Check the accuracy of calculations against estimates and specifications for the integrated technology job
 - Identify any materials or devices necessary to conduct the calculations accurately

Context of and specific resources for assessment

- Assessment should be conducted in a real or simulated workplace environment using procedures, information and resources typical of a workplace.
- Where simulation is used, the conditions for assessment must be authentic and as far as possible reproduce and replicate the workplace
- Resources required for assessment include:
 - Suitable work environment
 - Facilities, equipment and materials to undertake the work specified including access to:
 - Computers and appropriate software
 - Calculators
 - Physical measuring devices

Methods of assessment

- Assessment must include the demonstration of practical skills in the conduct of an integrated technology project and may also include:
 - Verbal/written tests of underpinning knowledge
 - Assignments
 - Case study analysis

Guidance information
for assessment

- This unit must be assessed in combination with the unit:
VU21535 – Implement an integrated technology project

VU21535 Implement an integrated technology project

Unit Descriptor

This unit of competency sets out the knowledge and skills required to carry out an integrated technology project by merging distinct technology domains to achieve an innovative and integrated technical solution. This includes planning, preparation and implementation of a project, in accordance with a project management plan. The use of appropriate mathematical techniques is required to determine system parameters.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit of competency would apply in an environment where merging technologies are utilised for innovative technical applications.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Prepare for an integrated technology project

- 1.1 **OH&S** and **environmental requirements** for a given work area are established
- 1.2 The OH&S requirements and risk control procedures required for the preparation of the work area are followed.
- 1.3 **Integrated technology** requirements and scope are determined from project briefs, specifications or discussions with **appropriate personnel**.
- 1.4 **Relevant variables** are calculated using the specifications for the project, or other data available, to confirm the expected project outputs.
- 1.5 The integrated technology project is planned and outcomes clearly specified and approved by appropriate personnel.
- 1.6 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.

	1.7	Resources and equipment needed for the project are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2. Implement the integrated technology project	2.1	OH&S requirements for carrying out the work are followed.
	2.2	Equipment/machines/plant are checked as being isolated, where necessary, in strict accordance with OH&S requirements.
	2.3	Project activities are undertaken in accordance with the project plan and within specified time lines and resources.
	2.4	Project activities are undertaken to reflect current knowledge, methods and techniques.
	2.5	Appropriate mathematical processes are used to calculate and monitor the project variables
	2.6	Project progress is regularly reviewed against project plan and discussed with appropriate personnel
	2.7	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	2.8	Methods for dealing with unexpected situations are selected on the basis of safety and specified project outcomes.
3. Evaluate and document project outcomes	3.1	OH&S requirements for completing the work are followed.
	3.2	Key outputs of the integrated technology project are measured, calculated and/or charted to confirm compliance with the specifications
	3.3	Equipment and tools used in the project are maintained and stored in accordance with enterprise procedures.
	3.4	Project outcomes are evaluated against specifications and objectives.
	3.5	Final project report is prepared and project is signed off according to enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- interact with clients to determine work requirements
- establish client needs in relation to the integrated technology project
- negotiate with clients on the project

- conduct basic project planning
- utilise a range of relevant mathematical techniques to calculate and chart project variables
- use a network to connect, control and integrate different technologies
- use an iterative cycle of prototyping, testing and evaluation to develop a functioning product
- use feedback to evaluate the success of the project
- write reports on the project in accordance with enterprise requirements
- present information in a clear and concise manner
- use tools and equipment correctly
- follow enterprise WHS procedures relevant to the project
- read and interpret equipment manuals

Required knowledge:

- relevant Occupational Health & Safety regulations and requirements
- project specifications including: defining the project; project briefs; key outputs; contracts; tenders
- relevant mathematical techniques, such as the use of geometry, trigonometry, algebra, graphs
- project management plans including: timelines, resources, costs, monitoring, project teams, milestones, contingencies, budgets
- project design including design sketches and drawing; design calculations
- presentation methods

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 in the Performance Criteria is detailed below.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Integrated technology may include:

- fluid power
- computer network technology
- wireless technology
- robotics and embedded controller technology
- photonics technology
- energy generation

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager

- site engineer
- trainer
- mentor
- teacher
- team member

Resources and equipment may include:

- appropriate tools
- test equipment
- consumables
- network cards/ connectors
- appropriate software licences
- manufacturers' specifications and manuals
- diagnostics software

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Mathematical processes may include:

- addition
- subtraction
- multiplication
- division
- percentages
- geometry
- trigonometry
- algebra
- graphs

Key outputs may include:

- Electrical power
- Hydraulic power
- Heat output
- Flow rates
- Machine efficiency

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.

- In particular this will incorporate evidence that shows a candidate is able to:
 - implement relevant occupational health and safety
 - demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - utilise an appropriate level of mathematical skill to calculate relevant project variables
 - demonstrate the ability to implement an integrated technology project by merging distinct technology fields to achieve an innovative and integrated technical solution.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team.
- Evidence should show competency working in realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required.
- The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

-
- Assessment must include the demonstration of practical skills in implementing an integrated technology project and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - a portfolio of documentary evidence
- The project documentation must include a project management plan with specified outcomes. The assessment of the project is against these specified outcomes.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

Guidance information for assessment

-
- This unit must be assessed in combination with the units:
- VU21534 Apply mathematics in an integrated technology project
- VU21536 Apply computer tools in an integrated technology context

VU21536 Apply computer tools and networking in an integrated technology context

Unit Descriptor This unit of competency sets out the knowledge and skills required to use relevant computer software and hardware to complete a range of integrated technology projects. This may involve the establishment of networked control of multiple technological devices and services.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the Unit This unit of competency would be applied where merging technologies are being utilised for innovative technical applications. These could include a wide spectrum of engineering applications, such as mechanical, electro-mechanical, robotics, hydraulic and pneumatic sub-systems or systems.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Determine computer and network requirements for the integrated technology project	1.1 OH&S and environmental requirements for a given work area are established
	1.2 The OH&S requirements and risk control procedures required for the preparation of the work area are followed.
	1.3 Nature and scope of the <i>integrated</i> control system and network is established from project briefs, specifications or discussions with appropriate personnel
	1.4 Computer tools are selected and procured to meet the integrated technology project needs, in accordance with enterprise procedures
	1.5 Network operating system versions and updates needed to configure and maintain the network are obtained in accordance with established procedures and checked against job specifications.
	1.6 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.

	1.7	The computer tools are trialled to ensure their suitability for the integrated technology project.
2. Configure and maintain control system networks.	2.1	Relevant OH&S measures and procedures for carrying out the work are followed.
	2.2	Control application network components are installed, upgraded and configured in accordance with manufacturer's specifications and enterprise procedures
	2.3	Devices, desktop environment, network protocols and services and system security are implemented in accordance with requirements.
	2.4	Network malfunctions are identified and rectified using control devices, storage, network protocols, connections and services and system security configuration processes.
	2.5	Network performance and reliability is monitored and optimised in accordance with established procedures.
	2.6	Methods for dealing with unexpected situations are selected based on discussions with appropriate personnel, job specifications and enterprise procedure
	2.7	Computer back-up arrangements are put in place to protect project outputs
3. Produce integrated technology project outputs	3.1	Relevant OH&S requirements for performing the work are followed.
	3.2	Computer output is checked to confirm compliance with the specifications and enterprise procedures
	3.3	Output style and format is confirmed as being consistent with specification and enterprise procedures
	3.4	Computer files and data are saved in accordance with enterprise procedures
	3.5	Appropriate personnel are notified, in accordance with enterprise procedures, that the project has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- following enterprise OH&S procedures relevant to the project
- interpreting instructions and specifications for computer application tasks
- preparing workplace for safe computer usage
- using a word-processor to create engineering documents, customise page layout, format documents, create tables, add images, use mail merge and print documents

- using a database application to modify and develop data tables, create forms and reports to logically retrieve and present information
- using a spreadsheet application to modify and create spreadsheets, format cells and spreadsheet, and apply engineering formulas in spreadsheets and create graphs and charts
- using CAD drawing tools and library components to modify and create engineering drawings
- developing open and common proprietary control system networks models (layers) and protocols
 - CANopen, ControlNet, Devicenet, Ethernet, Foundation Fieldbus, Interbus, Modbus, Profibus
- develop a network of computers and control hardware such as:
 - I/O devices
 - actuators
 - peripherals such as 2D and 3D printers
 - automation production machines
- checking and testing that computer generated output conforms to problem description and specification
- altering and customising computer programs
- writing short test routines
- accessing offline and online help and tutorial support

Required knowledge:

- relevant Occupational Health & Safety regulations and requirements
- project specifications including: defining the project; project briefs; key outputs; computer tools required etc
- functions and capabilities of various types of computer applications used in an engineering workplace
- project management plans including: timelines, resources, costs, monitoring, project teams, milestones, contingencies, budgets
- control system networks interface
- data link models or layer! encompassing:
 - device types
 - bus arbitration
 - device initialisation
 - synchronous/Asynchronous messaging.
 - time management
 - link active scheduler specific functions
- bus monitor encompassing:
 - capturing
 - filtering
- fieldbus message specification encompassing:
 - virtual field device
 - object dictionary
 - communicate objectives
 - communicate services
- high speed Ethernet encompassing:
 - protocols
 - FDA agents
 - messaging
 - sessions
 - time synchronisation
 - redundancy

- computer back-up techniques and data security processes

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 in the Performance Criteria is detailed below.

OH&S requirements may include:

- legislation
- ergonomic furniture
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- lighting
- ergonomic furniture
- waste management
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Integrated technology may include but is not limited to:

- fluid power
- computer network technology
- wireless technology
- robotics and embedded controller technology
- photonics technology
- energy generation

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Computer tools may include, but are not limited to:

- computer hardware
- computer networks
- internet access
- database software

- spreadsheet software
- word processing software
- simulation software
- computer-assisted design (CAD)
- electrical/electronics schematic capture and simulation
- fluid power control schematic capture and simulation
- process control modelling and simulation
- diagnostics software

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Computer output may include:

- reports
- spreadsheets
- database
- graphs
- design
- control mechanisms, such as fluid power and electronic controls
- robotics
- open & common control system networks – (Check if required)

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and environment.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement relevant occupational health and safety requirements

	– select computer tools appropriate to integrated technology project needs – utilise a range of computer tools to achieve relevant integrated technology project outputs – utilise appropriate computer data security and back-up processes. – develop control system networks models (layers) and protocols
Context of and specific resources for assessment	• This unit may be assessed on-the-job, off-the-job or a combination of both on and off-the-job. • Where assessment occurs off-the-job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. • The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. • Evidence should show competency working in a realistic environment and a variety of conditions. • The candidate will have access to all tools, equipment, materials and documentation required. • The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
Method of assessment	• • Assessment must include the demonstration of practical skills in utilising relevant computer tools in an integrated technology project and may also include: – observation of processes and procedures; – oral and/or written questioning on required knowledge and skills; – testimony from supervisors, colleagues, clients and/or other appropriate persons; – a portfolio of documentary evidence • Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons. • Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
Guidance information for assessment	• • This unit must be assessed in combination with the unit: • VU21535 – Implement an integrated technology project

Elective Units

VU21610 Perform precision measurements

Unit Descriptor	This unit of competency sets out the knowledge and skills required to make accurate measurements using a wide range of basic engineering and scientific measuring instruments and devices. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.
Employability skills	This unit contains Employability Skills.
Application of the Unit	The unit applies to enterprises requiring the use of a range of measuring devices and instruments. Measurements may be undertaken across a wide spectrum of engineering applications such as mechanical, electro-mechanical, electronics, hydraulic and pneumatic devices or systems.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1	Determine measurement task requirements	1.1 <i>OH&S requirements</i> and <i>environmental requirements</i> for a given work area are clarified. 1.2 Established OH&S requirements and risk control measures and procedures for the preparation of the work area are followed. 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with <i>appropriate personnel</i>. 1.4 Nature and scope of the measuring task is established from job brief or discussions with appropriate personnel. 1.5 Measuring device is selected and obtained, in accordance with <i>enterprise procedures</i>. 1.6 Operating instructions, manuals and calibration information are identified and collected, as required. 1.7 Appropriate personnel are consulted to ensure the task is coordinated effectively with others involved at the work site.
2		2.1 OH&S requirements for carrying out measurement task are followed.

Perform measurement task	2.2	Measurement devices and instruments are used according to manufacturers' specifications and enterprise procedures.
	2.3	Correct measurement techniques are used and measurements are checked for accuracy and validity.
	2.4	Dimensions or cumulative results are determined or verified using basic calculations where required.
	2.5	Measurements are recorded and expressed with appropriate precision and units.
	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3 Complete measuring procedures	3.1	OH&S requirements for completing the work are followed.
	3.2	Work site is made safe, in accordance with established safety procedures.
	3.3	Routine care and storage of devices is undertaken according to manufacturers' specifications and enterprise procedures.
	3.4	Measurements are logged and recorded in accordance with enterprise procedures
	3.5	Appropriate personnel are notified that the task has been completed, in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills

- selecting the appropriate measuring device for given measurement tasks
- using appropriate measuring techniques
- conducting simple calculations, such as addition, subtraction, multiplication, division, fractions, decimals to the scope required by this unit
- making measurements to the finest graduation of the selected measuring device
- handling and storing measuring devices in accordance with manufacturers' specifications or standard operating procedures
- checking measuring devices for correct operation before use
- making, where appropriate, routine adjustments to measuring devices
- reading, interpreting and following information on written job instructions, specifications, standard operating procedures, charts, lists, drawings and other applicable reference documents
- planning and sequencing operations
- checking and clarifying task related information
- checking for conformance to specifications
- preparing drawings/sketches as required

Required knowledge

- relevant Occupational Health & Safety regulations and requirements
- a range of measuring devices and instruments
- correct and appropriate measuring techniques for a range of measuring devices
- procedures for handling and storing a range of measuring devices
- procedures for adjusting, calibrating and zeroing a range of measuring devices
- methods of communicating measurements by logging, recording or sketching, as required
- safe work practices and procedures

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- clients
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

Measuring devices and instruments may include but are not limited to:

- tapes
- rulers
- callipers
- micrometer
- dial gauge
- electrical meters - analog and digital
- cathode ray oscilloscope
- counter/timer
- spectrum analyser
- thermometer
- hygrometer
- hydrometer
- barometer

Basic calculations including:

- addition
- subtraction
- multiplication
- division
- fractions
- decimals

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Workplace Health and Safety procedures and practices including the use of risk control measures;
 - demonstrate required knowledge and skills as described in this unit;
 - demonstrate the ability to make precision measurements consistently and in different contexts. This includes a range of measuring devices appli-

cable to mechanical, electro-mechanical, electronics, hydraulic and pneumatic components or systems.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team.
- The assessment environment should not disadvantage the candidate.
- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required.
- The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Employability Skills

VU21611 Dismantle and assemble engineering components or subsystems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to dismantle and reassemble engineering components or sub-systems. This includes the use and selection of appropriate tools for the task, identification and replacement of damaged/faulty parts.

Requisite or co-requisite skills in the use of portable hand and power tools, reading engineering drawings and performing basic measurements are required

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability skills

This unit contains Employability Skills.

Application of the Unit

The unit applies to enterprises requiring the disassembly and re-assembly of components and sub-assemblies as part of maintenance or manufacturing procedures. Tasks are undertaken across a wide spectrum of engineering applications for example mechanical, electro-mechanical, hydraulic and pneumatic components or sub-assemblies.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Prepare to disassemble component or subassembly

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and clarified.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 Individual **components and subassemblies** are identified and disassembly techniques are determined from documentation, job brief or discussions with appropriate personnel.
- 1.5 Component identification and labelling/tagging methods are determined in accordance with **enterprise procedures**.
- 1.6 Equipment, tools, and measuring devices needed to carry out disassembly are obtained and checked for correct operation and safety.

		1.7	Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
2	Disassemble component or subassembly	2.1	OH&S requirements for carrying out disassembly work are followed.
		2.2	Components and subassemblies are disassembled or dismantled using appropriate methods and tools and according to manufacturers' specifications and enterprise procedures.
		2.3	Component parts are inspected and tagged/identified appropriately.
		2.5	Component faults and anomalies are identified and replacement components sourced where necessary.
		2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3	Prepare to reassemble component or subassembly	3.1	OH&S requirements for completing reassembly work are determined.
		3.2	Components and subassemblies are prepared for reassembly according to manufacturers' specifications and enterprise procedures.
		3.3	Equipment, tools, and measuring devices needed to carry out reassembly are obtained and checked for correct operation and safety.
4	Reassemble component or subassembly	4.1	OH&S requirements for completing reassembly work are followed.
		4.2	Component parts for reassembly are selected according to identification methods and drawings/specifications.
		4.3	Components and subassemblies are reassembled using appropriate methods and tools and according to manufacturers' specifications and enterprise procedures.
		4.5	Reassembled component and subassembly is checked for correct operation according to specifications.
5	Complete disassembly/assembly operations	5.1	OH&S requirements for completing the work are followed.
		5.2	Work site is made safe in accordance with established safety procedures.
		5.3	Disassembly - assembly task is documented in accordance with enterprise procedures.
		5.4	Appropriate personnel are notified, in accordance with enterprise procedures, that the task has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- sourcing disassembly/reassembly instructions, drawings and specifications

- interpreting disassembly/reassembly drawings, instructions and specifications
- preparing workplace and components for disassembly/reassembly
- using correct disassembly techniques
- selecting and using appropriate tools, techniques and equipment
- marking or tagging components
- inspecting components visually and dimensionally for conformance to specification in preparation for reassembly
- using, handling and caring for appropriate tools
- reassembling components/subassemblies
- disassembling/reassembling of unfamiliar components or subsystems
- checking and testing reassembled components and subassemblies for correct operation and readiness for use

Required knowledge:

- common disassembly/reassembly techniques and procedures
- component tagging and identification techniques
- measurement instruments, quantities and units
- inspection check methods
- component and subassembly operational tests
- enterprise OH&S procedures and policies.

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include, but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer

Components and subassemblies such as:

- trainer
- mentor
- teacher
- team member
- gearbox
- pneumatic door opener
- coupling
- pump
- bearings
- electrical appliances
- personal computer
- printer
- photocopier
- electric motor/generator
- wind turbine
- solar panel array

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement relevant Occupational Health and Safety procedures and practices, including the use of risk control measures;

- demonstrate the ability to disassemble and reassemble engineering components and subsystems consistently and in different contexts. This must include a variety of engineering components and subassemblies using different fasteners, attaching/connecting/mounting methods, adhesives, lubricants etc.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Employability Skills.

VU21554 Perform basic network and computer assembly

Unit Descriptor

This competency unit sets out the knowledge and skills required to construct and configure basic standalone computers and small networks consisting of a maximum of five computers linked by a network.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit of competency applies in a home, office or similar environment where merging technologies are applied for innovative technical applications.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1	Plan for computer system and network assembly	1.1 <i>OH&S requirements and specific safety requirements for a given area are obtained and applied.</i> 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area. 1.3 PC and network assembly requirements are identified from documentation, work sheets or consultation with <i>appropriate personnel.</i> 1.4 Identify key components of a PC and select appropriate component in accordance with enterprise procedures. 1.5 Appropriate network topology is selected to meet job requirements and checked with appropriate personnel. 1.6 Appropriate network components and software are selected to prepare for network installation. 1.7 <i>Appropriate personnel are consulted to ensure that work is coordinated effectively with others involved at the work site.</i> 1.8 <i>Resources and equipment</i> needed for the task are obtained in accordance with enterprise procedures and checked as fit for purpose.
2	Assemble and set up stand-alone computer	2.1 OH&S requirements and specific safety requirements for carrying out the work are followed.

	2.2	Computer components are selected and assembled to manufacturers' specifications and according to enterprise procedures .
	2.3	The computer is tested and the desktop is customised to job requirements.
	2.4	Basic computer system information is checked and, if appropriate, adjusted to specified requirements.
	2.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
3	Assemble and configure a local area network	
	3.1	OH&S requirements and specific safety requirements for carrying out the work are followed.
	3.2	Local area network computers are connected to the network using required network interfaces and connections according to manufacturers' specifications and enterprise procedures.
	3.3	The network server is configured for a dynamic host configuration protocol in accordance with manufacturers' specifications and enterprise procedures.
	3.4	Assembled and configured network is tested for operation and, if required, faults are corrected.
	3.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
4	Complete computer and computer network assembly	
	4.1	OH&S requirements for completing the work are followed.
	4.2	Equipment and tools used in assembly task are cleaned and stored in accordance with enterprise procedures.
	4.3	Worksite is cleared and made safe in accordance with OH&S requirements and enterprise procedures.
	4.4	Specifications of assembled systems are documented and stored in accordance with enterprise procedures.
	4.5	The computer system and computer network is checked to verify overall correct functioning and initial problems are rectified as required.
	4.6	Appropriate personnel are informed of completion of work and, if required, provided with a demonstration of the network system.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- using tools and equipment correctly
- following enterprise OH&S procedures
- reading and interpreting equipment manuals
- working as a member of a team
- starting, shutting down and restarting a computer
- working with icons
- recognising application windows
- resizing a desktop window
- viewing basic system information
- connecting computer systems
- creating a computer inventory
- installing motherboard, optical drive and video card
- fitting the computer case together
- connecting keyboard, mouse, monitor and power cord
- booting system for the first time
- adding a network interface card (NIC) and set the IP address
- connecting to the internet
- problem solving for a defined range of predicable problems
- troubleshooting common computer, computer network and peripheral device problems

Required knowledge:

- computer systems and programs
- computer types
- basic features of a graphical user interface environment
- software applications including: work processing; spreadsheets; databases; graphics applications; presentation applications; web browser and email.
- number systems
- laboratory safety and tools including electrostatic discharge (ESD)
- basic lab safety principles
- workspace practices to reduce ESD potential
- appropriate tools for networking and computer assembly work
- workspace cleaning supplies
- workplace testing equipment
- lab safety agreement
- computer system overview including: input process, output and storage
- boot process
- hardware components including: case; power supply; cooling systems, motherboard, motherboard form factors; motherboard components, CPUs; BIOS; expansion slots, riser cards, bus types
- memory components
- display components
- connector components
- storage components
- network components
- system resources

- portable devices
- computer assembly process
- assembly safety issues
- ESD precautions
- computer start-up sequence
- networking fundamentals including: file, print and application services; mail services; directory and name services; internet
- network administration
- simplex, half-duplex and full-duplex transmission
- types of networks
- DHCP servers
- default gateway
- domain name system
- network components including: network topologies, physical versus logical topology; networking media; common devices; server components
- LAN architectures including networking protocols, OSI model; TCP/IP utilities
- basic troubleshooting techniques

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include, but are not limited to:

- legislation
- protective personal equipment
- material safety management systems
- local safe operating procedures
- award provisions

Specific safety requirements may include, but are not limited to:

- procedures
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards

Appropriate personnel may include:

- Supervisor
- client / customer
- enterprise staff
- trainer
- teacher
- mentor
- business/enterprise owner/manager

Resources and equipment may include:

- appropriate tools
- test equipment
- consumables
- network cards/ connectors
- appropriate software licences
- manufacturers' specifications and manuals

- diagnostics software

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Computer system and computer network includes:

Systems using the following or similar operating systems

- DOS
- Windows 9x
- Windows NT, 2000 and XP
- Mac Os
- UNIX
- Linux
- Novell
- Cisco Systems

System hardware from various manufacturers including

- mother boards
- optical and hard disk and other drives
- power supplies
- memory
- computer cases and internal / external connections and expansion slots
- various cards such as video cards
- cooling systems
- peripherals devices including mice, keyboards, printers etc
- network interface cards
- routers
- switches
- hubs

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the

timeframes typically expected of the discipline, work function and industrial environment.

- Assessment should also reinforce the integration of the Employability Skills. In particular this will incorporate evidence that shows a candidate is able to:
 - implement relevant Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - demonstrate the ability to plan, assemble and set up a computer network systems in a home or business or similar environment on more than one occasion and in different contexts. The number of interconnected workstations should be limited to five.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- Evidence should show competency working in realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit could be assessed in conjunction with any other units covering computer system or computer networking assembly or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a

period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21555 Perform basic network and computer maintenance

Unit Descriptor

This competency unit sets out the knowledge and skills required to maintain, upgrade and troubleshoot basic standalone computers and small networks consisting of a maximum of five computers linked by a network.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills

Application of the Unit

This unit applies in a home, office or similar environment where merging technologies are applied for innovative technical applications.

ELEMENT

PERFORMANCE CRITERIA

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1 Plan for computer systems and network maintenance and upgrades

- 1.1 **OH&S requirements** and **specific safety requirements** for a given area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
- 1.3 Preventative **maintenance** task for **computer systems and networks** are planned in accordance with manufacturers' specifications and **enterprise procedures**.
- 1.4 Computer systems and network corrective maintenance tasks and **upgrades** are planned in accordance with manufacturers' specifications and **enterprise procedures**.
- 1.5 Computer systems and network components requiring upgrading are identified and appropriate upgrade components are selected in accordance with manufacturers' specifications and enterprise procedures.
- 1.6 **Appropriate personnel** are consulted to ensure that work is coordinated effectively with others involved at the work site.
- 1.7 **Resources and equipment** needed for the task are obtained in accordance with enterprise procedures and checked as fit for purpose.

2	Perform computer systems and network upgrades	2.1 OH&S requirements and specific safety requirements for carrying out the work are followed.
		2.2 Select, install and configure upgrades to computer systems and network in accordance with enterprise procedures.
		2.3 The upgraded computer systems and network is tested and all functions are verified in accordance with manufacturers' specifications and enterprise procedures.
		2.4 If required, inoperative functions are identified and rectified.
		2.5 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
3	Perform preventative and corrective maintenance on computer systems and networks	3.1 OH&S requirements and specific safety requirements for carrying out the work are followed.
		3.2 Preventative maintenance on computer systems and network is carried out in accordance with enterprise procedures.
		3.3 Corrective maintenance on computer systems and network is undertaken in accordance with enterprise procedures.
		3.4 Faults in computer systems and networks are identified and rectified using current industry practice.
		3.5 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
4	Complete computer systems and network upgrades and maintenance	4.1 OH&S requirements for completing the work are followed.
		4.2 Tools, resources and equipment are maintained and stored in accordance with enterprise procedures.
		4.3 If appropriate, worksite is cleared and made safe in accordance with OH&S requirements and enterprise procedures.
		4.4 Specifications of upgraded computer systems and networks are documented and stored in accordance with enterprise procedures.
		4.5 Outcomes of preventative and corrective maintenance are documented in accordance with enterprise procedures.

- 4.6 Appropriate personnel are informed of completed work task and, if required, provided with a demonstration of the functioning computer system and network.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Using tools and equipment correctly
- Following enterprise OH&S procedures
- Reading and interpreting equipment manuals
- Starting, shutting down and restarting a computer
- Working with icons
- Recognising an application window
- Resizing a desktop window
- Viewing basic system information
- Setting clock and date
- Minimising, maximising and exiting
- Adjusting screen display
- Setting and altering desktop settings
- Adjusting audio volume
- Starting menu options
- Using recycle bin
- Characterise computer displays
- Upgrading video with a video acceleration board
- Adding audio capabilities with a sound card
- Configuring external peripherals
- Adding hardware to a server
- Upgrading server components
- Adding a network interface card (NIC) and set the IP address
- Connecting to the internet
- Connecting a printer
- Sharing a printer
- Adding a network printer
- Dealing with paper problems
- Disposing of hazardous materials
- Using material safety and data sheets
- Undertaking preventative maintenance for computer peripherals
- Undertaking preventative maintenance for computer networks
- Troubleshooting common computer, computer network and peripheral device problems

Required knowledge:

- IT fundamentals including: computer systems and programs, computer types, connecting computer systems
- Basic features of graphical user interface (GUI) environment
- Laboratory safety and tools including: electrostatic discharge (ESD); basic safety principles, practices to reduce ESD; tools, cleaning supplies, testing equipment; safety agreement

- Computer system overview including: boot process; hardware components; memory components; display components; connector components, storage components; network components; network interface card (NIC); system resources; portable devices
- Basic hardware for multimedia upgrades including: video adapter; sound cards and speaker systems, common media file formats used in multimedia applications; MPEG hardware versus software, optical drives
- Network server overview including hardware RAID versus software RAID; hardware based RAID configuration
- Networking fundamentals including: file, print and application services; mail services; directory and name services; internet
- Network administration
- Simplex, half-duplex and full-duplex transmission
- Types of networks
- DHCP servers
- Default gateway
- Domain name system
- Network components including: network topologies, physical versus logical topology; networking media; common devices; server components
- LAN architectures including networking protocols, OSI model; TCP/IP utilities
- Printers and printing
- Elements of a preventative maintenance program including: tools and equipment; environmental guidelines; electrostatic discharge
- Basic trouble shooting techniques

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- local safe operating procedures

Specific safety requirements may include, but are not limited to:

- procedures
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards

Maintenance may include:

- programmed preventative maintenance
- corrective maintenance
- computer systems
- computer networks
- peripherals devices

Computer systems and networks includes:

Systems using the following or similar operating systems

- DOS
- Windows 9x
- Windows NT, 2000 and XP

- Mac Os
- UNIX
- Linux
- Novell
- Cisco Systems

System hardware from various manufacturers including

- mother boards
- optical and hard disk and other drives
- power supplies
- memory
- computer cases and internal / external connections and expansion slots
- various cards such as video cards
- cooling systems
- peripherals devices including mice, keyboards, printers etc
- network interface cards
- routers
- switches
- hubs

Upgrades may include:

Computer system upgrades:

- multimedia capabilities such as sound cards or video cards
- optical and hard drives
- mother boards
- memory
- peripheral device upgrades such as printers or external disk drive upgrades
- network interface cards

Computer network upgrades:

- redundant Array of Inexpensive Disks (RAID)
- network peripheral device upgrades such as printers or external disk drives upgrades
- server processor upgrades
- hubs
- routers
- switches

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures
- programmed maintenance procedures
- preventative and corrective maintenance procedures

Appropriate personnel may include:

- Supervisor
- client / customer
- enterprise staff
- trainer
- teacher
- mentor
- business/enterprise owner/manager

Resources and equipment may include but are not limited to:

- appropriate tools
- test equipment
- consumables
- network cards/ connectors
- appropriate software licences
- manufacturers' specifications and manuals
- diagnostics software
- spare parts
- catalogues

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement relevant Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria range;
 - demonstrate the ability to plan and undertake preventative and corrective maintenance and plan and undertake upgrades of computer systems and networks in a home, business or similar environment on more than one occasion and in different contexts. The number of interconnected workstations should be limited to five.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- Evidence should show competency working in realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit could be assessed in conjunction with any other units covering computer systems or computer networking maintenance or upgrading or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21556 Install and configure basic network and computer operating systems

Unit Descriptor This competency unit sets out the knowledge and skills required to install and configure computer and network operating systems. This unit covers stand alone computer operating systems and network operating systems suitable for small networks not exceeding five workstations.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills

Application of the Unit This competency unit applies in a home, office or similar environment where computers are utilised and the upgrading of software and operating systems occurs frequently.

ELEMENT PERFORMANCE CRITERIA

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1	Plan for operating system installation	1.1 OH&S requirements and specific safety requirements for a given area are obtained and understood. 1.2 Established OH&S requirements and risk control measures and procedures are followed for the preparation of the work area. 1.3 Preventative maintenance task for computer systems and networks are planned in accordance with manufacturers' specifications and enterprise procedures. 1.4 Computer systems and network corrective maintenance tasks and upgrades are planned in accordance with manufacturers' specifications and enterprise procedures. 1.5 Computer systems and network components requiring upgrading are identified and appropriate upgrade components are selected in accordance with manufacturers' specifications and enterprise procedures.
2	Install and configure operating system	2.1 OH&S requirements and specific safety requirements for carrying out the work are followed. 2.2 Pre-installation precautions are taken and data is backed up, if required, in accordance with enterprise procedures.

	2.3	Operating system is installed, configured and customised according to specifications, manufacturers' documentation and enterprise procedures.
	2.4	Ensure that latest security and other patches are taken into consideration during the installation process.
	2.5	Operating system installation is tested for functionality and any installation problems are dealt with in accordance to enterprise procedures.
	2.6	Decisions for dealing with unexpected situations are made based on discussions with appropriate personnel , job specification and enterprise procedures.
3	Complete and document installation process	
	3.1	OH&S requirements and specific safety requirements for completing the work are followed.
	3.2	Resources and equipment used in installation task are maintained and stored in accordance with enterprise procedures.
	3.3	If required, installed operating system is registered according to manufacturers' documentation and enterprise procedures.
	3.4	Outcome of the installation task is documented in accordance with enterprise procedures.
	3.5	Appropriate personnel are informed of completed installation task and, if required, provided with a demonstration of the functioning <i>operating system</i> installation.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Using tools and equipment correctly
- Following enterprise OH&S procedures
- Reading and interpreting equipment manuals
- Creating a boot disk
- Booting system with a disk
- Editing system configuration files
- Naming files
- Naming directories and folders
- Using text editing application to create a file (document)
- Copying, cutting or creating shortcuts
- Viewing document details
- Recognising file types
- Selecting, copying and moving files
- Searching for a file, folder or directory
- Making backup copies of files onto a disk or other device

- Using the recycle bin
- Adding/removing programs
- Adding/removing hardware
- Managing display and sounds
- Partitioning a hard drive
- Formatting a hard drive
- Installing a GUI based operating system including upgrades
- Finding help
- Adding software drivers
- Uninstalling operating systems

Required knowledge:

- Operating system fundamentals including: system components; system functions; system types and basic terminology
- Command line interface (CLI) including: file structure; basic commands; DOS configuration files
- Memory management including: memory types, management tools, types of memory, memory conflicts; real versus protected mode memory addressing
- GUI file structure and file management systems
- Operating system management with control panel including: system applet; printer; display and sounds
- Systematic troubleshooting techniques
- Common setup errors
- System properties and identifying icon symbols

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 in the Performance Criteria is detailed below.

OH&S requirements may include but are not limited to::

- legislation
- protective equipment
- material safety management systems
- local safe operating procedures

Specific safety requirements may include:

- procedures
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards

Enterprise procedures may include but are not limited to::

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Operating system may include:

- DOS
- Windows 9x

- Windows 2000 and XP
- Mac Os
- UNIX
- Linux
- Network Operating systems

Appropriate personnel may include:

- supervisor
- client / customer
- department personnel
- trainer
- teacher

Resources and equipment may include:

- appropriate tools
- test equipment
- consumables
- appropriate software licences
- manufacturers' specifications and manuals
- diagnostics software
- computer network with workstations
- access to internet

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular, assessment requires evidence that shows a candidate is able to:
 - implement relevant Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - demonstrate the ability to plan, install and configure a range of operating systems in a home or business or similar environment on more than one occasion and in different contexts. This includes at least one stand alone operating system and one network operating system.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- Evidence should show competency working in realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit could be assessed in conjunction with any other units covering computer and network operating systems or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21565 Install and test a home entertainment system

Unit Descriptor

This competency unit sets out the knowledge and skills required to install and test a home entertainment system. This includes inter-connecting domestic video, audio and control equipment to create an integrated home entertainment system.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This competency unit applies typically to a home environment and the installation work is predominantly carried out on customers' premises.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan to install a home entertainment system	1.1 OH&S requirements and specific safety requirements for a given area are determined. 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area 1.3 Home entertainment equipment installation requirements are determined from documentation, job sheets or discussions with appropriate personnel. 1.4 Installation site is assessed in preparation for installation task and installation task is planned in consultation with appropriate personnel. 1.5 Appropriate personnel are consulted to ensure that work is coordinated effectively with others involved at the work site. 1.6 Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked as being fit for the purpose.
2. Install and test a home entertainment system	2.1 OH&S requirements and specific safety requirements for carrying out the work are followed. 2.2 Equipment is checked as being isolated, where necessary, in strict accordance with OH&S requirements. 2.3 Home entertainment equipment is obtained, unpacked and checked for damage prior to installation. 2.4 Home entertainment equipment is installed, connected and configured according to requirements of appropriate personnel, manufacturers' specifications and enterprise procedures.

	2.5	Home entertainment system is tested for functionality to requirements of appropriate personnel and any identified problems are rectified.
	2.6	Decisions for dealing with unexpected situations are made based on discussions with appropriate personnel, job specification and <i>enterprise procedures</i> .
	2.7	Client is trained how to operate the home entertainment system
3. Complete and document installation.	3.1	OH&S requirements and specific safety requirements for carrying out the work are followed.
	3.2	Equipment and tools used in installation task are maintained and stored in accordance with enterprise procedures.
	3.3	Outcome of the installation task is documented in accordance with enterprise procedures.
	3.4	Appropriate personnel are informed of completed installation task and, if required, provided with a demonstration of the functioning home entertainment system.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Using tools and equipment correctly
- Following enterprise OH&S procedures
- Reading and interpreting equipment manuals
- Making decisions within a limited range of options
- Demonstrating questioning and active listening to clarify general information
- Installing domestic entertainment components
- Testing installations
- Troubleshooting connection issues
- Troubleshooting picture and sound issues
- Communicating with clients
- Completing workplace documentation
- Providing client training

Required knowledge:

- Input devices including: DVD players; CD players; turntables; electronic game players; VCRs; cable TV; computers; satellite dishes; DVD recorders; wireless input devices
- Connectors including: SCART; AV; coaxial; S video; wireless links
- Surround sound including: components (receivers, amplifiers, speakers); data decoding; dolby decoding; dolby surround sound; prologic; digital theatre systems; MPEG; MP3
- Output devices including: televisions (CRT, LCD, plasma, rear projection, digital, overhead projectors); speakers (wired, wireless; in wall speaker systems, sub woofers); surround sound formats (5.1, 7.1)
- Control devices including remote controls; universal remotes
- Troubleshooting methodology

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- local safe operating procedures

Specific safety requirements may include:

- procedures
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards

Home entertainment equipment may include, but is not limited to:

- televisions
- speaker, connector and power cable
- DVD, CD player, VCR and other input devices
- antennas
- surround sound receivers

Appropriate personnel may include:

- speakers
- amplifiers
- computers
- remote controls
- supervisor
- customer
- sales representative
- manager
- trainer
- mentor
- teacher
- team member

Resources and equipment may include, but are not limited to:

- appropriate tools and equipment
- cables and connectors
- manufacturers' manuals and specifications
- test equipment
- consumables

Enterprise procedures may include, but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular, assessment requires evidence that shows a candidate is able to:
 - implement relevant Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - demonstrate the ability to plan, install and configure a range of home entertainment systems and show clients how it operates in a home or similar environment on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- Evidence should show competency working in realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit could be assessed in conjunction with any other units covering home entertainment system set up or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;

- testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21557 Install and configure a home or small office network

Unit Descriptor

This unit of competency sets out the knowledge and skills required for entry level networking support to establish a small office or home office internet connected PC network.

This unit, together with VPAU646 *Install and configure a small to medium business network* provides skills and knowledge that align with network industry certifications.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The qualification's Employability Skills Summary in which this unit is included will assist in identifying employability skill requirements.

Application of the Unit

The unit applies to a home office or small business requiring the use of network and internetwork connectivity. This unit is applicable to small networks with simple IP addressing schemes that share a limited range of resources. Physical connections may be wired or wireless and simple firewall security employed.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable

1. Plan the installation of a home or small office network.

PERFORMANCE CRITERIA

Performance criteria indicate the standard of performance required to demonstrate achievement of the element. Terms requiring explanation or further definition should be bolded and italicised and detail provided in the range statement.

Assessment of performance is to be consistent with the evidence guide

- 1.1 ***OH&S requirements*** and ***environmental requirements*** for a given work area are obtained and clarified in consultation with ***appropriate personnel***.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel.
- 1.4 Nature and scope of the network and ***network resources*** is established from job briefs or discussions with appropriate personnel.
- 1.5 ***Personal computer system*** and ***network device*** requirements are planned for, selected and obtained in accordance with ***enterprise procedures***.
- 1.6 Operating instructions, manuals, hardware and software testing methodologies are identified and collected as required.

	1.7	Appropriate personnel are consulted to ensure the task is co-ordinated effectively with others involved at the work site.
2. Install and trouble-shoot a home or small office network.	2.1	Personal computer systems are setup according to manufacturers' specifications and enterprise procedures.
	2.2	Network resources are set up, configured and shared between network devices.
	2.3	Network addressing is determined by or verified using basic calculations where required.
	2.4	Troubleshooting of network and internet connectivity is performed according to manufacturers' specifications and enterprise procedures.
	2.5	Security threats are recognised and control measures initiated according to enterprise procedures.
	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3. Complete and document network installation.	3.1	Work site is made safe in accordance with established safety procedures.
	3.2	Installation software, logical and physical diagrams, IP addressing schemes are stored and recorded in accordance with enterprise procedures.
	3.3	Network administrator and security access codes and passwords are stored and recorded in accordance with enterprise procedures.
	3.4	Appropriate personnel are notified, in accordance with enterprise procedures, that the task has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Correctly using tools and equipment.
- Following enterprise OH&S procedures.
- Installing, configuring and maintaining basic wired and wireless computer networks, systems and peripherals.
- Planning, selecting, installing and configuring network operating systems.
- Designing a small computer network using appropriate protocols, tools and models to provide a specified range of services.
- Developing a security policy for a small computer network.
- Configuring the security features of a network to minimise risk of any security breach.
- Troubleshooting common network problems in accordance with help desk procedures.
- Working with customers and peers to achieve outcomes.

Required knowledge:

- Correct usage of tools and equipment.
- Enterprise OH&S procedures.
- Basic computer systems and network operating systems.

- Computer networking principles (wired and wireless).
- Network addressing systems (basic).
- Network services and associated network models and protocols.
- Network security management.
- Troubleshooting procedures.

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- customer/client
- manager
- site engineer
- trainer
- mentor
- teacher
- team member
- files, software, DHCP server, DNS server, web browser.

Network resources may include:

Personal computer system may include:

- PC hardware
- operating system
- interface cards
- peripheral devices
- media

Network devices may include:

- switch, hub, router (wired or wireless), print server, network attached storage device.

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

Basic calculations may include:

- addition
- subtraction
- multiplication

- division
- fractions
- decimals
- binary number system

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria.

In particular this shall incorporate evidence that shows a candidate is able to:

- (i) implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
- (ii) demonstrate required knowledge and skills as described in this unit;
- (iii) demonstrate competence within a timeframe typically expected of the discipline, work function and industrial environment;
- (iv) Within the constraints of a home or small office network, consistently demonstrate the ability to:
 - a. Plan the installation of an internet connected network.
 - b. Setup and configure wired and wireless networks with simple addressing schemes.
 - c. Troubleshoot network and internet connectivity.
 - d. Set up resource sharing.
 - e. Deploy simple firewall network security.

Context of and specific resources for assessment

Evidence should show competency working in a realistic environment and a variety of conditions.

The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures;
- oral and/or written questioning on required knowledge and skills;
- testimony from supervisors, colleagues, clients and/or other appropriate persons;
- inspection of the final product or outcome;
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

Assessment should reinforce the integration of the Employability Skills

Guidance information for assessment

There is no concurrent assessment recommendation for this unit.

Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts.

VU21558 Install and configure a small to medium business network

Unit Descriptor

This unit of competency sets out the knowledge and skills required to establish and support a small to medium business network capable of providing WAN connectivity and common WEB internet services.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

The unit applies to small and medium size businesses requiring the use of wired network connectivity. This unit is applicable to networks that employ subnet addressing and provide ISP services over a secure network.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan the installation of a small to medium enterprise network.

- 1.1 ***OH&S and environmental requirements*** for a given work area are obtained and clarified in consultation with ***appropriate personnel***.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel.
- 1.4 Nature and scope of the business network and ***network resources*** is established from job briefs or discussions with appropriate personnel.
- 1.5 Computer system and ***network device*** requirements are planned for, selected and obtained in accordance with ***enterprise procedures***.
- 1.6 Operating instructions, manuals, hardware and software testing methodologies are identified and collected as required.
- 1.7 Appropriate personnel are consulted to ensure the task is coordinated effectively with others involved at the work site.

2. Install and configure a small to medium enterprise network.	2.1 Wired infrastructure is set up according to manufacturers' specifications and enterprise procedures.
	2.2 Resource sharing is setup and configured on a network server.
	2.3 WAN connection and ISP services are installed and configured in accordance with enterprise procedures.
	2.4 Troubleshooting of network and internet connectivity is performed according to manufacturers' specifications and enterprise procedures.
	2.5 Data backup and disaster recovery measures are implemented according to enterprise procedures.
	2.6 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3. Complete and document network installation.	3.1 Work site is made safe in accordance with established safety procedures.
	3.2 Installation software, logical and physical diagrams, IP addressing schemes are stored and recorded in accordance with enterprise procedures.
	3.3 Network administrator and security access codes and passwords are stored and recorded in accordance with enterprise procedures.
	3.4 Appropriate personnel are notified, in accordance with enterprise procedures, that the task has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Determining the business needs of a small ISP.
- Planning wired network infrastructure.
- Installing, configuring and troubleshooting networking devices.
- Developing network documentation and maintaining network records.
- Modifying and translating network and port addresses to establish connectivity.
- Using router testing methodologies to verify a given configuration.
- Implementing WAN services to the internet.
- Instigating data backup and disaster recovery procedures
- Identifying customer requirements and providing help desk support.

Required knowledge:

- Correct usage of tools and equipment.
- Enterprise OH&S procedures.
- Network models and topologies.

- Subnet addressing.
- ISP services.
- WAN services and ISP responsibilities
- Network device configuration.
- Data backup services and procedures.
- Troubleshooting procedures.

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 in the Performance Criteria is detailed below..

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include, but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- customer/client
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Network resources may include:

- files
- software
- DHCP server
- DNS server
- web browser.

Network device includes, but is not limited to:

- switch
- router
- server
- wired infrastructure for a small to medium size business.

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication

- manufacturers' specifications
- operational procedures
-

Wired infrastructure may include:

- copper and fibre cables
- connectors and cabling
- distribution frames

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular assessment requires evidence that shows a candidate is able to:
 - implement relevant Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - Within the constraints of a small to medium size business network, consistently demonstrate the ability to:
 - a. Plan the installation of a network that uses subnet addressing and provides ISP services.
 - b. Setup and configure wired infrastructure.
 - c. Troubleshoot local network and WAN connectivity and services.
 - d. Configure resource sharing on a network server.
 - e. Provide network data back up and disaster recovery.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Employability Skills

VU21559 Implement and troubleshoot enterprise routers and switches

Unit Descriptor

This unit of competency sets out the knowledge and skills required to configure and program routers and switches to establish voice and data services and applications over LAN and WAN connections for enterprise networks.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit applies to medium to large enterprises requiring the use of internetwork services and applications.

Furthermore, this unit applies to networks employing VLAN connectivity and hierarchical addressing schemes and where access control will be used to achieve network security.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan the implementation of network routers and switches.

- 1.1 ***OH&S and environmental requirements*** for a given work area are obtained and clarified in consultation with ***appropriate personnel***.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel.
- 1.4 Nature and scope of network routers and network switches is established from job briefs or discussions with appropriate personnel.
- 1.5 ***Network services and network application*** requirements are planned for, selected and obtained in accordance with ***enterprise procedures***.
- 1.6 Operating instructions, manuals, hardware and software diagnostic tools are identified and made available, as required.

	1.7 Appropriate personnel are consulted to ensure the task is coordinated effectively with others involved at the work site.
2. Implement network switches and routers.	2.1 Routers and switches are configured according to manufacturers' specifications and enterprise procedures.
	2.2 Addressing scheme is determined and applied using basic calculations .
	2.3 Network WAN links are activated and verified.
	2.4 Network services and network applications are enabled to the network.
	2.5 Traffic access and filtering are set up, according to enterprise procedures.
3. Troubleshoot network switches and routers.	3.1 Diagnostic and analysis tools are used to monitor network performance and isolate faults
	3.2 Troubleshooting of network and internet connectivity is performed according to manufacturers' specifications and enterprise procedures.
	3.3 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
4. Document configuration and troubleshooting records.	4.1 Work site is made safe in accordance with established safety procedures.
	4.2 Router and switch configuration details are recorded and stored in accordance with enterprise procedures.
	4.3 Fault history and network recovery actions are recorded and stored in accordance with enterprise procedures.
	4.4 Appropriate personnel are notified, in accordance with enterprise procedures, that the task has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Using tools and equipment correctly.
- Following enterprise OH&S procedures.
- Configuring switches and routers to enable LAN and WAN links.
- Using a hierarchical IP network address scheme.
- Connecting enterprise networks using WAN services and applications
- Connecting the enterprise network to external services.
- Using appropriate tools to analyse enterprise network.

- Configuring and activating network access and security measures.
- Troubleshooting network faults and implementing recovery action.
- Maintaining enterprise network documentation.

Required knowledge:

- Tool and equipment correct usage.
- Enterprise OH&S procedures.
- Features and applications in the enterprise.
- Network modelling.
- Enterprise switching and routing protocols and strategies
 - Multilayer switching
 - Hierarchical addressing
 - Routing protocols
 - VLAN routing
- Implementing enterprise WAN links.
- Access control lists.
- Network diagnostic and troubleshooting techniques.
- Enterprise record keeping procedures.

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include, but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- customer/client
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Network service includes:

- Domain Name System - DNS

- Dynamic Host Configuration Protocol – DHCP
- Web services
- Collaborative services
- Authentication servers
- Directory services
- Network file system
- e-mail
- printing

Network application such as:

Enterprise software applications

- spreadsheet
- word-processor
- media player

Enterprise procedures may include, but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

Basic calculations including:

- addition
- subtraction
- multiplication
- division
- fractions
- decimals
- binary number system

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular, assessment must include evidence that a candidate is able to:

- implement relevant Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
-
- demonstrate competence within a timeframe typically expected of the discipline, work function and industrial environment;
- Within the constraints of a medium to large enterprise network, consistently demonstrate the ability to:
 - a) Determine customer networking requirements.
 - b) Configure routers and switches using hierarchical addressing over VLANs to meet network link requirements.
 - c) Enable and control access to network services and applications across the network.
 - d) Diagnose and rectify network hardware and device configuration faults.
 - e) Document configuration information, fault finding history and remediation action.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include :
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in

a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21560 Design, install and configure an internet

Unit Descriptor

This unit of competency sets out the knowledge and skills required to design an enterprise internetwork, procure LAN/WAN requirements and perform network upgrades.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills

Application of the Unit

This unit applies to the design, installation and configuration of a network suitable for a large enterprise. The design will include determining network requirements and creating network design including topology selection for wired and wireless infrastructure. Advanced routing and addressing schemes will be utilised in the design.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

1. Plan the design and installation of an internetwork.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 ***OH&S and environmental requirements*** for a given work area are obtained and clarified in consultation with ***appropriate personnel***.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel.
- 1.4 Nature and scope of the ***internetwork*** is established from job briefs or discussions with appropriate personnel and design specifications agreed to.
- 1.5 Network hardware and ***network device*** requirements are determined, selected and obtained in accordance with ***enterprise procedures***.
- 1.6 Equipment manuals and programming instructions are identified and collected as required.
- 1.7 Appropriate personnel are consulted to ensure the task is coordinated effectively with others involved at the work site.

2. Design an internetwork.	2.1 Network Topology is selected after considering technical requirements, constraints (physical and financial) and expansion projections.
	2.2 Network devices and network resources are determined, including wired and wireless implementations.
	2.3 Network security is incorporated in network design in accordance with enterprise procedures.
	2.4 Router and switch configurations are determined to meet design specifications
3. Install and configure an designed internetwork.	3.1 Network hardware is installed in to meet network topology and in accordance with enterprise procedures.
	3.2 Routers and switches are configured to satisfy the logical connection of the internetwork.
	3.3 Connectivity and performance tests are conducted to verify the installed network meets the design specification.
	3.4 Troubleshooting of installed internetwork is performed according to manufacturers' specifications and enterprise procedures.
	3.5 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
4. Complete and document network design and installation.	4.1 Work site is made safe in accordance with established safety procedures.
	4.2 Design, installation, configuration and troubleshooting documentation is stored and recorded in accordance with enterprise procedures.
	4.3 Internetwork administrator and security access codes and passwords are stored and recorded in accordance with enterprise procedures.
	4.4 Appropriate personnel are notified, in accordance with enterprise procedures, that the task has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Correctly using tools and equipment.
- Following enterprise OH&S procedures.
- Determining customer requirements and negotiating a design specification.
- Applying network design methodologies to design networks that provide a range of services and applications found in larger networks.

- Identifying the technical requirements, constraints and manageability issues for a given customer network requirement.
- Determining the impact of upgrading hardware and software on network functionality.
- Conducting a wireless site survey
- Analysing the impact of applications on traffic flow in the network
- Installing a network design

Required knowledge:

- Tool and equipment correct usage.
- Relevant enterprise OH&S procedures.
- OSI layered communication model.
- Network requirements
 - Applications
 - Quality of service
 - Manageability
 - Lifecycle
- Network design concepts
 - Physical and financial constraints
 - business requirements
 - network topologies
 - wired or wireless options
 - security
- Troubleshooting
 - Impact of network failure
 - Maintenance
 - Troubleshooting methodology

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include, but are not limited to:

- liquid waste
- solid waste

Appropriate personnel may include:

- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise
- supervisor
- customer/client
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Internetwork including:

- connection of two or more distinct computer networks or network segments via a common routing technology.

Network device including:

- switch, router, server, including cable and wireless interconnectivity for a SOHO, medium and enterprise networks.

Enterprise procedures may include, but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

Network topology including:

- physical and logical interconnection between network devices. For example ring, mesh, tree, star and bus.

Network resources including:

- files, software, printers

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates need to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.

- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - within the environment of a large enterprise network, consistently demonstrate the ability to:
 - a) Determine customer requirements.
 - b) Design an internetwork that uses advanced routing and addressing techniques.
 - c) Install an internetwork according to design specification.
 - d) Configure network devices to meet design functionality.
 - e) Document internetwork design, installation and configuration.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21561 Build a simple network and establish end to end connectivity

Unit Descriptor

This unit of competency sets out the knowledge and skills required to apply understanding of the architecture, structure, functions and components of a computer network to build a simple network and establish end to end connectivity.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills

Application of the Unit

The unit applies to simple network environments demonstrating the use of network and internetwork connectivity using a range of client server applications and services.

ELEMENT

PERFORMANCE CRITERIA

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Identify the hardware and software components required to build a simple network	1.1 Network devices for both the OSI and TCP/IP layered models of a computer network are identified. 1.2 Computer operating system commands required to program the Local Area Network (LAN) card are obtained from manufacturers' relevant operating manuals, data books or relevant online resources. 1.3 Relevant commands of a Network Operating System to affect the network devices' connection to a LAN is obtained from relevant operating manuals, data books or relevant online resources. 1.4 Cable network devices and components are identified from a network topological drawing. 1.5 A simple network topology is translated into a cabled network.
2. Create a simple network addressing scheme	2.1 A network addressing scheme is calculated for an IPv4 addressing scheme using basic methods. 2.2 A network addressing scheme is calculated for an IPv6 addressing scheme using basic methods. 2.3 IP addresses for end points and network devices are determined by using basic method calculations.
3. Build and verify a network.	3.1 Connections between network hardware are established according to manufacturers' specifications and established procedures.

- 3.2 Routers are configured to establish end to end connectivity.
- 3.3 **Base level troubleshooting** skills and procedures are utilised to establish or repair network connectivity.
- 3.4 **Network resources** are set up, configured and shared between network devices.
- 4. Report network build completion.
 - 4.1 Work site is made safe in accordance with established safety procedures.
 - 4.2 Network schematics and the network addressing scheme are documented and network performance is demonstrated to **relevant personnel**.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Following relevant enterprise OH&S procedures.
- Using appropriate tools to develop and test network addressing.
- Sourcing Computer operating system commands
- Sourcing Network operating system commands
- Translating paper network designs into a sketch of physical devices and connections
- Creating an addressing scheme that contains sub-net addressing
- Setting IP addresses on end points and network devices
- Configuring interfaces and testing and verifying correct functionality
- Configuring applications and verifying their connection to provide network services
- Troubleshooting common network problems in accordance with help desk procedures.

Required knowledge:

- Correct usage of tools and equipment
- Enterprise OH&S procedures
- Network devices
- Computer operating system commands
- Network operating system commands
- Network architecture
- The internet and computer network communication
- OSI and TCP/IP model.
- Encapsulation and de-encapsulation concepts as they relate to data flow in a network
- Network addressing schemes
 - o Classful & VLSM
 - o IPv4 and IPv6 Addressing
 - o Network address translation - NAT

-
- Cabling of LANs
 - Base level troubleshooting procedures.

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Network devices may include:

- Hubs
- Switches
- Routers
- Workstations (data end points)

Computer operating system may include but is not limited to:

- Windows XP, Windows Vista, Windows 7, Windows 8
- Linux
- Apple Computer Operating System (Lion etc)

Network Operating Systems such as:

- Command Line Interface for text based Cisco devices
- Flash based http server
- Cisco Configuration Professional (CCP)

Simple network topology

- Network design at this level should contain no more than two or three end users, routers and switches

Network addressing including:

- static and dynamic addressing
- sub-netting

Basic methods

- addition
- subtraction
- multiplication
- division
- decimal, binary, hexadecimal number systems
- Host based subnet

End points may include but are not limited to:

- Personal computers
- Laptops
- Tablets

Base level troubleshooting: may include:

- Ping
- Traceroute
- Examination of router routing table
- Examination of ARP table
- Inspection of interface configuration:
 - IPconfig
 - Show CDP Neighbors
 - Show IP interface brief

- Show interface

Network resources including:

- files, software, TFTP Server, Wireshark

Relevant personnel such as:

- supervisor
- manager
- site engineer
- trainer
- mentor
- teacher

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - given a base level network design, consistently demonstrate the ability to:
 - a) Demonstrate an understanding of how data flows from end to end in a basic network LAN
 - b) Develop a network addressing scheme.
 - c) Determine required network components to build the network.
 - d) Plan, build, configure, test and analyse the performance of a network.
 - e) Troubleshoot network problems

f) Work with peers

Context of and specific resources for assessment

- This unit is usually assessed in a simulated work environment.
- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required and have access to any relevant manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21562 Configure and troubleshoot network switches and routers

Unit Descriptor This unit of competency sets out the knowledge and skills required to use appropriate tools, equipment, software and protocols to configure and troubleshoot network switches and routers.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills

Application of the Unit The unit applies to the configuration, analysis and troubleshooting of routers and switches in small to medium sized business networks.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Configure network switches	1.1 The nature and scope of network switching requirements is established from a sample of <i>small network topologies</i> and discussions with <i>relevant personnel</i> .
	1.2 Network switches are setup and configured according to manufacturers' specifications and enterprise procedures.
	1.3 Multiple VLANs are configured and established across the network.
	1.4 <i>Layer 2 (switch) section</i> of a small network is configured to meet network specifications.
	1.5 <i>Standard troubleshooting techniques</i> are utilised to establish end to end connectivity.
2. Configure routing protocols for a small network	2.1 The nature and scope of network routing is established from a sample of small network topologies or discussions with appropriate personnel
	2.2 Operating instructions, manuals, hardware and software tests are identified and collected as required
	2.3 Network routers are setup and configured according to manufacturers' specifications and enterprise procedures
	2.4 A small network is built and configured to meet specifications
	2.5 Standard troubleshooting techniques for routers are utilised to establish end to end network connectivity

3. Configure and verify IP services on a router.	3.1 IP addresses are allocated to hosts according to network design. 3.2 Dynamic host configuration protocol (DHCP) and Network Address Translation (NAT) are implemented. 3.3 Dynamic host configuration protocol (DHCP) is configured and verified on the network router. 3.4 Network Address Translation (NAT) is configured and verified on the network router.
4. Secure a network using router services.	4.1 Security threats are Identified and recognised, and control measures initiated according to enterprise procedures. 4.2 Layer 3 security for a network utilising Access Control Lists (ACL's) is implemented to protect from base level security threats. These are to be recorded in accordance with enterprise procedures. 4.3 A network is secured from common threats using ACL's positioned appropriately on the router interfaces
5. Build and verify a network containing routers and switches.	5.1 Connections between network hardware are established according to manufacturers' specifications and established procedures. 5.2 Routers and switches are configured to establish end to end connectivity for a Small to Medium enterprise network 5.3 Standard troubleshooting techniques are utilised to establish or repair network connectivity
6. Report network configuration completion to supervisor.	6.1 Work site is made safe in accordance with established safety procedures 6.2 Access control lists are recorded in accordance with enterprise procedures. 6.3 Network schematics and the network addressing scheme are documented and/or network performance is demonstrated to the supervisor.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Correctly using tools and equipment.
- Following relevant enterprise OH&S procedures.
- Designing and building a interVLAN switched network
- Configuring a switch using VLAN trunking and Spanning Tree protocols.
- Configuring a network to support multiple VLANs
- Implementing IP addressing schemes and security strategies.
- Configuring interfaces and protocols for network switches and routing.
- Verifying end to end connectivity for switches

- Verifying routing is functional
- Troubleshooting routing for small networks.

Required knowledge:

- Correct usage of tools and equipment.
- Enterprise OH&S procedures.
- Switching concepts and MAC addresses
- Typical network bottlenecks
- Access and Trunking ports
- Base level network security with switches
- VLAN Trunking Protocol
- Spanning Tree Protocol
- InterVLAN routing
- Network segmentation with VLANs
- Routing tables and Packet Forwarding
- Static routes
- Default routes
- Dynamic Routing
- Distance Vector Routing Protocols
 - eg. RIP v1 and v2
- Scalable routing strategies
 - eg VSLM and CIDR
- Routing Tables.
- Link-State routing Protocols
 - eg OSPF.
- Hybrid routing protocols
 - eg EIGRP.
- Security protocols using access lists
- DHCP use to generate end point layer 3 addresses
- Network Address Translation (NAT)

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Small network topologies:

- A network that includes up to 5 switches and routers

Relevant personnel such as:

- supervisor
- manager
- site engineer
- trainer
- mentor
- teacher

Layer 2 (switch) section:

- Layer 2 connectivity testing
- Layer 1 (physical layer) connectivity confirmation

Standard troubleshooting techniques may include:

- Ping
- Traceroute
- Examine router routing table
- Examine ARP table
- Inspection of interface configuration:
 - IPconfig
 - Show CDP Neighbors
 - Show IP interface brief
 - Show interface

Dynamic host configuration protocol (DHCP)

- Issue server commands to enable IP addresses to issued to end points
- End point IP address confirmation

Network Address Translation (NAT):

- NAT is deployed to the extent of:
 - Conservation of network addresses
 - Provision of security by limiting the entry and exit paths of data to a network

Access control lists may indicate authorised:

- Users
- Access privileges
- Blockage of source or destination addresses
- Blocking types or traffic
- Blocking ports

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices within the constraints of a small to medium network, consistently demonstrate the ability to:

- a) Plan, implement and test network switch design for a small network to meet design specification requirements.
- b) Configured protocols on network routers.
- c) Manage network addressing.
- d) Construct and Troubleshoot the network.
- e) Install network security.

Context of and specific resources for assessment

- This unit is usually assessed in a simulated work environment.
- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required and have access to any relevant manuals and reference materials

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21563 Scale an existing network

Unit Descriptor

This unit of competency sets out the knowledge and skills required to apply understanding of the architecture, components and operations of routers and switches to configure, analyze and troubleshoot large moderately complex networks.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills

Application of the Unit

The principles of this unit are applied to a network in order to expand (scale) the network, and improve reliability without the need for a complete network redesign. The unit can be applied to the configuration, analysis and troubleshooting of routers in small to medium sized business networks.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Identify network features required to scale a Small to Medium enterprise network.

- 1.1 Details and location of a network requiring scaling are determined by discussion with **relevant personnel**.
- 1.2 The needs of an existing network to support future growth are evaluated using **network mobility** and **router redundancy** projections.
- 1.3 Expansion of an existing network to accommodate predicted growth is planned and designed.
- 1.4 **Network bottlenecks** are identified and **link aggregation methodology** implemented to enable an increase in data throughput.

2. Plan and implement scalable changes to an existing small to medium network.

- 2.1 Router interfaces are setup according to manufacturers' specifications and enterprise procedures.
- 2.2 Scalable routing protocols (Single and multi-area OSPF, EIGRP and advanced EIGRP) are implemented to achieve network design requirements.
- 2.3 Classless addressing is implemented across a network.
- 2.4 Troubleshooting of network routing is performed according to manufacturers' specifications and enterprise procedures.

- 2.5 **Network resources** are set up, configured and shared between network devices
- 2.6 Computer and wireless networking equipment are installed and configured in accordance with manufacturers' specifications and enterprise procedures.
- 2.7 Basic network security features are configured according to job requirements and enterprise procedures.
- 2.8 The wireless local area network is tested for functionality and, if appropriate, faults are corrected.
- 2.9 **Base level troubleshooting** skills are utilized to verify network connectivity.
- 3. Report and document completion of scaling changes.
 - 4.1 Work site is made safe in accordance with established safety procedures.
 - 4.2 Network schematics and network addressing scheme are documented and/or network performance is demonstrated to relevant personnel.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Correctly using tools and equipment
- Following relevant enterprise OH&S procedures
- Reading and interpreting equipment manuals
- Applying basic planning skills
- Making decisions within a limited range of options
- Implementing IP addressing schemes and security strategies
- Configuring interfaces and protocols for network routing
- Configuring Etherchannel for increased data throughput
- Verifying routing is functional
- Troubleshooting advanced routing for client networks
- Identifying network bottlenecks
- Performing diagnostics for the wireless local area network (WLAN)
- Configuring services for a WLAN
- Configuring radio and Ethernet
- Managing configuration files
- Accessing network status, statistics and performance metrics
- Installing antennas for a WLAN
- Completing workplace documentation

Required knowledge:

- Correct usage of tools and equipment.
- Enterprise OH&S procedures.
- Sources of equipment manuals and manufacturers' specifications
- Decision making options
- Principles of scaling a network
- Scalable network architectures
 - Core Layer
 - Distribution Layer
 - Access Layer
- Principles of router redundancy
- Likely causes of network bottlenecks
- Etherchannel configuration for increased data throughput
- Spanning Tree Implementation Methodologies:
 - Rapid Spanning Tree Protocol (RSTP)
 - Per VLAN Spanning Tree Plus Protocol (PVST+)
- Diagnostic techniques for wireless local area networks (WLAN)
- Configuration services for WLAN
- Radio and Ethernet configuration
- Configuration file management
- Network status and network statistics performance indicators
- Routing and Packet Forwarding
- Static Routing
- Dynamic Routing
- Scalable routing strategies
 - eg VSLM and CIDR
- Routing Tables
- Link-State routing Protocols.
 - eg OSPF single and multiarea
- Hybrid routing protocols
 - eg EIGRP
- Workplace documentation requirements.

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Relevant personnel may include:

- supervisor
- manager
- site engineer
- trainer
- mentor
- teacher

Network mobility may include:

- establishing network capabilities to enable
 - Working from home
 - Working remotely
 - Use of smart devices

Router redundancy may include, but is not limited to:

- Hot Standby Router Protocol (HSRP)

Network bottlenecks including:

- switch trunk links
- highly subscribed LAN ports
- highly subscribed WANs

Link aggregation methodology may include, but is not limited to:

- Etherchannel

Network resources including:

- Files
- Software
- TFTP Server
- Wireshark

Base level troubleshooting: may include:

- Ping
- Traceroute
- Examination of routing table
- Examination of ARP table
- Inspection of interface configuration:
 - IPconfig
 - Show CDP Neighbors
 - Show IP interface brief
 - Show interface

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices within the constraints of a small to medium network, consistently demonstrate the ability to:
 - a) Produce network design that utilises scalability in order to meet future design specification.
 - b) Configure scalable routing protocols on network routers.
 - c) Manage network addressing.
 - d) Troubleshoot the network.
 - e) Implement WLANs solutions for end user mobility

Context of and specific resources for assessment

- This unit is usually assessed in a simulated work environment.
- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required and have access to any relevant manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;

- inspection of the final product or outcome;
- a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21564 Establish connectivity to a wide area network (WAN)

Unit Descriptor

This unit of competency sets out the knowledge and skills required to use appropriate tools, equipment, software and protocols to establish connectivity to a wide area network.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills

Application of the Unit

The unit applies to establishing connectivity of medium to large enterprise networks requiring secure WAN access.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan connectivity to a WAN.	1.1 The nature and scope of the network, <i>WAN connection and performance expectations</i> are established by consultation with <i>relevant personnel</i> 1.2 Network hardware, software, <i>WAN communication protocol</i> requirements are planned for, selected and obtained in accordance with <i>enterprise procedures</i> 1.3 Operating instructions, manuals and installation procedures are identified and collected as required
2. Configure devices to achieve WAN connectivity for a medium enterprise	2.1 A WAN accessible network is installed according to manufacturers' specifications and enterprise procedures. 2.2 A network is set up and configured to provide WAN access. 2.3 <i>Network Address Translation (NAT)</i> is deployed on the network for increased security and to conserve IPv4 addresses 2.4 WAN point to point connection is configured and verified 2.5 A Frame Relay WAN communication protocol comprising multiple sites is configured and verified
3. Troubleshoot medium enterprise WAN links	3.1 <i>Established troubleshooting procedures</i> are utilized to identify and rectify WAN implementation issues

	3.2	Solutions to resolving WAN implementation issues are documented using established enterprise processes.
4. Monitor network performance.	4.1	Software tools are used to monitor and measure network performance
	4.2	Network baseline service level is established
	4.3	Network performance abnormalities are identified
	4.4	Changes to the network are planned and iteratively executed to restore baseline network performance and services
5. Report completion of network installation maintenance.	5.1	Work site is made safe in accordance with established safety procedures.
	5.2	Network schematics and network addressing scheme are documented and network performance is demonstrated to relevant personnel.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Using tools and equipment correctly
- Following enterprise OH&S procedures
- Identifying customer requirements
- Determining and selecting appropriate WAN configurations
- Facilitating network connectivity by installing and configuring a WAN communication protocol such as PPP, HDLC and Frame Relay
- Establishing base line WAN performance
- Selecting the most cost effective solution for the customer
- Troubleshooting client network problems using industry standard troubleshooting methodologies and tools.

Required knowledge:

- Correct tool and equipment usage
- Enterprise OH&S procedures
- OSI layered communication model
- WAN link protocols such as PPP, HDLC, LAPB and Frame Relay.
- VPN Technologies
- ADSL Technologies
- IP Addressing services and network scaling
- Methods to secure Site to Site Connectivity
 - VPN's
 - IPsec
 - Tunnels
- Tools to monitor a network
 - Syslog
 - SNMP

- Netflow
- Wireshark

– WAN troubleshooting methodologies and analysis and diagnostic tools

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

WAN connection and performance expectations may include, but are not limited to:

- Connection bandwidth
- Connection services
- ISP connections
- IP Telephony future requirements

Relevant personnel such as:

- supervisor
- manager
- site engineer
- trainer
- mentor
- teacher

WAN communication protocols including:

- SLIP
- HDLC
- PPP
- Frame Relay

Enterprise procedures may include, but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

Established troubleshooting procedures:

- Ping
- Traceroute
- Examine router routing table
- Examine ARP table
- Inspection of interface configuration:
 - IPconfig
 - Show CDP Neighbors
 - Show IP interface brief
 - Show interface

Network Address Translation (NAT):

- NAT is deployed to the extent of:
 - Conservation of network addresses

- Provision of security by limiting the entry and exit paths of data to a network

Software monitoring tools. may include, but are not limited to:

- Wireshark
- Syslog
- Simple Network Management Protocol (SNMP)
- Netflow

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Install and maintain a WAN. In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures
 - Within the constraints of a medium to large enterprise network, consistently demonstrate the ability to:
 - a) Plan the installation of a WAN accessible network.
 - b) Select and apply WAN link protocols.
 - c) Configure IP addressing across the WAN.
 - d) Troubleshoot WAN communication issues.
 - e) Install WAN access security measures.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team.

- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Employability Skills

VU21388 Set up and test an embedded control system

Unit Descriptor	This unit of competency sets out the knowledge and skills required to install, set up and test embedded control systems used for automatic or semi-automatic operation of a wide range of consumer and industrial equipment. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.
Employability Skills	This unit contains Employability Skills.
Application of the Unit	This unit applies in a home, office or similar environment where embedded control systems are utilised to operate a wide range of consumer and industrial equipment.
ELEMENT	PERFORMANCE CRITERIA
Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1. Plan to set up, install and test an embedded control system	1.1 <i>OH&S requirements</i> and <i>environmental requirements</i> for a given work area are obtained and understood. 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area. 1.3 <i>Embedded control system</i> installation and set up requirements are determined from documentation, job sheets or discussions <i>with appropriate personnel</i>. 1.4 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site. 1.5 <i>Resources and equipment</i> needed for the task are obtained in accordance with <i>enterprise procedures</i> and checked for correct operation and safety.
2. Install and test an embedded control system	2.1 OH&S requirements for carrying out the work are followed. 2.2 Equipment/machines/plant are checked as being isolated, where necessary, in strict accordance with OH&S requirements. 2.3 Embedded control system is installed and configured according to given requirements, manufacturers' manuals and enterprise procedures. 2.4 Embedded control system is programmed either in circuit or in a programmer according to requirements, manufacturers' specifications and enterprise procedures. 2.5 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.

	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3. Verify operation and complete documentation	3.1	OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with established safety procedures
	3.3	Equipment and tools used in installation task are maintained and stored in accordance with enterprise procedures.
	3.4	Embedded control system is tested for correct operation in accordance with requirements, manufacturers' specifications and enterprise procedures.
	3.5	Embedded control system installation and configuration is documented and stored, in accordance with enterprise procedures.
	3.6	Appropriate personnel are informed of the completion of work and, if required, provided with a demonstration of the operation of the embedded control system.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of predictable problems
- Install an embedded control system
- Plan a procedure
- Test micro controllers including power up routine; resetting; booting; reprogramming; functional testing

Required knowledge:

- Embedded controller applications including industrial; commercial; domestic
- Micro controller features including fabrication techniques; architecture; memory features and options; power management; input and output features; interrupts; special features (eg. watch-dog timers, digital signal processors, clock monitor, resident program loader)
- Micro controller software including machine language, assembler language, interpreters; compilers; development tools; simulators; debuggers

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Embedded control system includes:

- controller board
- micro controller
- memory devices
- input sensors
- output devices

Appropriate personnel may include, but are not limited to:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Resources and equipment may include:

- appropriate tools
- appropriate spare parts
- cables and connectors
- test equipment
- consumables
- appropriate software licences
- manufacturers' specifications and manuals
- diagnostics software
- personal computer
- programming tools

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit, as specified by the criteria, including required knowledge
- The candidate must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - (i) implement Occupational Health and Safety workplace procedures and practices, including the use of risk control measures;
 - (ii) demonstrate the ability to install, set up and test embedded control systems on more than one occasion and in different contexts.
 - (iii) the demonstration must include reprogramming the embedded controller systems at least on one occasion and in different contexts.

Context of and specific resources for assessment

This unit may be assessed on the job, off the job or a combination of both on and off the job. . Evidence should show competency working in a realistic environment and a variety of conditions.

Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations

- The candidate will have access to all tools, equipment, materials and documentation required.
- The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit could be assessed in conjunction with any other units covering embedded control systems or other units

Method of assessment

- requiring the exercise of the skills and knowledge covered by this unit.
- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
 - Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
 - Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21387 Test and verify correct operation of a “by-wire” control system

Unit Descriptor

This unit of competency sets out the knowledge and skills required to test and verify correct operations of a by-wire control system. This includes input transducers, output devices, serial bus concepts, channel multiplexing and use of this technology in aviation, automotive, building automation and remote control applications.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit applies in a home or commercial environment where “by-wire” technology is utilised for a range of control applications.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan to install and test a “by-wire” control system

- 1.1 ***OH&S requirements*** and ***environmental requirements*** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
- 1.4 ***Control application*** that may be performed by a “by-wire” system is analysed, documented and discussed with appropriate personnel.
- 1.5 Control application installation and testing requirements are determined from documentation, job sheets and discussions with appropriate personnel.
- 1.6 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
- 1.7 ***Resources and equipment*** needed for the task are obtained in accordance with ***enterprise procedures*** and checked for correct operation and safety.

2. Install and test “by-wire” control system

- 2.1 OH&S requirements for carrying out the work are followed.
- 2.2 Equipment/machines/plant are checked as being isolated, where necessary, in strict accordance with OH&S requirements.
- 2.3 “By-wire” control system is installed in accordance with requirements, manufacturers’ specifications and enterprise procedures.

	2.4	By-wire control system is tested for functionality and, if necessary, faults are located and rectified.
	2.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3.	Verify and document by wire control system.	3.1 OH&S requirements for carrying out the work are followed.
		3.2 Work site is made safe, in accordance with established safety procedures
		3.3 Equipment and tools used in construction task are maintained and stored according to enterprise procedures.
		3.4 By-wire control system function and requirements are verified, documented and information stored according to enterprise procedures.
		3.5 Appropriate personnel are informed of the completion of work and, if required, provided with a demonstration of the operation of the “by-wire” control system.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of predictable problems
- Plan a procedure
- Install a by-wire system
- Test installation
- Troubleshoot by-wire installation

Required knowledge:

- Control input fundamentals including positional information; potentiometers; incremental (feedback requirements) and absolute
- Control output fundamentals including motors; servos; solenoids; valves; pneumatics; hydraulics
- Control channel media including wire; fibre; wireless RF; remote control
- Serial bus fundamentals including serial data asynchronous and synchronous; closes – separate and embedded; device addressing
- Serial bus technology eg. CAN bus; I²C bus; 1-wire bus

- Multiplexing including TDM time division; STDM statistical time division; FDM frequency division
- Control technology applications eg. aviation (fly-by-wire); automotive; home automation; remote control
- Control setup and testing procedures including isolation; safety requirements; interlocks; documentation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Control application may include:

- aerospace
- automotive
- industrial

- building control
- remote control

Resources and equipment may include:

- appropriate tools
- appropriate spare parts
- cables and connectors
- test equipment
- consumables
- appropriate software licences
- manufacturers' specifications and manuals
- diagnostics software
- personal computer
- programming tools
- input devices
- output devices
- control system

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this must incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices, including the use of risk control measures, as specified in the performance criteria;

- demonstrate the ability to test and verify correct operations of a “by-wire” control system on more than one occasion and in different contexts

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team.
- The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- This unit could be assessed in conjunction with any other units covering control concepts or other units requiring the exercise of the skills and knowledge covered by this unit.

VU21352 Implement a digital circuit using a programmable logic device (PLD)

Unit Descriptor This unit of competency sets out the knowledge and skills required to implement, from a given design file, digital circuits on programmable logic devices. These devices may include PLDs, CPLDs, FPGAs or similar technologies.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the Unit This unit of competency applies in a home or commercial environment where programming logic devices are required for a range of electronic control applications.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan for programming a PLD
 - 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
 - 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
 - 1.3 **PLD** programming requirements are established from documentation job sheets and discussion with **appropriate personnel**.
 - 1.4 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
 - 1.5 **Resources and equipment** needed for the task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.
2. Program a PLD
 - 2.1 OH&S requirements for carrying out the work are followed.
 - 2.2 Equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements.
 - 2.3 PLD is programmed according to requirements, manufacturers' specifications and enterprise procedures.
 - 2.4 PLD circuit implementation is tested for functionality, according to requirements and enterprise procedures.

	2.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3. Verify and document PDL circuit implementation	3.1	OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with established safety procedures.
	3.3	Equipment and tools used in the implementation task are maintained and stored according to enterprise procedures.
	3.4	Digital circuit function and requirements are verified, documented and information stored according to enterprise procedures.
	3.5	Appropriate personnel are informed of the completion of work and, if required, provided with a demonstration of the operation of the digital circuit.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Work in a team
- Use diagnostic tools
- Plan a procedure
- Install ISEs
- Configure and use ISEs
- Create ISE project
- Design ISE entry
- Assign I/O
- Use simulation tools
- Use program device
- Compile code
- Program a target programmable logic device including programming host to target printed circuit board (PCB) interconnection eg. JTAG and IEEE1149.1
- Download design to target device
- Test target device including isolation, safety requirements interlocks; documentation

Required knowledge:

- Programmable logic devices eg. PLDs; CPLDs; FPGAs
- Programmable logic device characteristics including size; macro cells; speed
- Integrated software environment (ISE) eg. Xilinx; Altera; Lattice
- Hardware description languages eg VHDL, VHSIC
- EDA electronic design automation netlist capture
- Schematic capture

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

PLD may include:

- PLDs
- CPLDs
- FPGAs

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Resources and equipment may include:

- appropriate tools
- appropriate spare parts
- cables and connectors
- test equipment
- consumables
- appropriate software licences
- manufacturers' specifications and manuals
- diagnostics software
- personal computer
- programming tools
- PLD device and board
- input devices and output devices

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria range;
 - demonstrate implementation of a digital circuit by programming a programmable logic device on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The assessment environment should not disadvantage the candidate.
- Evidence should show competency working in realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required.
- The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- This unit could be assessed in conjunction with any other units covering programmable logic devices or other units requiring the exercise of the skills and knowledge covered by this unit.

VU20906 Configure and program a basic robotic system

Unit Descriptor

This unit of competency sets out the knowledge and skills required to configure and program a basic robotic system. Typical tasks for basic robotics system operation include pick and place, motion, navigation. Code development will include testing code and producing code to control robotic systems. This unit does not include large, complex industrial robotic systems used in manufacturing operations.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication. However, practice in this unit is subject to regulations directly related to occupational health and safety.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit of competency applies in a home or commercial environment where robotic systems are utilised for a range of repetitive and routine tasks.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

1. Plan the configuration and programming of a basic robotics system

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and understood
- 1.2 Established **OH&S requirements** and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 Routine tasks that may be performed by a robotics system are analysed, documented and discussed with **appropriate personnel**.
- 1.5 **Robotic system** configuration and programming requirements are determined from documentation, construction briefs and discussions with **appropriate personnel**.
- 1.6 **Appropriate personnel** are consulted to ensure the work is coordinated effectively with others involved at the work site.
- 1.7 **Resources and equipment** needed for the task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.

2. Configure and program a robotics system	2.1 OH&S requirements for carrying out the work are followed.
	2.2 Equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements .
	2.3 Robotic system is constructed and programmed in accordance with requirements, manufacturers' specifications and enterprise procedures .
	2.4 Robotic system is programmed and configured for the intended task according to manufacturers' specifications and enterprise procedures .
	2.5 Robotic system is tested for correct operation and, if required, incorrect hardware and software functions are identified and rectified.
	2.6 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel , job specifications and enterprise procedures .
	2.7 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3. Verify and document robotics system	3.1 OH&S requirements for completing the work are followed.
	3.2 Work site is made safe in accordance with established safety procedures.
	3.3 Hardware and software tools used in configuration and programming tasks are maintained and stored according to enterprise procedures .
	3.4 Robotic system overall function and requirements are verified, documented and information stored according to enterprise procedures .
	3.5 Appropriate personnel are informed of the completion of work and, if required, provided with a demonstration of the operation of hardware and software aspects of the robotics system .

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of predictable problems

- Plan a procedure
- Work in a team
- Install and configure integrated programming environments (IPE)
- Save, edit, document and compile code
- Define and document a basic robotic task including requirement list; task steps; input requirements; output requirement; logic states
- Test code including systematic fault finding and documentation; debuggers and simulation; fault isolation; input checking; output checking; diagnostic code
- Troubleshoot robot operation

Required knowledge:

- Types of robotic devices including mobile robots; autonomous robots; robotic arms
- Robot axis and degrees of movement
- Robot power requirements and movement eg. stationary robots with mains derived power; mobile robots with batteries; battery duration and recharging
- DC motor types including permanent magnet DC motors; brushed motors; brushless motors; stepping motor
- DC motor controls including speed control (pulse width modulation); forward and reverse control; 'H' drive
- Positional feedback and servo systems including potentiometers; encodes (incremental and absolute)
- Solenoid actuators
- Input basic transducers including switches; potentiometers; IR infra red sensors; ultra sonic sensors
- Robot electronics fundamentals including CPU/controller; input interfaces, analogue, digital; output interfaces, analogue, digital, drive capabilities protection
- Drive mechanisms including gearboxes; belts; chains
- Robot construction including metal; wood; plastic; composite
- Download interfaces including RS232; USB; IEEE1394
- Flowchart symbols
- Flowchart decisions and logic
- Program code including input statements; output statements; logical operators (AND, OR, NOT, XOR, shift); mathematical operators; flow control (IF THEN, FOR, WHILE); program modules (CALL, RETURN)
- Code download including programming interfaces; isolation; programming mode; operational mode

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 in the Performance Criteria is detailed below.

OH&S requirements may include
but are not limited to:

- legislation
- protective equipment
- material safety management systems

	• hazardous substances and dangerous goods code • local safe operation procedures • awards provisions
Environmental requirements may include	• liquid waste • solid waste • gas, fume, vapour, smoke emissions, including fugitive emissions • excessive energy and water use • excessive noise
Appropriate personnel may include but are not limited to:	• supervisor • leading hand • foreman • manager • site engineer • trainer • mentor • teacher • team member
Robotic system may include	• mobile robots • autonomous robots • robotic arms
Resources and equipment may include but are not limited to:	• appropriate tools • test equipment • consumables • appropriate software licences • manufacturers' specifications and manuals • diagnostics software • personal computer • programming tools
Enterprise procedures may include but are not limited to:	• the use of tools and equipment • instructions, including job sheets, cutting lists, plans, drawings and designs • reporting and communication • manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment. Assessment should also reinforce the integration of the Employability Skills.

In particular this will incorporate evidence that shows a candidate is able to:

- implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
- demonstrate the ability to configure a basic robotic system to perform basic tasks such as pick and place, motion and navigation on more than one occasion and in different contexts; and
- demonstrate the ability to program a small robotic system to perform basic tasks on more than one occasion and in different contexts.

Context of and specific resources for assessment

Evidence should show competency working in realistic environment and a variety of conditions.

- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

This unit could be assessed in conjunction with any other units covering robotic systems or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures;
- oral and/or written questioning on required knowledge and skills;
- testimony from supervisors, colleagues, clients and/or other appropriate persons;
- inspection of the final product or outcome;
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21537 Use computers for engineering related work activities

Unit Descriptor	This unit of competency sets out the knowledge and skills required to operate a computer, organise the desktop, select the appropriate engineering application package and process information for a range of functions. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.	
Employability Skills	This unit contains Employability Skills.	
Application of the Unit	This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a Certificate II qualification or higher.	
ELEMENT	PERFORMANCE CRITERIA	
Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.	
1 Set up computer hardware and software to perform engineering tasks.	1.1	The computer processing requirements of a task are identified.
	1.2	Suitable computer hardware and appropriate application software is selected, in accordance with the task requirements.
	1.3	Computer hardware and applications software is made operational, according to manufacturers' specifications and enterprise procedures .
2 Perform required computer processing task to perform engineering tasks.	2.1	Occupational health and safety requirements , relevant Australian standards, codes of practice, manufacturer's specifications, environmental requirements and enterprise procedures are identified and adhered to.
	2.2	Computer hardware is adjusted and used to meet ergonomic requirements, in accordance with enterprise procedures and any specific safety requirements are observed.
	2.3	Information processing task is performed to requirements.
	2.4	Information processing output is checked for correctness.
	2.5	Unexpected situations are dealt with safely and reported to the appropriate personnel .
3 Store or output processed information to	3.1	Information processing results are checked prior to storage, transfer, or print.

perform engineering tasks.	3.2	Processed information is stored, transferred, or printed.
4 Shut down computer hardware and software.	4.1	Relevant files and/or data are saved prior to shutdown.
	4.2	Shutdown procedures for application software and equipment are followed according to enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- input and run a simple program
- enter data related to the specific engineering task
- save data related to the specific engineering task
- retrieve data for the specific engineering task
- print out data for the specific engineering task
- organize the desktop
- use application programs: spreadsheet, database, drafting

Required knowledge:

- computers in the metals and engineering industry
- types of computers
- hardware names
- meaning of words and terms commonly associated with computers
- purpose of input devices, output devices and ancillary storage devices
- application packages used in the metals and engineering industry

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Computer hardware may include:

- stand-alone computers
- networked computers
- mainframe computer terminals
- Computer peripherals
- printers
- loggers
- plotters
- display units
- keyboards
- pointing devices

Application software may include:

- operating system
- engineering spreadsheet applications
- job logs data base
- engineering drafting software
- machining control software
- maintenance scheduling software

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Occupational health & safety requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operating procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Specific safety requirements may include:

- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards
- follow confined spaces procedures
- first aid.

Information processing task may include:

- computations
- drafting

Appropriate personnel may include:

- jobs log data base entry and retrieval
- set up and monitor machine control
- file generation, retrieval and maintenance
- information output in hard and soft copy
- supervisor
- leading hand
- foreman
- trainer
- teacher

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of Employability Skills.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - Use computers to perform a range of engineering tasks
 - Demonstrate an appropriate level of skills enabling employment

Context of and specific resources for assessment

- This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include access to:
 - OH&S policy and work procedures and instructions.
 - a realistic workplace environment and a variety of conditions;
 - relevant machines, tools, materials and consumables
 - relevant plans, drawings and instructions
 - Manufacture's specifications/manuals.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures

- oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.

VU21538 Perform basic computational principles in engineering work activities

Unit Descriptor This unit of competency sets out the knowledge and skills required to perform basic computations in the workplace. This includes interpretation of graphs and charts, and preparation of material and resource estimates.

The skills and knowledge described in this unit do not require a licence to practice in the workplace.

Employability Skills This unit contains Employability Skills.

Application of the Unit The unit applies to enterprises requiring the application of numeric and computational skills to perform basic engineering tasks determine materials ordering requirements.

ELEMENT PERFORMANCE CRITERIA

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1	Select required computations to perform engineering tasks.	1.1 <i>OH&S requirements</i> and <i>specific safety requirements</i> for a given area are obtained and understood 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area. 1.3 Required <i>computational tasks</i> are identified through request, work orders or equivalent and clarified with the <i>appropriate personnel</i>. 1.4 Information and specifications for the required computations are obtained according to <i>enterprise procedures</i>. 1.5 <i>Computational processes</i> required to complete the task are selected.
2	Carry out required computations to perform engineering tasks.	2.1 OH&S requirements and specific safety requirements for carrying out the work are followed. 2.2 Basic features of an electronic calculator are explained and utilised to efficiently perform computational processes. 2.3 Computations needed to assist in the performance of work activities are carried out.
3.		3.1 Quantities of materials and resources required to complete work activities are estimated.

Prepare estimates to perform engineering tasks.	3.2	The time needed to complete work activity is estimated.
4. Interpret graphical representation of information to perform engineering tasks.	4.1	Information represented in graphs and charts is interpreted correctly. .
	4.2	Information gathered from the interpretation of graphs and charts is utilised to complete the engineering task.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- performing basic arithmetic calculations
- performing calculations involving length, perimeter, area and volume
- rounding off estimated answers
- expressing information in fractional or decimal format as a percentage
- using appropriate mathematical operations
- performing calculations involving ratios or proportions
- performing metric/imperial measurement conversions
- producing simple charts or graphs from given information
- interpreting charts and graphs correctly
- undertaking numerical operations, geometry and calculations

Required knowledge:

- techniques for estimating approximate answers
- concepts of perimeter, area and volume
- mixed numbers, decimals, fractions and whole numbers
- concept of percentage
- concept of ratio and proportion
- units of measurement: length, mass, area, volume, temperature, density
- measurement for value: storage, proportion, weight, size, height, length, stacking/handling, size/type
- types of charts and graphs

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include, but are not limited to::

- legislation
- protective equipment

Specific safety requirements may include:

- material safety management systems
- local safe operating procedures
- procedures
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards

Computational tasks may include:

- money
- volume
- area
- weight
- time
- circumference
- length and distance
- quantities
- metric/imperial measurement conversions

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- trainer
- teacher

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Computational processes may include:

- addition
- multiplication
- division
- subtraction
- percentages
- fractions
- ratios
- square root

Graphs and charts including:

- area

- bar
- pie
- line
- curve

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
 - Select appropriate computations to plan and conduct engineering tasks;
 - Perform required computations to plan, conduct or complete engineering tasks;
 - Prepare estimates to plan, conduct, or complete engineering tasks;
 - Interpret graphical representation of information to plan, conduct, or complete engineering tasks.

Context of and specific resources for assessment

- This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a realistic workplace environment and under a variety of conditions.
- Assessment requires access to:
 - OH&S policy and work procedures and instructions.
 - a real or simulated workplace environment.
 - relevant machines, tools, materials and consumables
 - relevant plans, drawings and instructions
 - manufacture's specifications/manuals.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons

- inspection of the final product or outcome
 - a portfolio of documentary evidence.
-
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
 - Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.
 - Assessment should also reinforce the integration of employability skills.

VU21539 Use fundamental refrigeration principles and processes to make refrigeration and/or air conditioning equipment operational

Unit Descriptor	This unit of competency sets out the knowledge and skills required to make refrigeration and air conditioning equipment operational. This involves retro fitting existing domestic and light commercial refrigeration and air conditioning equipment with alternative refrigerants, reconditioning/replacing components, returning to service, testing equipment, and completing basic service reports for administrative action. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.
Employability Skills	This unit contains Employability Skills.
Prerequisite Unit(s)	MEM18001C Use hand tools MEM18002B Use power tools/hand held operation VU20910 Produce basic engineering sketches and drawings VU21538 Perform basic computational principles in engineering work activities
Application of the Unit	This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a Certificate II qualification or higher.
ELEMENT	PERFORMANCE CRITERIA
Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1. Assess refrigeration/air conditioning system operation	1.1 General operational status and <i>refrigeration and air conditioning system</i> information are identified through request, work orders, plans, drawings and instructions, questioning or equivalent and clarified with the <i>appropriate personnel</i>. 1.2 <i>Occupational health and safety requirements</i>, relevant Australian standards, industry codes of practice, manufacturer's specifications, <i>environmental requirements</i> and <i>enterprise procedures</i> are identified and adhered to. 1.3 Operational checks and tests are performed using refrigeration/air conditioning principles, procedures, <i>test equipment</i> and safety requirements.

	1.4	Faults are localised by inspection and testing using refrigeration and air conditioning principles, procedures and safety requirements.
	1.5	Malfunctions are verified and corrective action is confirmed with appropriate personnel.
2. Repair/replace re- frigeration/air condi- tioning components	2.1	Refrigerant is removed safely from the system and contained in accordance with standard operating procedures and regulatory requirements, where appropriate.
	2.2	Faulty components are dismantled and repaired/replaced to manufacturer's specifications, as required.
	2.3	Specific safety requirements and procedures are followed and hazard control measures implemented, where practicable.
	2.4	Unexpected situations are dealt with safely and reported to the appropriate personnel.
3. Return refrigera- tion/air conditioning equipment to service	3.1	Components are reassembled and tested for correct operation and assessed against specification.
	3.2	The refrigeration system is charged with the correct refrigerant in accordance with standard operating procedures.
	3.3	System is checked for operational performance and conform- ance to specifications using refrigeration/air conditioning princi- ples and applicable system test procedures.
4. Complete work re- quirements	4.1	Completed work is reported to appropriate personal in accord- ance with enterprise procedures.
	4.2	Work area is cleared of waste, cleaned and secured following enterprise procedures.
	4.3	Tools and equipment are maintained and stored following enter- prise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- plan job and task sequence
- detect leaks
- reclaim and evacuate refrigerants
- analyse hazards
- select correct refrigerant for a given system
- obtain and interpret drawings, instructions, specifications, procedures, codes and regulations

- test and check refrigeration components and systems
- determine pressures and temperatures
- use equipment and test techniques
- identify faulty components and system contamination
- apply safety procedures, standard operating procedures and legislative requirements to all work undertaken
- select appropriate materials, equipment and solutions for specific refrigeration systems

Required knowledge:

- refrigeration terminology, definitions and applications
- refrigeration principles
- refrigeration condition
- pressure enthalpy chart
- heat, pressure and temperature
- pressure temperature relationship
- absolute and gauge pressure
- major applications and types of equipment
- air conditioning terminology, definitions and applications
- comfort zone
- air conditioning processes
- basics of ventilation
- basic system layout
- SAA codes
- Psychrometric charts and sling psychrometer
- heat load estimation, calculation and industry figures
- refrigeration piping, joining and sealing
- types of refrigerants
- refrigerant identification and safety
- refrigeration system components and oils
- safety plan
- safe work practices and procedures

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Refrigeration and air conditioning systems such as:

- commercial
- industrial
- domestic
- marine
- transport applications

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- trainer/coach
- teacher
- client

Occupational health & safety requirements such as:

- AS - HB40 Refrigeration and Air Conditioning Codes of Practice, and relevant Ozone and Greenhouse substance legislation.
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operating procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise
- proximity to other personnel

Enterprise procedures such as:

- the use of tools and equipment
- instructions, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Test equipment including

- pressure gauges, multi-meter, ammeter, meg-ohm meter, vacuum pump, vacuum gauges

Refrigerant such as:

- CFCs, HCFC's, HFCs, natural refrigerants, ammonia, etc.

Specific safety requirements such as:

- working safely around air conditioning and refrigeration equipment
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures

- awareness of electrical hazards
- follow restricted spaces procedures
- first aid

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
 - assess the viability of repair and replacement
 - organise resources for repair and replacement
 - repair and replace air-conditioning components
 - return refrigeration/air conditioning equipment to service

Context of and specific resources for assessment

- Assessment should be conducted in a real or simulated workplace using procedures, information and resources typical of a workplace.
- Assessment requires access to:
- relevant OH&S policy and work procedures and instructions.
- real or simulated workplace environment.
- relevant machines, tools, materials and consumables
- relevant plans, drawings and instructions
- manufacture's specifications/manuals.

Method of assessment

- Assessment must involve the demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.

- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.
- Assessment should also reinforce the integration of employability skills.

VU20916 Create engineering drawings using computer aided systems

Unit Descriptor This unit of competency sets out the knowledge and skills required to produce engineering drawings using a computer aided system.

The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships and the like.

Employability Skills This unit contains Employability Skills.

Prerequisite Unit MEM16008A Interact with computing technology

Application of the Unit This unit would be applied by entry level engineering workers required to undertake a range of well-defined drawing activities using a computer aided system.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Prepare CAD environment	1.1 <i>Task requirements</i> and drawing specifications are identified and clarified with the <i>appropriate personnel</i>. 1.2 <i>Equipment</i> is started and shutdown to <i>enterprise procedures</i>. 1.3 Screen areas and files are accessed using basic menus and commands. 1.4 <i>Specific safety requirements</i> are followed and hazard control measures implemented where practicable. 1.5 Basic parameters are set for the given task.
2. Create and modify drawings	2.1 Simple 2D and 3D drawings and entities are created and edited/modified to the relevant standards (AS1100) using basic features of the software. 2.2 Drawings and entities are edited/modified according to task requirements. 2.3 Drawings are plotted to the required standard. 2.4 Completed drawings are checked for conformance to specifications, standards and requirements.

3. Produce output	3.1 Files are saved, transferred and printed according to task requirements.
	3.2 Linked entities are listed in a bill of materials format according to task requirements.
	3.3 Supplementary data is extracted from drawing to meet job requirements and may include area, lengths, angles and perimeters, volume, mass and centre of gravity.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required skills:

- enter and navigate the CAD system
- access and recall drawings
- set basic parameters
- select command input and methods
- use coordinate systems and their applications
- customise basic menus and system defaults
- save, transfer and print drawing files to a specified drive or directory
- extract supplementary data with respect to drawn shapes/features
- produce detailed views
- produce bills of material
- develop basic macros
- construct basic shapes using 2D and 3D CAD
- create, edit and modify simple 2D and 3D drawings to the relevant standards using basic drawing features of the software system
- hatch or fill areas
- create ruled and revolved surfaces in 3D space and their applications
- link drawing entities to database attributes
- plot CAD drawings (pre-set parameters)
- exit and shut down CAD system

Required knowledge:

- functions and features of CAD software system
- screen display areas and their functions
- reasons for basic parameters
- drawing scales
- basic system variables and their customisation
- procedures for customising system variables
- basic drafting standards/procedures
- geometric construction methods for basic shapes and polygons

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 in the Performance Criteria is detailed below.

Task requirements may include:

- timeframe for task
- tools and equipment
- working with others
- materials, parts and other resources
- specifications
- procedures
- special reporting requirements
- quality measures

Appropriate personnel may include but are not limited to:

- supervisor
- leading hand
- foreman
- trainer/coach
- teacher

Equipment

- hardware and peripherals
- CAD software

Resources may include but are not limited to:

- work requests/sheets
- plans, drawings and sketches
- personal protective equipment
- CAD system and software
- Reference manuals

Enterprise procedures may include but are not limited to:

- the use of CAD equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Specific safety requirements may include but are not limited to:

- working safely in a CAD environment
- risk and hazard recognition in a CAD environment
- emergency procedures
- legislation
- protective equipment
- local safe operating procedures
- awards provisions

Supplementary data

- area
- lengths
- angles and perimeters
- volume
- mass
- centre of gravity

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- A person who demonstrates competency in this unit must be able to safely handle engineering materials. Competency in this unit cannot be claimed until all prerequisites have been satisfied.
- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range; and
 - produce engineering drawings using a computer aided system

Context of and specific resources for assessment

- This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:
- OH&S policy and work procedures and instructions.
- Access to workplace environment.
- Operational access to relevant machines, tools, materials and consumables
- Access to relevant plans, drawings and instructions
- Manufacture's specifications/manuals.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures,

product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Evidence can be gathered through a variety of ways including:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.
- Assessment should also reinforce the integration of employability skills.

VU21540 Assemble and test electronic engineering equipment and make it operational

Unit Descriptor	This unit of competency sets out the knowledge and skills required to assemble and test electronic engineering equipment and make it operational. This involves identifying task requirements, preparing components, assembling electronic equipment and testing equipment to ensure correct operation. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.
Employability Skills	This unit contains Employability Skills.
Prerequisite Units	MEM18001C Use hand tools MEM18002B Use power tools/hand held operation VU21538 Apply basic computational principles in engineering work activities
Application of the Unit	This competency unit would be applied by those responsible for assembling and testing electronic engineering equipment to make it operational. The work would normally be conducted under supervision

ELEMENT

Elements describe the essential outcomes of a unit of competency.

1. Plan to assemble electronic equipment

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 Task outcomes and ***task requirements*** are identified and clarified, if necessary, with ***appropriate personnel***.
- 1.2 ***Safe work practices*** and ***enterprise procedures*** are identified and followed and hazard control measures implemented, where practicable.
- 1.3 A work plan is prepared, including sequence of operations.
- 1.4 ***Electronic equipment*** functions are determined by reference to circuit diagrams, equipment manuals and/or consultation with equipment operator, where appropriate.
- 1.5 Required ***components*** and ***resources*** for assembly are identified.
- 1.6 ***Factors affecting performance*** of the task are identified and accounted for, where possible.

2. Prepare materials and equipment	2.1 Equipment, components and resources are obtained and checked as fit for purpose. 2.2 Materials and components are prepared according to task and process requirements. 2.3 Assembly and test equipment is selected appropriate to the task and according to relevant engineering principles and conditions.
3. Assemble electronic engineering components	3.1 Correct components are selected by code/colour or other identification methods. 3.2 Components/devices are prepared for soldering or other termination methods. 3.3 Cables are connected to a variety of plug and socket combinations as required. 3.4 Components are handled and stored in accordance with enterprise procedures. 3.5 Assembly is produced following correct sequence of operations taking into account environmental requirements. 3.6 Unexpected situations are dealt with safely and reported to the appropriate personnel.
4. Test equipment and make it operational	4.1 Equipment/sub-assemblies are checked for correct operation, using electronic principles, test procedures, test equipment and applicable safety measures. 4.2 Equipment built-in test functions are run and results recorded to standard operating procedures where appropriate. 4.3 Faults in assembly or soldering are identified and corrected action taken according to enterprise procedures. 4.4 Faulty components are dismantled and repaired/replaced to manufacturer's specifications as required. 4.5 Test data is recorded/input as required.
5. Complete work requirements	5.1 Completed work is reported to appropriate personal according with enterprise procedures. 5.2 Work area is cleared of waste, cleaned and secured following enterprise procedures.

5.3 Tools and equipment are maintained and stored following enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- plan a job and sequence tasks
- obtain resources required for the job
- interpret circuit diagrams, manuals, specifications, schematics, maintenance records, supplier catalogues
- prepare components and devices for soldering and termination
- connect cables to plugs and sockets
- select and use electronic assembly hand and power tools
- run built-in test functions
- locate, read and record built-in fault indicators
- record electronic equipment test results
- records faults and/or equipment status
- obtain error code interpretation codes
- handle and store components
- isolate electronic equipment and sub-assemblies

Required knowledge:

- basic electronic terminology and term definitions
- electrical principles associated with electronic sub-assemblies
- major applications and types of electronic equipment
- polarity indicators
- calculations and formulae
- electronic components
- assembly tools and equipment
- termination methods
- connection methods for a variety of plugs and sockets
- hand and power tools used in the assembly process
- test/check procedures
- tools and techniques to adjust, tune and calibrate
- error indicators and error code interpretation
- anti-static procedures and techniques
- safe handling and storage requirements of electrical and electronic components

- hazards and control measures
- safe work practices and procedures
- implications of electro-static discharge on electronic equipment

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Task requirements may include:

- timeframe for task
- tools and equipment
- working with others
- materials, parts and other resources
- specifications
- procedures
- special reporting requirements
- quality measures

Appropriate personnel may include, but are not limited to:

- supervisor
- leading hand
- foreman
- trainer/coach
- teacher
- client

Safe work practices may include:

- working safely with tools and equipment
- risk and hazard recognition and control
- protective equipment
- emergency procedures
- local safe operating procedures
- awards provisions
- first aid
- awareness of electrical hazards

Enterprise procedures may include:

- the use of tools and equipment
- instructions, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Electronic equipment may include:

- amplifiers
- analogue/digital hardware

- communication
- consumer audio/video
- electronic appliances
- scanning systems
- security/fire systems
- power supplies and test equipment

Components may include:

- discrete components
- circuit boards
- connectors
- plug-in items
- power supplies

Resources may include:

- work requests/sheets
- personal protective equipment
- plans, drawings and sketches
- measuring equipment
- tools
- test equipment and instruments
- consumables

Factors affecting performance may include:

- wrong or damaged parts
- unexpected or potential delays
- environmental factors – weather, noise, dust etc.
- hazards
- insufficient or incorrect information
- material shortages

Test equipment may include:

- voltmeters
- ammeters
- cathode ray oscilloscopes
- frequency counters
- continuity testers

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise
- proximity to other personnel

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- A person who demonstrates competency in this unit must be able to safely assemble and test electronic engineering equipment. Competency in this unit cannot be claimed until all prerequisites have been satisfied.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures
 - Assemble and test electronic equipment
 - Demonstrate an appropriate level of skills enabling employment

Context of and specific resources for assessment

- This unit should be assessed in a real or simulated workplace using procedures, information and resources typical of a workplace.
- Assessment requires access to:
- relevant OH&S policy and work procedures and instructions.
- real or simulated workplace environment.
- relevant machines, tools, materials and consumables
- relevant plans, drawings and instructions
- manufacturer's specifications/manuals.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a

number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

- Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.
- Assessment should also reinforce the integration of employability skills.

VU20177 Plan and build a system using fibre optic equipment

Unit Descriptor

This unit of competency sets out the knowledge and skills required to plan and build systems using fibre optics equipment. This includes identifying fibre optic components and equipment, interconnecting them and performing measurements on the operating circuits.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

The required outcomes described in this unit of competency contain applicable facets of Employability Skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 2 or higher. The unit applies to industrial environments where fibre optics is used for telecommunications or industrial control purposes.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1.	Plan a fibre optics circuit	1.1 OH&S and environmental requirements for a given work area are obtained and understood. 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed. 1.3 The requirements for building a fibre optic circuit are identified from documentation, job sheets or discussions with appropriate personnel. 1.4 A diagram of the circuit, meeting established requirements, is prepared according to enterprise procedures and approved by appropriate personnel. 1.5 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site. 1.6 Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2.	Build a fibre optics circuit	2.1 OH&S requirements for carrying out the work are followed. 2.2 Equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements. 2.3 Fibre optic circuit components are interconnected according to a connections diagram, manufacturers' specifications and enterprise procedures. 2.4 The fibre optic circuit is checked for functionality and, if necessary, faults rectified in accordance with enterprise procedures. 2.5 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and implementation of risk management and enterprise procedures. 2.6 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3.	Perform functional measurements and complete report	3.1 OH&S requirements for completing the work are followed. 3.2 Work site is made safe in accordance with established safety procedures. 3.3 Equipment, tools used in implementation task are maintained and stored according to enterprise procedures.

- 3.4 Required circuit parameters are measured, verified against requirements and documented in accordance with ***enterprise procedures***.
- 3.5 ***Appropriate personnel*** are informed of the completion of work and, if required, provided with a demonstration of the operation of the fibre optic circuit.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

Sound working knowledge of:

- Light sources in fibre optics including lasers and LEDs
- Light receivers in fibre optics including photo diodes and photo transistors
- Wave guides and transmission media including air, water and optical fibre
- Measurement equipment
- Power sources
- Project management

Required knowledge:

Ability to:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Complete workplace documentation
- Read and understand procedures
- Use diagnostic tools
- Plan a procedure
- Draw circuits
- Work as a member of a team
- Use assembling and dismantling techniques

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Appropriate personnel may include

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures

Environmental requirements may include

- gas, fume, vapour, smoke emissions, laser light including fugitive emissions
- excessive energy and water use
- excessive noise

Enterprise procedures may include

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Resources and equipment may include

- fibre optics test equipment
- power meters
- fibre amplifiers
- bit rate testers
- bandwidth testers
- lasers
- optical fibre
- appropriate tools
- appropriate electronics/computer test equipment
- manufacturers' manuals and data sheets
- vendor catalogues

Fibre optics circuit components may include

- optical fibre
- lasers

- optical connectors
- couplers
- attenuators
- wavelength division multiplexers
- patch cords
- optical sensors
- splitters
- attenuators

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
 - demonstrate essential knowledge and associated skills as described in this unit;
 - demonstrate the implementation of planning and building circuits using fibre optics equipment on more than one occasion and in different contexts.

Context of and specific resources for assessment

Evidence should show competency working in realistic environment and a variety of conditions.

- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered

by this unit would be demonstrated by an individual working alone or as part of a team.

- The assessment environment should not disadvantage the candidate.
- This unit could be assessed in conjunction with any other units covering fibre optics applications or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Evidence can be gathered through a variety of ways including:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU20178 Use fibre optic equipment in engineering technology

Unit Descriptor This unit of competency sets out the knowledge and skills required to use fibre optic equipment to measure, calculate and detect distance, movement, size, colour and shape in engineering processes.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication. However, practice in this unit is subject to regulations directly related to occupational health and safety

Employability Skills The required outcomes described in this unit of competency contain applicable facets of Employability Skills.

Application of the Unit This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 2 or higher. The unit applies to industrial environments where fibre optic technology is used in engineering tasks or for engineering control purposes

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

6	Prepare for use of fibre optics within an engineering process	1.1	OH&S and environmental requirements for a given work area are obtained and understood.
		1.2	Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
		1.3	Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel .
		1.4	The requirements for the use of fibre optics within an engineering process are identified from documentation, job sheets or discussions with appropriate personnel .
		1.5	A detailed work schedule for the task is drawn up according to enterprise procedures and approved by appropriate personnel .
		1.6	Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
		1.7	Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2.	Assemble fibre optics equipment/components to an engineering process	2.1	OH&S requirements for carrying out the work are followed.
		2.2	Equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements .
		2.3	Using connections diagram and relevant documentation fibre optics equipment/components are incorporated into the engineering process according to manufacturers' specifications and enterprise procedures .
		2.4	The fibre optics equipment/components are checked for functionality and if necessary, faults are rectified or reported in accordance with enterprise procedures .
		2.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel , job specifications and enterprise procedures .
		2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3.	Test for function and document task	3.1	OH&S requirements for completing the work are followed.
		3.2	Work site is made safe in accordance with established safety procedures.
		3.3	Equipment, tools used in assembly tasks are maintained and stored according to enterprise procedures .

- 3.4 The engineering process is tested for functionality against requirements and documented according to **enterprise procedures**.
- 3.5 **Appropriate personnel** are informed of the completion of work and if required provided with a demonstration of the operation of the engineering task.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required knowledge:

Sound working knowledge of:

- Parameter selection including optical spectrum for the application and angle of detection
- Types of fibre optic devices including detectors (eg. LDR; LDT; photo transistors; photo diodes) and light source (LEDs, ILDs, lasers)
- Interfacing including electronics systems; communications systems; computer systems; mechanical systems
- Control technology including positional information; input/output; control media; feedback technology

Required skills:

Ability to:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Assess risk
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of predictable problems
- Plan a process
- Use assembling and dismantling techniques
- Test for functionality
- Troubleshoot installation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Appropriate personnel may include

- Supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Enterprise procedures may include

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Resources may include

- fibre optic test equipment
 - power meters
 - fibre amplifiers
 - bit rate testers
- lasers
- optical fibres
- appropriate tools
- appropriate electronics /computer test equipment
- manufacture manuals and data sheets
- vendor catalogues

Equipment may include

- optical components
- mechanical components
- electronic /electrical components
- computer software/hardware
- power sources

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment. Assessment should also reinforce the integration of the Employability Skills.

In particular this will incorporate evidence that shows a candidate is able to:

- (i) implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
- (ii) demonstrate essential knowledge and associated skills as described in this unit;
- (iii) demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
- (iv) demonstrate the ability to integrate fibre optics equipment into an engineering task to measure, calculate and detect distance, movement, size, colour and shape in engineering processes on more than one occasion and in different contexts.

Context of and specific resources for assessment

Evidence should show competency working in realistic environment and a variety of conditions.

- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

This unit could be assessed in conjunction with any other units covering fibre optic applications or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures;
- oral and/or written questioning on required knowledge and skills;
- testimony from supervisors, colleagues, clients and/or other appropriate persons;
- inspection of the final product or outcome;
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated

by colleagues, supervisors, clients or other appropriate persons.

Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU20179 Use fibre optic equipment in communications technology

Unit Descriptor This unit of competency sets out the knowledge and skills required to use fibre optic equipment to generate, transmit and detect data in communications technology.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication. However, practice in this unit is subject to regulations directly related to occupational health and safety

Employability Skills The required outcomes described in this unit of competency contain applicable facets of Employability Skills.

Application of the Unit This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 2 or higher. The unit applies to industrial environments where fibre optic technology is used in engineering tasks or for engineering control purposes.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1.	Prepare for use of fibre optics within an communications process	1.1 OH&S and environmental requirements for a given work area are obtained and understood.
		1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
		1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel .
		1.4 The requirements for the use of fibre optics within a communications system are identified from documentation, job sheets or discussions with appropriate personnel.
		1.5 A detailed work schedule for the task is drawn up according to enterprise procedures and approved by appropriate personnel.
		1.6 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
		1.7 Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2.	Assemble fibre optics equipment/components into a communications system	2.1 OH&S requirements for carrying out the work are followed.
		2.2 Equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements.
		2.3 Using connections diagram and relevant documentation fibre optic equipment/ components are incorporated into the communications system according to manufacturers' specifications and enterprise procedures.
		2.4 The fibre optics equipment/components are checked for functionality and if necessary, faults are rectified or reported in accordance with enterprise procedures.
		2.5 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.

	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3.	Test for function and document task	3.1 OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with established safety procedures.
	3.3	The communications system is tested for functionality against requirements and documented according to enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required knowledge:

Sound working knowledge of:

- Parameter selection including optical spectrum for the application and angle of detection
- Types of fibre optic devices including detectors (eg. LDR, LDT, photo transistors, photo diodes); light sources (LEDs, ILDs, lasers); fibre types; passive optical devices; active optical devices
- Interfacing including electronics systems; communications systems; computer systems
- Data transfer including bit rate and optical – electrical conversions
- Testing including bit error rate; fibre damage; test equipment

Required skills:

Ability to:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Assess risk
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of predictable problems
- Plan a process
- Use assembling and dismantling techniques
- Test for functionality
- Troubleshoot installation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Appropriate personnel may include

- Supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Enterprise procedures may include

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Resources may include

- fibre optic test equipment
 - power meters
 - fibre amplifiers

- bit rate testers
- lasers
- optical fibres
- appropriate tools
- appropriate electronics /computer test equipment
- manufacturers' manuals and data sheets
- vendor catalogues

Equipment may include

- optical components
- mechanical components
- electronic /electrical components
- computer software/hardware
- power sources

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment. Assessment should also reinforce the integration of the Employability Skills.

In particular this will incorporate evidence that shows a candidate is able to:

- (i) implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
- (ii) demonstrate essential knowledge and associated skills as described in this unit;
- (iii) demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
- (iv) demonstrate the ability to integrate fibre optics equipment to generate, transmit and detect data in communications technology on more than one occasion and in different contexts.

Context of and specific resources for assessment

Evidence should show competency working in realistic environment and a variety of conditions.

- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

This unit could be assessed in conjunction with any other units covering fibre optic applications or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures;
- oral and/or written questioning on required knowledge and skills;
- testimony from supervisors, colleagues, clients and/or other appropriate persons;
- inspection of the final product or outcome;
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21552 Operate a small power supply system

Unit Descriptor This unit of competency sets out the knowledge and skills required to monitor the operation of a small scale power supply system at the site of power supply system. The output of the system is not to exceed 32VDC and not to be connected to the main electricity grid.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the Unit This unit of competency applies in domestic, office, commercial or industrial environments where small scale power systems are used to power fixed or mobile electrical and electronic systems. It applies in rural, metropolitan and remote locations

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Prepare to operate small scale power supply systems
 - 1.1 ***OH&S requirements and environmental requirements*** for a given work area are obtained and understood.
 - 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
 - 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
 - 1.4 ***Small scale power supply system*** requirements are determined and discussed with appropriate personnel.
 - 1.5 Small scale power supply system status is identified and confirmed in accordance with ***enterprise procedures***.
 - 1.6 Pre-operational checks are carried out on small scale power supply system equipment in accordance with enterprise procedures.
 - 1.7 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
 - 1.8 ***Resources and equipment*** needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety.

2. Operate small scale power supply system	2.1 Locally controlled system component/s are identified and operated, in accordance with OH&S requirements and enterprise procedures.
	2.2 Supply system is operated within limits of the system design, enterprise procedures and in strict accordance with OH&S requirements.
	2.3 Supply system is monitored and observed to detect deviations from normal operating conditions , in accordance with enterprise procedures.
	2.4 Corrective actions are taken to rectify deviations from normal operating conditions, in accordance with enterprise procedures.
	2.5 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and enterprise procedures.
3. Complete operation of small scale power supply system	3.1 OH&S requirements for completion of operation of small scale power supply system are followed.
	3.2 Work site is made safe in accordance with enterprise procedures.
	3.3 Documentation is updated and deviations from normal operating conditions are reported in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow relevant enterprise OH&S procedures
- Assess risk associated with operation of a small scale power supply system
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of predictable problems
- Plan a process
- Use assembling and dismantling techniques
- Identify faults and abnormal operating conditions
- Use computer based control systems to monitor system operation

- Use other indicators (eg. sound, visual, smell, touch) to monitor system operation

Required knowledge:

- Mobile and fixed emergency power supplies
- Inverters
- Rectifiers
- Uninterruptible power supplies
- DC power supplies and generating sets
- Back-up generators for remote area power supplies
- Types of batteries (lithium, Ni, Cd, Ni, MH)
- Solar, micro hydro and wind generated extra low voltage power supplies
- Control systems
- Control system gauges and indicators
- Computer monitors and read outs
- Electrical power supply system problems including: charge and discharge cycle; electrical power sags and brownouts; blackouts; surges and spikes; distortion RF (frequency); Restricted/unreliable access to grid; Rectification; Battery storage of excess power; Risks associated with power loss in these environments; Risks associated with power surges and distortion; Controller or control system indicator malfunction
- Physical power supply system problems including excessive vibration; corrosion; flow; controller and indicator faults; lubrication; operating environmental issues
- Power system components and their function
- Sources of energy from which electricity may be generated including wind, solar, battery, petrol, diesel, biomass, micro hydro
- Essential electrical theory
- Physics associated with differing sources of energy from which electricity may be generated
- Legislative and statutory issues associated with power systems
- Normal power system operating conditions
- Use of test equipment and gauges and indicators to assess operation of power systems
- Statutory and legislative issues

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include, but are not limited to:

- legislation
- statutory requirements
- procedures to ensure applications requiring higher voltage power supplies are dealt with by suitably licensed and competent persons
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Small scale power supply system may include:

- power supply units not exceeding 32V output
- wind
- micro hydro
- solar
- emergency power supplies
- battery based power supply systems

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- logs and systems for reporting abnormal operation or systems
- manufacturers' specifications and operational procedures

Resources and equipment may include:

- computer software
- internet access

Normal operating conditions may include:

- manufacturers manuals and data sheets
- engineering drawing standards
- cables and connectors
- tools
- multimeter
- consumables
- power supply components – fixed and mobile
- power output is within manufacturer and enterprise requirements
- physical condition and functioning of power system components is within manufacturer, enterprise and statutory requirements
- The power systems does not exhibit any abnormal operating conditions or faults including but not limited to following list:
 - Corrosion
 - Excessive vibration
 - Controller malfunctions
 - Lubrication failure
 - Electrical faults
 - Excessive environmental impacts
 -

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - demonstrate the operation of small scale power supply systems on more than one occasion and in different contexts

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.

Method of assessment

- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- Evidence should show competency working in real or simulated workplace environment under a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- The assessment environment should not disadvantage the candidate.
- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21553 Assemble and connect an extra low voltage battery power source

Unit Descriptor

This unit of competency sets out the knowledge and skills required to select the type, capacity and configuration of a battery source for a given DC load. This includes wiring up and testing the installation. The voltage of the battery source must not exceed 24 volts DC.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit of competency applies in domestic or commercial environments where battery sources are used to power fixed or mobile electrical equipment.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Prepare for battery source assembly

1.1 ***OH&S requirements and environmental requirements*** for a given work area are obtained and understood.

1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.

1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.

1.4 Battery source requirements are determined and discussed with appropriate personnel.

1.5 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.

1.6 ***Resources and equipment*** needed for the task are obtained in accordance with ***enterprise procedures*** and checked for correct operation and safety.

2. Assemble and connect battery source

2.1 OH&S requirements for carrying out the work are followed.

2.2 Equipment/machines/plant are checked as being isolated, where necessary, in strict accordance with OH&S requirements.

2.3 Battery sources are assembled in accordance with requirements and enterprise procedures.

	2.4	Wiring systems are installed, terminated and connected in accordance with requirements, manufacturers' specifications and enterprise procedures.
	2.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3.	Complete the installation	
	3.1	OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with enterprise procedures.
	3.3	Final inspections are undertaken to ensure the battery source and wiring systems conform to requirements and enterprise procedures.
	3.4	Final tests are undertaken to ensure the battery source satisfies operating specifications.
	3.5	Work completion is notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Assess risk in relation to assembling and connecting an extra low voltage battery power source
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of predictable problems
- Plan a process for assembling and connecting the ELV battery power source
- Work as a member of a team
- Assemble and wire up battery bank and accessories including sizing battery bank; selecting battery type; determine battery configuration (eg. series, parallel)
- Inspect and test battery bank including wiring continuity and connections; specific gravity; terminal voltage on load

Required knowledge:

- Primary battery cells including Leclanche (dry cell) and lithium cells

- Secondary battery cells including lead-acid (e.g. sealed and Gel cells); nickel-alkaline (eg. nickel-cadmium – vented and sealed, nickel-iron, nickel metal hydride); other (eg. lithium-ion; lithium-polymer)
- Battery characteristics including charge/discharge cycle; charging methods (constant voltage/constant current); memory effect; temperature effects; capacity; specific gravity; ampere-hour efficiency; storage density; internal resistance
- Battery care and disposal including safe handling practices; shelf life; self-discharge; storage conditions; charge levels

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Resources may include:

- computer software
- Internet access
- stationery
- manufacturers' manuals and data sheets
- drawing standards
- Wiring Rules

Equipment may include:

- cables and connectors
- multimeter
- tools
- hydrometer
- load resistors (variable)
- primary and/or secondary cells
- consumables

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
 - demonstrate the ability to plan, assemble, connect and test of extra low voltage sources comprised of either primary or secondary cells on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. Evidence should show competency working in realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required.

Method of assessment

- The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- The assessment environment should not disadvantage the candidate.
- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21541 Maintain rechargeable battery systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to plan, maintain and commission commonly used rechargeable (secondary) battery systems not exceeding 24 volts DC.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit of competency applies in domestic or commercial environments where battery sources are used to power fixed or mobile electrical/electronic equipment.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Prepare for maintenance of a rechargeable battery system	1.1 <i>OH&S requirements</i> and <i>environmental requirements</i> for a given work area are obtained and understood. 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area. 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with <i>appropriate personnel</i>. 1.4 Battery system requirements are determined and discussed with appropriate personnel. 1.5 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site. 1.6 <i>Resources and equipment</i> needed for the task are obtained in accordance with <i>enterprise procedures</i> and checked for correct operation and safety.
2. Maintain rechargeable battery system	2.1 OH&S requirements for carrying out the work are followed. 2.2 Equipment/machines/plant are checked as being isolated, where necessary, in strict accordance with OH&S requirements. 2.3 Maintain battery system in accordance with requirements and enterprise procedures.

	2.4	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	2.5	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3. Commission rechargeable battery system and complete work task	3.1	OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with enterprise procedures.
	3.3	Final inspections are undertaken to ensure the battery system conforms to requirements and enterprise procedures.
	3.4	Final tests are undertaken to ensure the battery system satisfies operating specifications.
	3.5	Work completion is notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures relevant to rechargeable battery system
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of predictable problems
- Plan a maintenance program
- Use assembling and dismantling techniques
- Maintain battery systems including conditioning and priming; electrolyte replacement; voltage measurements; state of charge measurement
- Analyse battery systems including function; characteristics; software

Required knowledge:

- Rechargeable battery system fundamentals including open and closed loop systems; system characteristics; component parts; system configurations; transducers
- Safety hazards including handling battery electrolyte; battery disposal; gassing/explosions; ventilation requirements; short circuits; appropriate clothing
- Battery types including lead-acid; nickel-cadmium; nickel metal hydride; lithium-ion; lithium-polymer

- Battery charging methods including constant voltage; constant current; pulse charging methods; overcharging considerations; trickle charging, cycling
- Non correctable battery problems including high self-discharge; low capacity cells; cell mismatch; shorted cells; loss of electrolyte

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Resources and equipment may include

- cables and connectors
- meters/testers
- tools
- hydrometer
- load resistors (variable)
- secondary cells (including sealed types)

- consumables
- battery chargers
- inverters
- rectifiers
- controllers

Enterprise procedures may include

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
 - plan for maintenance of a rechargeable battery system
 - maintain and commission a rechargeable battery systems on more than one occasion and in different contexts, which includes photovoltaic systems, mobile telephones and laptop computers.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- The assessment environment should not disadvantage the candidate.
- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21542 Identify and locate building blocks of a centralised power generation system

Unit Descriptor This unit of competency sets out the knowledge and skills required to locate and identify the building blocks and outline broad principles of operation for a reticulated centralised power system.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the Unit This unit of competency applies to industries that provide generation and reticulation of electricity to customers.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Obtain information about a centralised power generation system	1.1 <i>OH&S requirements</i> and <i>specific safety requirements</i> for a given area are obtained and understood.
	1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
	1.3 Major plant and equipment of a centralised power generation system are identified by using block diagrams, circuit diagrams and industry specifications.
	1.4 Regulatory requirement of supply and voltage level specifications for given generation plant, reticulation and distribution systems are obtained and understood.
	1.5 A report is planned and outcomes clearly specified and approved by <i>appropriate personnel</i> , if required.
	1.6 <i>Resources and equipment</i> needed to interact at the work site are obtained, in accordance with <i>enterprise procedures</i> and checked as fit for purpose.
	1.7 Appropriate personnel are consulted to ensure that work is coordinated effectively with others involved at the work site.

2. Locate the building blocks of the system	2.1 OH&S requirements for carrying out the work are followed.
	2.2 Equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements.
	2.3 Personal protective equipment (PPE) is selected and worn in accordance with enterprise procedures.
	2.4 Building blocks of a power generation system are identified and their operation is confirmed.
	2.5 Major generation and transmission equipment in a centralised power generation site are located according to requirements.
	2.6 Typical voltage levels of the power generation system are identified.
	2.7 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	2.8 Methods for dealing with unexpected situations are selected on the basis of safety and specified project outcomes.
3. Document and report on the system	3.1 OH&S requirements for completing the work are followed.
	3.2 Tools, equipment, PPE and any surplus resources and materials are where appropriate, cleaned checked and returned to storage in accordance with established procedures.
	3.3 Appropriate records are updated in accordance with instructions and enterprise procedures.
	3.4 Final report is prepared and is signed off according to enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Follow enterprise OH&S procedures
- Assess risk associated with the operation of a centralised power generation system
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of problems
- Access information relating to a centralised power generation system

- Use personal protective equipment

Required knowledge:

- Generation systems including high voltage generation; brown coal, wind; hydro; co-generation
- Power system plants including alternating current generators; transformers; circuit breakers; isolators; lines; cables; towers
- Reticulation systems including overhead and underground, urban/rural, high voltage customers and high-rise building reticulation; effects of industrial and commercial customers on the system; methods used to ensure continuity of supply
- Transmission systems including lines, buses, transformers and cables
- Distribution systems including three phase, single phase and single wire earth return systems; spur, parallel and ring systems
- Regulatory conditions of supply and utilisation including units, systems, voltage levels, power factors, wave-form distortion and transient loading; compliance with Australian Standards
- Renewable energy generation including wind; photo-voltaic cells and hydro systems
- Wind energy conversion systems including wind farms; major specifications for HV generation; terminology, units; symbols; wind patterns in Australia; local terrain; wind speeds; direction; turbulence; wind power and measuring instruments

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Specific safety requirements may include

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor

Resources and equipment may include

- teacher
- team member
- maps
- plant drawings
- block and circuit diagrams
- personnel protective equipment
- manufacturers' manuals
- specific safety regulations
- regulatory requirements

Enterprise procedures may include

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Building blocks of a power generation system may include

- primary energy source
 - steam
 - wind
 - hydro
 - diesel/petrol engines
 - renewable energy sources
- generators
 - AC/DC generators
 - single phase
 - three phase
- transmission substation
- power transmission lines/grid
- distribution grid
- distribution substation
- distribution bus
- power transformers
- taps
- consumer connection/metering
- safety devices
 - fuses
 - circuit breakers
- emergency power supplies

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
 - demonstrate the ability to locate and identify the building blocks and outline broad principles of operation for a reticulated centralised power system. This includes identifying building blocks of a centralised power system in abstract form on maps/diagrams and using maps/diagrams locating them within plant and installations. An explanation of purpose and function must be given.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit could be assessed in conjunction with any other units covering electrotechnology competencies or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include::

- observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21543 Set up an extra low voltage emergency power supply system (not exceeding 32V)

Unit Descriptor This unit of competency sets out the knowledge and skills required to select the type, capacity and configuration of an emergency power supply system not exceeding 32V.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the Unit This unit of competency applies in domestic, office, commercial or industrial environments where emergency power systems are used to power fixed or mobile electrical and electronic equipment. It applies in rural, metropolitan and remote locations

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Prepare for extra low voltage (ELV) emergency power supply installation	1.1 <i>OH&S requirements</i> and <i>environmental requirements</i> for a given work area are obtained and understood.
	1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
	1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented, in consultation with <i>appropriate personnel</i> .
	1.4 <i>Emergency power supply requirements</i> are determined and discussed with appropriate personnel.
	1.5 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
	1.6 <i>Resources and equipment</i> needed for the task are obtained in accordance with <i>enterprise procedures</i> and checked for correct operation and safety.
2. Install ELV emergency power supply system	2.1 OH&S requirements for carrying out the work are followed.
	2.2 Equipment/machines/plant are checked as being isolated where necessary, in strict accordance with OH&S requirements.

	2.3	ELV emergency power supply system is installed in accordance with emergency power supply requirements and enterprise procedures.
	2.4	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, emergency power supply requirements and enterprise procedures.
	2.5	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3.	Complete the installation	
	3.1	OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with enterprise procedures.
	3.3	Final inspections are undertaken to ensure the system conforms to emergency power supply requirements and enterprise procedures.
	3.4	Final tests are undertaken to ensure the ELV emergency power supply system functions as required.
	3.5	Work completion is notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Assess risk in setting up an ELV emergency power supply system
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve
- Plan a process for setting up an ELV emergency power supply system
- Use assembling and dismantling techniques
- Test for functionality of an ELV emergency power supply system
- Troubleshoot installation of an ELV emergency power supply system

Required knowledge:

- Extra low voltage power supply systems
- Mobile and fixed emergency power supplies
- Inverters
- Uninterruptible power supplies

- DC power supplies and generating sets
- Back-up generators for remote area power supplies
- Types of batteries (e.g. lithium, Ni Cd, Ni MH)
- Solar and wind generated extra low voltage power supplies
- Electrical power supply problems including: charge and discharge cycle; electrical power sags and brownouts; blackouts; surges and spikes; distortion RF (frequency); restricted and unreliable access to grid, risks associated with power loss; risks associated with power surges and distortion
- Extra low voltage power supply applications (e.g. home, office, medical, industrial, commercial, other); locations (e.g. rural, metropolitan, marine, remote); appropriateness of particular equipment to given applications
- Local regulations

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- Defining and identifying extra low voltage applications
- Procedures to ensure applications requiring higher voltage power supplies are dealt with by suitably licensed and competent persons
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include but are not limited to:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor

Emergency power supply requirements may include:

- teacher
- team member
- assessing risks involved with not having access to emergency power
- applications requiring fixed and mobile emergency power supply units not exceeding 32V output
- applications requiring uninterruptable extra low voltage power supply

Resources and equipment may include

- cables and connectors
- tools
- multimeter
- consumables
- extra low voltage power supply components – fixed and mobile
- extra low voltage uninterruptible power supply components
- manufacturers manuals and data sheets
- engineering drawing standards

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control;

- demonstrate the ability to plan, install, connect and test extra low voltage emergency power supply systems on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The candidate will have access to all tools, equipment, materials and documentation required and be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21544 Install a sustainable extra low voltage energy power system

Unit Descriptor This unit of competency sets out the knowledge and skills required to plan to install, install and commission a sustainable energy power system.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the Unit This unit of competency applies in domestic, industrial or commercial environments, where appropriate sustainable energy systems are employed.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan to install a sustainable energy system
 - 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
 - 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
 - 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
 - 1.4 **Sustainable energy system** requirements are determined and discussed with appropriate personnel.
 - 1.5 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
 - 1.6 **Resources and equipment** needed for the task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.
2. Install a sustainable energy system
 - 2.1 OH&S requirements for carrying out the work are followed.
 - 2.2 Equipment/machines/plant are checked as being isolated, where necessary, in strict accordance with OH&S requirements.
 - 2.3 Equipment/machines/plant are installed in accordance with requirements, manufacturers' specifications and enterprise procedures.

	2.4	Wiring systems are installed, terminated, tested and connected in accordance with requirements, manufacturers' specifications and enterprise procedures.
	2.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, and implementation of risk management and enterprise procedures.
	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3.	Commission a sustainable energy system and complete work task	
	3.1	OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with enterprise procedures.
	3.3	Final inspections are undertaken to ensure the sustainable energy system installation conforms to requirements and enterprise procedures.
	3.4	Final tests are undertaken to ensure the sustainable energy system satisfies operating specifications.
	3.5	Work completion is notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills

- Use tools and equipment correctly
- Follow enterprise relevant OH&S procedures
- Read and interpret equipment manuals
- Complete workplace documentation relating to the work
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve
- Plan a process for installing the sustainable energy power source
- Use assembling and dismantling techniques
- Test for functionality of the sustainable energy power source
- Troubleshoot installation
- Work as a member of a team

Required knowledge:

- Causes and consequences of the greenhouse effect
- Energy usage in Australia including types and methods; contribution to the greenhouse effect; greenhouse gases other than CO₂
- Opportunities for reducing greenhouse emissions including domestic, commercial and industrial strategies; trade related technologies and methods

- Overview of sustainable energy technologies including photovoltaic; solar; micro-hydro; wind energy conversion
- Economic benefits of sustainable energy initiatives
- Major categories of energy storage methods (eg. chemical conversions; gravitational, potential, kinetic, heat)
- Basic characteristics of energy storage methods including energy density and commercial availability
- Operating low voltage DC appliances including low voltage tapping from a battery of cells; separate cells; sealed nickel-cadmium cells; low voltage adapter; DC to DC converters
- Power inverters including types, output waveforms and efficiency
- Controllers including blocking diode; low voltage disconnect; charge regulators; over-voltage shunt; connections
- Photovoltaic terminology; units/conversions, symbols
- Photovoltaic modules including types, efficiency and applications
- Photovoltaic fundamentals including IV curves; irradiance and temperature effects; blocking and bypass diodes; wiring diagrams and configurations; specifications
- Solar radiation fundamentals including terminology; units/conversions; symbols; sun position; sun path diagrams; solar radiation on fixed and tracking collectors; specifications
- Micro-hydro fundamentals including terminology; units/conversions; symbols; flow rates, heads and assessment; turbines; operating characteristic; control requirements; specifications
- Wind energy conversion fundamentals including terminology; units/conversions; symbols; wind patterns; local terrain, wind speed, direction, turbulence and wind power; maps, data sheets and measuring instruments; characteristics; applications; specifications

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- Awards provisions

Environmental requirements may include

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include

- supervisor
- leading hand
- foreman

	• manager • site engineer • trainer • mentor • teacher • team member
Sustainable energy systems may include	• photovoltaic • solar radiation • micro-hydro • wind energy conversion • storage devices
Resources and equipment may include	• cables and connectors • meters • test equipment • tools • personal computer/laptop • calculator • primary and/or secondary cells • consumables • inverters • rectifiers • voltage regulators • controllers
Enterprise procedures may include	• the use of tools and equipment • instructions, including job sheets, plans, drawings and designs • reporting and communication • manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.

Context of and specific resources for assessment

- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - demonstrate the planning, installation, testing and commissioning of one(1) only of the four sustainable energy systems indicated in the Range Statement on more than one occasion and in different contexts.
- Assessment should be conducted in a real or simulated work environment under a variety of conditions.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team.
- The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21581 Build a small wireless LAN

Unit Descriptor

This competency unit sets out the knowledge and skills required to construct, configure and operate a small wireless local area network consisting of a maximum of five computers linked through a network to the internet.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This competency unit applies to a domestic or office environment where a small wireless computer network is required.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Plan for wireless network implementation

1.1 ***OH&S requirements*** and ***specific safety requirements*** for a given area are obtained and understood.

1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.

1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.

1.4 Wireless local area network requirements are determined from documentation, job sheets or discussions with appropriate personnel.

1.5 ***Computer and wireless network equipment*** are selected and the installation is planned taking operational requirements into consideration.

1.6 Appropriate personnel are consulted to ensure that work is coordinated effectively with others involved at the work site.

1.7 ***Resources and equipment*** needed for task are obtained in accordance with enterprise procedures and checked for correct operation and safety.

2

2.1 OH&S requirements and specific safety requirements for carrying out the work are followed.

Install and configure wireless local area network	2.2 Computer and wireless networking equipment are installed and configured in accordance with manufacturers' specifications and enterprise procedures. 2.3 Network services are configured according to job requirements and enterprise procedures. 2.4 Basic network security features are configured according to job requirements and enterprise procedures. 2.5 The wireless local area network is tested for functionality and, if appropriate, faults are corrected. 2.6 Decisions for dealing with unexpected situations are made based on discussions with appropriate personnel, job specification and enterprise procedures.
3 Complete the wireless local area network	3.1 OH&S requirements for completing the work are followed. 3.2 Worksite is cleaned and made safe in accordance with OH&S requirements and enterprise procedures. 3.3 Equipment and tools used are maintained and stored in accordance with enterprise procedures. 3.4 Wireless network installation and configuration details are documented and stored in accordance with enterprise procedures. 3.5 The wireless local area network is checked to verify overall correct functioning and initial problems are rectified as required. 3.6 Appropriate personnel are informed of the completion of work and, if required provided with a demonstration of the wireless network system.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Read and interpret equipment manuals
- Apply basic planning skills
- Make decisions within a limited range of options
- Complete workplace documentation
- Perform diagnostics for the wireless local area network (WLAN)
- Configure services for the WLAN

- Configure radio and Ethernet
- Manage configuration files
- Access status and network statistics and performance
- Install antenna for the WLAN
- Configure users and WEP
- Configure associations and filters
- Troubleshoot OSI, TCP/IP, WLAN, LAN and single point failures
- Monitor and manager WLAN

Required knowledge:

- Protocols and network interface cards including: (802.11 standard; 802.11 MAC layer; physical layer; client adaptors; client utility
- Wireless radio technology including: essential mathematics, electromagnetic waves, signals in time, signals in frequency, radio systems multiple access, radio wave propagation
- Wireless topologies including: components; WLAN topologies; channel set up; bridge topologies
- Access points including: access point connection; basic configuration; management navigation; Ethernet port configuration; AP radio configuration
- Bridges and ports
- Antenna theory and physics including: 2.4 Ghz Omni-directional antennas; 2.4 Ghz directional antennas; 5 Ghz antennas; cable and accessories; link engineering
- WLAN security technologies
- Scalable enterprise WLAN security solutions
- Troubleshooting methodology and diagnostic tools
- Wireless organisations and certifications including: standards bodies; vendors and products

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- local safe operating procedures

Specific safety requirements may include

- procedures
- first aid
- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards
- follow confined spaces procedures

Appropriate personnel may include

- supervisor
- department supervisor
- department personnel
- trainer
- teacher

Computer and wireless network equipment may include

- routers, switches and hubs
- network cable
- UPS
- antennas (ceiling, mast, pillar, integrated, Yagi and dish)
- lightning arrestors
- bridges
- amplifiers
- wireless NICs
- desk top and lap top computers networked and stand alone

Resources and equipment may include

- appropriate tools
- test equipment
- consumables
- network cards/connectors
- appropriate software and licenses
- manufacturers' specifications and manuals
- diagnostic software

Enterprise procedures may include

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.

- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - demonstrate the ability to construct, configure and operate a small wireless local area network consisting of a maximum of five computers linked through a network to the internet on more than one occasion and in different contexts. It must include appropriate computers, routers, switches, antennas, NICs hubs and other computer wireless networking equipment.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit could be assessed in conjunction with any other units covering computer networking or wireless technologies or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include::
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21566 Install and test a wireless intercom system

Unit Descriptor This competency unit sets out the knowledge and skills required to install and test a wireless intercom system.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the Unit This competency unit applies in a home, office, industrial or similar environment where wireless intercom systems are installed and used.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1	Plan for wireless intercom system installation	1.1 <i>OH&S requirements</i> and <i>specific safety requirements</i> for a given area are obtained and understood. 1.2 Establish OH&S requirements and risk control measures and procedures are followed in the preparation of the work area. 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with <i>appropriate personnel</i>. 1.4 <i>Wireless intercom system</i> requirements are determined from documentation, job sheets or discussions with appropriate personnel. 1.5 Wireless intercom system components are selected and the installation is planned taking operational requirements into consideration. 1.6 Appropriate personnel are consulted to ensure that work is coordinated effectively with others involved at the work site. 1.7 <i>Resources and equipment</i> needed for task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2	Install and configure a wireless intercom system	2.1 OH&S requirements and specific safety requirements for carrying out the work are followed. 2.2 <i>Wireless intercom equipment components</i> are installed and configured in accordance with manufacturers' specifications and <i>enterprise procedures</i>.

	2.3	The wireless intercom system is tested for functionality and, if appropriate, faults are corrected.
	2.4	Wireless intercom system is interfaced with wired communication systems, if required.
	2.5	Decisions for dealing with unexpected situations are made based on discussions with appropriate personnel, job specification and enterprise procedures.
3	The wireless intercom system is completed	
	3.1	OH&S requirements for completing the work are followed.
	3.2	Equipment and tools used are maintained and stored in accordance with enterprise procedures.
	3.3	Wireless intercom system installation and configuration details are documented and stored in accordance with enterprise procedures.
	3.4	The system is checked to verify overall correct functioning and initial problems are rectified as required.
	3.5	Appropriate personnel are informed of the completion of work and, if required, provided with a demonstration of the system.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Read and interpret equipment manuals
- Provide basic one-to-one instruction
- Apply basic project planning skills
- Use diagnostic tools relevant to a wireless intercom system
- Make decisions within a limited range of options
- Troubleshoot connection, picture and sound issues relevant to a wireless intercom system
- Communicate with clients
- Complete workplace documentation
- Provide client training in the operation of a wireless intercom system

Required knowledge:

- Wireless intercom components including: base stations; antennas; head and handsets; belt packs; microphones; repeaters; computer interfaces; network interfaces
- Wireless theory including: essential mathematics; electromagnetic waves; signals in time; signals in frequency; radio systems; multiple access; radio wave propagation; signal strength (gain/attenuation); noise; sampling; error rates
- Wireless protocols and standards including: voice activated; push to talk; multi channel systems; full and half duplex; DECT; 2-way radio; network compatibility; internet protocol compatibility
- Troubleshooting methodology

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- local safe operating procedures

Specific safety requirements may include

- procedures
- first aid
- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards
- follow confined spaces procedures

Appropriate personnel may include

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Wireless intercom system may include

- analog systems
- digital systems

Resources and equipment may include Wireless intercom equipment components may include Enterprise procedures may include	• full duplex • low cost systems • high quality systems • door phone intercoms • cue monitoring • interfaces to other communication systems • appropriate tools • test equipment • consumables • cables and connectors • manufacturers' specifications and manuals • base stations • antennas • head and handsets • belt packs • microphones • repeaters • computer interfaces • network interfaces • the use of tools and equipment • instructions, including job sheets, plans, drawings and designs • reporting and communication • manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidate must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk

control measures as specified in the performance criteria;

- install and configure an intercom system and demonstrate its operation in a home or similar environment on more than one occasion and in different contexts

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit could be assessed in conjunction with any other units covering wireless intercom systems or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21567 Conduct a site survey for a wireless network

Unit Descriptor

This competency unit sets out the knowledge and skills required to conduct a site survey for a wireless network and produce documentation for network implementation or upgrade.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This competency unit applies to a domestic or office environment where wireless network communications is required.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Plan a wireless site survey

- 1.1 **OH&S requirements** and **specific safety requirements** for a given area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel.
- 1.4 Wireless network requirements are determined from documentation, job sheets or discussions with **appropriate personnel**.
- 1.5 A facilities floor plan diagram is obtained or, if required, drawn depicting the location of walls, walkways etc. and interpreted.
- 1.6 Site survey is planned in consultation with appropriate personnel and according to **enterprise procedures**.
- 1.7 Current **wireless networking equipment** layout, parameters and other relevant information, if existing, are obtained, if appropriate.
- 1.8 Appropriate personnel are consulted to ensure that work is coordinated effectively with others involved at the work site.
- 1.9 **Resources and equipment** needed for survey are obtained in accordance with enterprise procedures and checked for correct operation and safety.

2	Conduct site survey	2.1 OH&S requirements and specific safety requirements for conducting a site survey are followed.
		2.2 The current wireless network performance, if available, is documented according to enterprise procedures.
		2.3 The survey area is visually inspected and potential barriers to RF propagations identified and discussed with appropriate personnel.
		2.4 Areas for fixed and mobile users are identified and noted on facilities diagram.
		2.5 Access point locations are identified provisionally using appropriate RF site survey tools and/or software.
		2.6 Locations of access points are verified by temporary installation and operational testing.
		2.7 Appropriate contingency actions are taken if site survey is hindered by lack of access, or other issues.
		2.8 Decisions for dealing with unexpected situations are made based on discussions with appropriate personnel, job specification and enterprise procedures.
3	Document site survey	3.1 OH&S requirements and specific safety requirements for completing a site survey are followed.
		3.2 Worksite is cleaned and made safe in accordance with OH&S requirements and enterprise procedures.
		3.3 Equipment and tools used are maintained and stored in accordance with enterprise procedures.
		3.4 Findings and recommendations of the site survey are documented and final location of access points recorded on the facilities diagram in accordance with enterprise procedures.
		3.5 Appropriate personnel are notified of completion of site survey.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow relevant enterprise OH&S procedures
- Read and interpret equipment manuals

- Work in a team to conduct the site survey
- Make decisions within a limited range of options
- Complete workplace documentation
- Perform NIC diagnostics
- Configure services
- Configure radio and Ethernet ports
- Manage configuration files
- Install antenna for a wireless network
- Configure users and WEP
- Configure associations and filters
- Use diagnostic tools to problem solve for a range of predictable problems
- Troubleshoot OSI, TCP/IP, WLAN problems and single point failures, and LAN
- Monitor and manage WLAN

Required knowledge:

- Protocols and network interface cards (NIC) including: 802.11 standard; 802.11 MAC layer; physical layer; client adaptors; client utility
- Wireless radio technology including: essential mathematics; electromagnetic waves; signals in time; signals in frequency; radio systems; multiple access; radio wave propagation
- Wireless topologies including: components; WLAN topologies; channel set up; bridge topologies
- Access points including: access point connection; basic configuration; management navigation, Ethernet port configuration; AP radio configuration
- Bridges and ports
- Status and network statistics and performance
- Antennas including: theory and physics; 2.4 GHz omni-directional antennas; 2.4 GHz directional antennas; 5 GHz antennas; cable and accessories; link engineering
- WLAN security technologies
- Scalable enterprise WLAN security solutions
- Troubleshooting methodology and diagnostic tools
- Wireless organisations and certifications including: standards bodies; vendors and products

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- local safe operating procedures

Specific safety requirements may include

- procedures
- first aid
- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards
- follow confined spaces procedures

Appropriate personnel may include

- supervisor
- department personnel
- department supervisors
- trainer
- teacher

Enterprise procedures may include

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Wireless networking equipment may include

- routers, switches and hubs
- network cable
- UPS
- antennas (ceiling, mast, pillar, integrated, Yagi and dish)
- lightning arrestors
- bridges
- amplifiers
- wireless NICs
- desk top and lap top computers networked and stand alone

Resources and equipment may include

- appropriate tools
- test equipment
- consumables
- network cards/connectors
- appropriate software and licenses
- manufacturers' specifications and manuals
- diagnostic software
- routers, switches and hubs

- network cable
- UPS
- antennas (ceiling, mast, pillar, integrated, yagi and dish)
- lightning arrestors
- bridges
- amplifiers
- wireless NICs
- desk top and lap top computers networked and stand alone

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
 - demonstrate the ability to plan, conduct and document a wireless network site survey on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

- This unit could be assessed in conjunction with any other units covering conducting site surveys of wireless networks or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21568 Set up and operate a wireless communications link

Unit Descriptor

This competency unit sets out the knowledge and skills required to set up and operate a wireless communications link. This includes point to point links for a range of purposes using a range of frequency bands and may extend into the infrared and visible portion of the electromagnetic spectrum.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This competency unit is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 2 or higher. It applies in a home, office, industrial or similar environment where point to point communication links are set up and operated.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Plan for setting up a wireless communications link

- 1.1 ***OH&S requirements*** and ***specific safety requirements*** for a given area are obtained and understood.
- 1.2 Establish OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
- 1.4 ***Wireless communications link*** requirements are determined from documentation, job sheets or discussions with appropriate personnel.
- 1.5 Regulatory requirements for setting up and operating the wireless communication link are established, appropriate actions are discussed with appropriate personnel and acted on.
- 1.6 ***Wireless communications link components*** are selected and the installation is planned taking operational requirements into consideration.
- 1.7 Appropriate personnel are consulted to ensure that work is coordinated effectively with others involved at the work site.

	1.8	Resources and equipment needed for task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2	Set up and operate a wireless communications link	2.1 OH&S requirements and specific safety requirements for carrying out the work are followed. 2.2 Wireless communications link components are installed and configured in accordance with manufacturers' specifications and enterprise procedures. 2.3 The wireless communications link is tested for functionality and, if appropriate, faults are corrected. 2.4 The wireless communications link is interfaced with wired communication systems, if required. 2.5 Decisions for dealing with unexpected situations are made based on discussions with appropriate personnel, job specification and enterprise procedures.
3	The wireless communications link is tested and completed	3.1 OH&S requirements and specific safety requirements for completing the work are followed. 3.2 Equipment and tools used are maintained and stored in accordance with enterprise procedures. 3.3 Wireless communications link installation, configuration and operation details are documented and stored in accordance with enterprise procedures. 3.4 The wireless communications link is checked to verify overall correct functioning and initial problems are rectified as required. 3.5 Appropriate personnel are informed of the completion of work and, if required, provided with a demonstration of the wireless intercom system.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow enterprise OH&S procedures
- Read and interpret equipment manuals
- Complete workplace documentation

- Plan a procedure
- Make decisions within a limited range of options
- Use diagnostic tools to problem solve for a range of predictable problems
- Follow testing procedures
- Troubleshooting connection issues
- Troubleshooting picture and sound issues

Required knowledge:

- Wireless fundamentals including essential mathematics; electromagnetic waves; signals in time; signals in frequency; radio systems; multiple access; radio wave propagation; antennas; modulation; signal strength eg gain and attenuation; noise sampling; error rates
- Wireless links including communications channel; regulations; limited bandwidth; power issues; security issues; equipment (eg. fixed, mobile, base); applications, operating protocols
- Wireless intercom components including transmitters and receivers; antennas; head and handsets; microphones; repeaters; computer interfaces; network interfaces
- Troubleshooting methodology

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- local safe operating procedures

Specific safety requirements may include

- procedures
- first aid
- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards
- follow confined spaces procedures

Appropriate personnel may include

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Wireless communications link may include

- analog systems
- digital systems
- full duplex
- low cost systems
- high quality systems
- interfaces to other communication systems
- line of sight
- over the horizon

Wireless communications link components may include

- transmitter
- receiver
- antennas
- head and handsets
- belt packs
- microphones
- repeaters
- computer interfaces
- network interfaces

Resources and equipment may include

- appropriate tools
- test equipment
- consumables
- cables and connectors
- manufacturers specifications and manuals
- communications link equipment

Enterprise procedures may include

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic.
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.

- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
 - demonstrate an understanding of the essential knowledge and associated skills as described in this unit;
 - demonstrate the ability to set up and operate a wireless communications link on more than one occasion and in different contexts.

Context of and specific resources for assessment

- Evidence should show competency working in realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- This unit could be assessed in conjunction with any other units covering wireless communications links or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Evidence can be gathered through a variety of ways including:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in

a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21569 Install communications antennae

Unit Descriptor

This competency unit sets out the knowledge and skills required to install communications antennas. This includes basic receiving and transmitting antennas for mainly domestic, small commercial and short distance communications application. This unit is not intended to cover the installation of antennas in complex communications networks and broadcasting applications and where the installation requires substantial mechanical support structures.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This competency unit applies in domestic or commercial environments where basic wireless communications links are required.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Plan for antenna installation

- 1.1 **OH&S** and ***specific safety requirements*** for a given area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
- 1.4 Installation requirements are identified from documentation, work sheets or consultation with appropriate personnel.
- 1.5 Installation is planned taking operational requirements into consideration.
- 1.6 Relevant Australian Communications Authority regulations are taken into account when planning installation task, if appropriate.
- 1.7 Appropriate personnel are consulted to ensure that work is coordinated effectively with others involved at the work site.
- 1.8 ***Resources and equipment*** needed for task are obtained in accordance with ***enterprise procedures*** and checked for correct operation and safety.

2	Install and configure antennas	2.1 OH&S and specific safety requirements for carrying out the work are followed. 2.2 Communications antenna equipment is selected according to job requirements and, if required, future needs are taken into account. 2.3 Communications antenna equipment are installed and configured in accordance with manufacturer's documentation and enterprise procedures. 2.4 For installation above ground all necessary precautions are taken to ensure safe installation at heights. 2.5 Antenna is connected to associated communications equipment, tested and communications link verified. 2.6 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
3	Complete the installation task	3.1 OH&S and specific safety requirements for completing the work are followed. 3.2 Equipment and tools used in installation task are cleaned and stored in accordance with enterprise procedures. 3.3 Worksite is cleared and made safe in accordance with OH&S requirements and enterprise procedures. 3.4 Documentation is completed in accordance with enterprise procedures. 3.5 Appropriate personnel are notified of completion of installation task.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Use tools and equipment correctly
- Follow relevant enterprise OH&S procedures
- Read and interpret equipment manuals
- Complete workplace documentation relating to the installation of communication antennas
- Make decision within a limited range of options
- Plan a procedure to install and configure communication antennas
- Use diagnostic tools to problem solve for a range of predictable problems

- Install antennas in accordance with established procedures

Required knowledge:

- Wireless radio technology including electromagnetic waves; signals in time; signals in frequency; radio systems; multiple access; radio wave propagation
- Wireless topologies including components; WLAN topologies; channel set up; bridge topologies
- Occupational health and safety including working at heights; precautions around electromagnetic radiation sources
- Antenna applications including wireless networks; short and long range communications; radio and television communications; microwave communications; satellite communications
- Antenna fundamentals including theory and physics; omni directional antennas; directional antennas; cable and accessories; link engineering
- Wireless organisations and certifications including standards bodies; regulators; vendors and products
- RF connectors including types, uses; conventions
- RF cables including coaxial; balanced; antenna wire
- Grounding materials

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include

- legislation
- protective equipment
- material safety management systems
- local safe operating procedures
- awards provisions

Specific safety requirements may include

- procedures
- first aid
- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards
- follow confined spaces procedures

Appropriate personnel may include

- supervisor
- trainer
- business / enterprise staff
- business / enterprise owner / manager

- teacher
- client
- customer

Resources and equipment may include

- work requests/sheets
- plans, drawings and sketches
- measuring equipment
- multi-meters
- measurement instruments
- gauges
- cable testers
- installation tools
- crimpers
- consumables

Enterprise procedures may include

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Communications antenna equipment may include

- cables and connectors
- mast
- pillar
- integrated
- Yagi
- TV and FM antennas
- vertical antennas
- microwave antennas
- dish
- lightning arrestors
- bridges
- splitters
- attenuators
- amplifiers
- desk top and lap top computers networked and stand alone

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
 - plan and install antennae of differing makes and function on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- The assessment environment should not disadvantage the candidate.
- This unit could be assessed in conjunction with any other units covering antenna installation or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in

a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21570 Apply electrical principles to route selection of power distribution networks

Unit Descriptor	This unit of competency sets out the knowledge and skills required to incorporate electrical design considerations in determining route selection for modification, extension or new electrical distribution infrastructure. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.
Employability Skills	This unit contains Employability Skills
Application of the Unit	The unit applies to low voltage (LV), high voltage (HV) and sub-transmission infrastructure which may be above ground or below ground.
ELEMENT	PERFORMANCE CRITERIA
Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
1. Plan route selection for power distribution network.	1.1 <i>OH&S requirements</i> and <i>environmental requirements</i> for a given work area are obtained and clarified in consultation with <i>appropriate personnel</i>. 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area. 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel. 1.4 Nature and scope of the <i>power distribution network</i> infrastructure works is established from job briefs or discussions with appropriate personnel. 1.5 <i>Infrastructure</i> requirements are planned for, in conjunction with appropriate personnel in accordance with <i>enterprise procedures</i>. 1.6 Engineering design rules and statutory requirements are identified and obtained in line with enterprise procedures. 1.7 Appropriate personnel are consulted to ensure the task is coordinated effectively with others involved at the work site.

2. Carry out route design for power distribution network.	2.1 Route selection is chosen to meet the requirements of key stakeholders and environmental requirements.
	2.2 Route choice is made to ensure safety of personnel in the vicinity of the power line, in accordance with enterprise procedures.
	2.3 Pole positioning is determined to provide power-line conductor clearance to ground, nearby structures, other power lines and aerial and/or underground services, in accordance with statutory requirements and enterprise procedures.
	2.4 Optimum pole spacing and positioning is determined by reference to graphs, charts, engineering aids and basic calculations .
	2.5 Detailed design sketches or field notes are prepared.
	2.6 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes
3. Complete route design.	3.1 Work site is made safe in accordance with established safety procedures.
	3.2 Detailed design drawings, sketches or field notes are passed on to appropriate personnel and stored and recorded in accordance with enterprise procedures.
	3.3 Appropriate personnel are notified, in accordance with enterprise procedures, that the task has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Using tools and equipment correctly.
- Following relevant enterprise OH&S procedures.
- Using office and engineering software applications.
- Applying mathematical principles to solve engineering problems.
- Selecting optimum route topology.
- Devising power system layouts.
- Incorporating safe electrical design principles in route selection.
- Determining pole placement for “working live” maintenance.
- Incorporating environmental factors in route design.
- Producing technical drawings, sketches and documents.
- Working with clients and peers to achieve outcomes.

Required knowledge:

- Correct usage of tools and equipment.
- Enterprise OH&S procedures.
- Basic computer applications and systems.
- Engineering applications of mathematical principles.
- Above and below ground transmission, distribution systems.
- Power system layouts.
- Electrical properties of materials.
- Electrical circuit, voltage, current and resistance.
- Insulation resistance and conductivity.
- Effects of HV proximity on nearby objects, environment and personnel.
- High voltage SWER systems.
- Powerline distribution installation and extension.
- AC transmission system components.
- Underground cable installation.
- Underground mains layout principles.
- Safe design principles.
- Environmental fundamentals.
- Standards for technical drawings and documents.
- Basic design characteristics of poles/structures and associated equipment.
- Design characteristics of underground and overhead conductors and cables, poles and structures.

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements

- adjacent vehicular traffic movement
- community amenity
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel

- electrical design technician or engineer
- draftsman

	• supervisor • customer/client • manager • trainer/mentor/teacher • team member
Power distribution network	• Above ground or below ground wired network of electricity supply to industry, commerce and the community.
Infrastructure	• poles, wires, cables and associated structural and electrical hardware to support electricity supply and distribution of up to 66kV.
Enterprise procedures	• following and interpreting engineering design rules, charts, tables and drawings • the use of tools and equipment • following and preparing instructions, including job sheets, plans, drawings and designs • reporting and communication • manufacturers' specifications • operational procedures
Key stakeholders	• employers • clients • community interest groups • government authorities • other contractors • employees
Basic calculations	• addition • subtraction • multiplication • division • fractions • decimals

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the

timeframes typically expected of the discipline, work function and industrial environment.

- Assessment should also reinforce the integration of the Employability Skills.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - consistently demonstrate the ability to determine a power distribution route that:
 - maximises the span between poles
 - meets engineering and technical specifications
 - complies with safety and statutory requirements
 - satisfies all client requirements.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21571 Apply electrical considerations to developing the design of power distribution infrastructure

Unit Descriptor

This unit of competency sets out the knowledge and skills required to incorporate electrical design considerations into the preparation of design drawings for modification, extension or new electrical distribution infrastructure. Sketches, engineering notes and instructions will be communicated to engineering draftspersons.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The qualification's Employability Skills Summary in which this unit is included will assist in identifying employability skill requirements.

Application of the Unit

The unit applies to low voltage (LV), high voltage (HV) and sub-transmission infrastructure which may be above ground or below ground.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

1. Prepare to carry out design of power distribution infrastructure.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 ***OH&S requirements*** and ***environmental requirements*** for a given work area are obtained and clarified in consultation with ***appropriate personnel***.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel.
- 1.4 The scope of ***power distribution network infrastructure*** works is established from job briefs and discussions with appropriate personnel.
- 1.5 Engineering design rules and statutory requirements are identified and obtained in line with ***enterprise procedures***.
- 1.6 Appropriate personnel and ***stake holders*** are consulted to ensure the task is coordinated effectively with others involved at the work site.

2. Carry out design of power distribution infrastructure.	2.1 Specification of pole diameter and pole material is selected according to design briefs.
	2.2 Pole height is determined from design brief and using graphs, charts and basic calculations.
	2.3 Specification of hole diameter and depth, pole footing and guying, hole backfilling and compaction are determined in line with enterprise procedures.
	2.4 Pole hardware selection and placement is specified to meet design brief and where required, facilitate live line maintenance in accordance with enterprise procedures.
	2.5 Detailed design field notes, sketches and instructions to be passed on to draftspersons are created in accordance with enterprise procedures.
	2.6 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes
3. Complete and document design of power distribution infrastructure.	3.1 Work site is made safe in accordance with established safety procedures.
	3.2 Detailed design field notes, sketches and hardware specifications are communicated to appropriate personnel.
	3.3 Appropriate personnel are notified, in accordance with enterprise procedures, that the task has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Correctly using tools and equipment.
- Following enterprise OH&S procedures.
- Using office and engineering software applications.
- Applying mathematical principles to solve engineering problems.
- Selecting structural components which have appropriate electrical properties.
- Determining pole type, height, diameter and material.
- Specifying hole diameter and depth, pole footing and guying, hole backfilling and compaction.
- Determining pole hardware requirements for powerline installation and extension.
- Specifying pole and hardware installation for “working live” maintenance.
- Selecting underground mains layout.
- Specifying underground cable installation.
- Producing technical sketches, drawings and documents.
- Working with clients and peers to achieve outcomes.

Required knowledge:

- Correct usage of tools and equipment.
- Enterprise OH&S procedures.
- Basic computer applications and systems.
- Engineering applications of mathematical principles.
- Above and below ground transmission, distribution systems.
- Electrical properties of materials.
- Cross-arm configurations
- Cable sizes, types and current capacity.
- Function and types of insulators, fuses, switches, transformer and sub-station.
- The principles of earthing and role of the earthing system.
- Earth resistance and earthing techniques.
- Above and below ground transmission, distribution systems.
- High voltage SWER system.
- Powerline distribution installation and extension.
- Pole and hardware installation and maintenance.
- Overhead line component fundamentals.
- Underground cable installation.
- Safe design principles.
- Environmental fundamentals.
- Standards for technical drawings and documents.
- Basic design characteristics of poles/structures and associated equipment.
- Design characteristics of underground and overhead conductors and cables, and structures.

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements

- adjacent vehicular traffic movement
- community amenity
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel

- electrical design technician or engineer

	• drafts person • supervisor • customer/client • manager • trainer/mentor/teacher • team member
Power distribution network	• Wired network of electricity supply to industry, commerce and the community.
Infrastructure	• poles, wires, cables and associated structural and electrical hardware to support electricity supply and distribution.
Enterprise procedures	• engineering design rules, charts, tables and specification drawings • the use of tools and equipment • instructions, including job sheets, plans, drawings and designs • reporting and communication • manufacturers' specifications • operational procedures
Stake holders	• employers • clients • community interest groups • government authorities • other contractors • employees

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment. Assessment should also reinforce the integration of the Employability Skills.

In particular this shall incorporate evidence that shows a candidate is able to:

- implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;

- demonstrate required knowledge and skills as described in this unit;
- demonstrate competence within a timeframe typically expected of the discipline, work function and industrial environment;
- consistently demonstrate the ability to prepare design sketches and instructions for draftspersons that:
 - meets design brief
 - specifies all required hardware and hardware attachment and spacings
 - satisfies engineering and technical specifications
 - complies with safety and statutory requirements
 - satisfies all client requirements

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

Assessment should reinforce the integration of the Employability Skills

VU21545 Evaluate proportional and servo controlled fluid power systems

Unit Descriptor

This unit provides the knowledge and skills to enable participants to design and draw/construct electro-proportional and servo control circuit diagrams. Participants will prepare, construct and evaluate electro-proportional and servo circuit capabilities against given system specifications and performance guidelines.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit would be applied by those involved in the optimisation and performance evaluation of electro-proportional and servo control systems. It involves the interpretation, capability assessment, and review of a design brief, the confirmation of functional schematics, documentation and supporting calculations. The preparation and evaluation of industry-based, test rigs or simulation bench electro-fluid power control circuit and systems, their componentry and their dynamic application under load conditions in accordance with recognised industry best practice.

It is suitable for fluid power system and automation designers and maintenance personnel, and those advancing engineering or related qualifications and careers.

Pre- Requisites

VU21546 Monitor and adjust an integrated fluid power control system

VU21547 Select components for an integrated fluid power design project

VU21548 Install and commission an integrated fluid power system

MEM23006A Apply fluid and thermodynamics principles in engineering

VU21270 Implement control processes using PLC's

Element

Performance Criteria

Elements describe the essential outcomes of a unit of competency

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide

1. Establish a requirements and performance brief.
 - 1.1 All health, safety and workplace practices for the evaluation task are mapped and tested against recognised industry best practice and codes of practice, prior to commencing the evaluation
 - 1.2 The evaluation briefs for the proportional and servo controlled **fluid power systems** are obtained and analysed
 - 1.3 The functional requirements and dynamic characteristics for the effective operation of proportional and servo controlled fluid power systems are determined.
 - 1.4 The proportional and servo controlled fluid power systems evaluation brief and specified outcomes are confirmed with the client.
2. Prepare and test a production system test facility or simulation test rig.
 - 2.1 A functional schematic diagram is produced showing system flow, key electro-fluid power components and control logic circuit overview.
 - 2.2 A **time-displacement diagram** of the system functions is tested and confirmed
 - 2.3 A **control logic diagram** for the system is tested and confirmed
 - 2.4 Specifications of all electro-fluid power components are determined and or confirmed by calculation, reference to manufacturer's data sheets and use of charts and graphs.
 - 2.5 The **ramp time** for both linear and rotary actuator circuits is calculated and the envisaged dynamic characteristics of the system are recorded.
 - 2.6 The maximum flow rates for linear and rotary actuator circuits are calculated for **accelerating and decelerating loads** and an appropriate **proportional servo valve** or valve spool option is selected
 - 2.7 The pressure in linear actuator circuits is calculated using established procedures and consideration for both decompression and pressure intensification rates and safety margins

- 2.8 An electro-fluid power control production system test facility or a simulation of the circuit and control system is **dynamically tested** and evaluated and the systems functionality, characteristics and performance data are logged against specifications
 - 2.9 All required components for the electro-fluid power control and system circuit are identified, sourced and supporting test data recorded and stored
3. Develop an evaluation response plan and preparation for rectification
 - 3.1 Electro-fluid power control circuit and system performance outcomes are data logged, recorded in accordance with guidelines and all variances to specification/s are identified.
 - 3.2 **Root cause analysis** of individual variances to specification are conducted using **relevant personnel**, methodologies and recorded data
 - 3.3 A recommendations strategy for rectification, recommissioning and re-evaluating the electro-fluid power control and system circuit to specification is produced by relevant personnel
4. Report findings and recommendations
 - 4.1 All revised documentation and specifications arising from the evaluation testing of the electro-fluid power production system test facility; or a simulation of the control circuit and system are recorded
 - 4.2 A final evaluation report is prepared including all findings and recommendations arising from the root cause analysis process and the outcomes against specifications
 - 4.3 Relevant personnel are briefed to support the revised control circuit and system modifications

Required Skills and Knowledge

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- Analysing electric/electronic circuits in relation to PLCs

- Identifying dangers associated with proportional and servo fluid power circuits
- Analysing system functional requirements
- Interpreting, designing, drawing and constructing suitable electric and fluid power circuit diagrams
- Utilising proportional and servo valves in fluid power circuits
- Utilising proportional valves for open and closed loop pump control
- Utilising data logging and supporting software
- Calculating PID control optimisation

Required knowledge:

- Dangers associated with fluid power circuits, especially with regard to electro fluid power control and systems
- Proportional and servo control for logic element technology applications
- Electro-proportional control hydrostatic-transmission characteristics and dynamics
- Standard symbols for fluid power circuits, including:
 - Pneumatic circuits
 - Hydraulic circuits
 - PLC circuits
- Types of proportional valves, including pressure, flow and directional-control valves
- Electronic controls, including:
 - proportional solenoids
 - position sensors - Linear variable displacement transducers (LVDT)
 - valve amplifiers – principles, features and set points
- Design considerations, such as:
 - open loop versus close loop characteristics
 - proportional and servo spool options, characteristics, valve power limits and pressure ratios
 - proportional and servo - travel function, flow function, pressure function
 - velocity erosion and proportional and servo valve filtration
 - load compensation
 - acceleration and deceleration forces
 - natural frequency of system
 - calculation of flow rate and pressure drop
 - Nyquist stability calculations
 - Natural frequency
 - Frequency response
 - Proportional and servo control systems within accumulator circuits
 - Hysteresis
 - Reversal error
 - Response sensitivity
 - Pressure compensation
 - Bode diagram – amplitude frequency relationship and phase frequency relationship
 - proportional and servo control for logic element technology applications
 - comparison pump-motor control characteristics of closed loop hydro-static transmissions
 - angular velocity and angular position
 - decompression, regeneration and pressure intensification in proportional and servo valve fluid power systems
 - thermal considerations within proportional and servo control fluid power systems
 - noise abatement and evaluation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Fluid power system refers to:

- A system that has a pump driven by a prime mover (such as an electric motor or IC engine) that converts mechanical energy into fluid energy.
- This fluid flow is used to actuate various devices, such as cylinders or motors

Time-displacement diagram means:

- The volume of fluid that is moved by a hydraulic pump in one cycle

Control logic diagram refers to:

- Diagrams that are specialized schematics commonly used to document industrial control logic systems. They are called "ladder" diagrams because they resemble a ladder, with two vertical rails (supply power) and as many "rungs" (horizontal lines) as there are control circuits to represent

Ramp time refers to:

- the time taken for a motor or a hydraulic pump to reach its maximum output

Accelerating and decelerating loads refers to:

- the change in condition encountered by both the fluid and the structural components within the fluid power circuit as a load is accelerated then decelerated

Proportional Servo valve includes:

- pressure valves
- flow valves
- directional-control valves

Dynamically tested refers to:

- the testing and evaluation process is conducted with the fluid power system under full load and operational conditions

Root cause analysis refers to:

- the standardised methodology of breaking a problem down to its smallest parts to identify the cause of a problem

Relevant personnel may include:

- Sales engineers
- Applications engineers
- Production personnel
- Service management
- Maintenance personnel
- Customers
- Technicians

Evidence Guide:

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- To be considered competent in this unit the candidate must provide evidence that they can achieve all of the elements of competency to the level specified by the associated performance criteria by using the required skills and knowledge.
- Specifically they must provide evidence that they can:
 - Identify dangers associated with electro-fluid power control circuits and systems
 - Design and calculate electro-proportional and servo valve control circuits and their supporting systems
 - Determine the dynamic functional requirements of electro-fluid power control circuits and systems
 - Safely and effectively evaluate electro-proportional and servo valve fluid power control circuits and systems against specifications
 - Incorporate proportional valves and servo valves in both open loop and closed loop fluid power systems, including hydro-static transmissions
 - Prepare and present detailed and concise technical reports
 - Be able to interpret variances in complex electro-proportional and servo valve control circuits and systems
 - Relate effectively to customer requests

Context of and specific resources for assessment

- Assessment should be conducted in a real or simulated workplace environment
- Where assessment occurs in a simulated environment the equipment, tools and processes used, should reflect the workplace as much as possible
- The resources required for assessment include:
 - Access to a real or simulated workplace environment
 - Fluid power systems specifications
 - Equipment and tools to complete the tasks

- Safe and effective workplace procedures

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - Verbal/written questions
 - Design and drawing projects
 - Calculation tests

VU21546 Monitor and adjust an integrated fluid power control system

Unit Descriptor This unit provides the knowledge and skills to enable participants to monitor instrumentation and transducers within an integrated fluid power control system involving detection, measurement and adjustment of control process variables.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the Unit This unit would be applied by those involved in monitoring and adjusting elements of an integrated fluid power process control system. It involves identifying, selecting, and adjusting a range of hardware items including instrumentation, transducers, sensors, control valves and the communication sub-system.

It is suitable for people working as fluid power technicians or system designers, draftspersons and maintenance personnel, and those pursuing careers and qualifications in engineering or related disciplines.

Pre- Requisites

VU21270	Implement control processes using PLC's
MEM23006A	Apply fluid and thermodynamics principles in engineering
VU21547	Select components for an integrated fluid power design project

Element

Elements describe the essential outcomes of a unit of competency

1. Identify the elements of a process control system

Performance Criteria

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide

- 1.1 The function of the ***process control***, monitored ***process variables*** and ***instrumentation*** are identified
- 1.2 ***Communication links*** and protocols for the workplace are identified
- 1.3 Types of ***signal*** within the control system are determined

	1.4 System infrastructure is inspected and static, and dynamic tests are completed to ensure capacity of the system to sustain calculated performance-characteristics
2. Select appropriate means of control function measurement	2.1 The accuracy of measurement is determined and the nature and range of error specified. 2.2 Closed-loop control optimisation calculations are completed to confirm control dynamics against specifications 2.3 Recommendations are prepared to optimise integrated fluid power process control system performance
3. Monitor and adjust the control process	3.1 Readings, measurements and data logging are performed to ascertain the limits of accuracy of the instrumentation and control system employed. 3.2 <i>Calculations</i> involving measured process control variables are performed to determine ~~process~~ performance. 3.3 Adjustments to hardware items are made to restore the system to be within calibration limits. 3.4 Status reports are completed and presented to relevant parties
4. Report results	4.1 Findings and recommendations are stored in the relevant project data base 4.2 Outcomes and recommendations are built into project team briefings 4.3 Existing process control project documentation, standard operating procedures (SOP's) and bill of materials (BOM's) are updated

Required Skills and Knowledge

This describes the essential skills and knowledge and their level, required for this unit

Required Skills:

- Identify process control variables, systems, topologies and multivariable systems
- Use instrumentation to detect and measure control variables
- Set up and adjust transducers, sensors and valves
- Identify and adjust on-off control, multi step and proportional integrative and derivative (PID) characteristics
- Identify and monitor communication signals (analog, digital and pneumatic), links and protocols
- Demonstrate application of correct safety and protection procedures
- Closed-loop driver card testing and replacement

Required Knowledge:

- Control variable definitions, quantities and units:
i.e.
 - Temperature
 - Pressure
 - Flow
 - Level
 - Density
- Control variable detection
- Use of instrumentation
- Control variable measurement
- Process control systems
 - Variables, systems, topologies, multivariable systems
 - Transducers, sensors, valves
 - On-off control, multi step, Proportional Integrative and Differential (PID)
 - Communication signals (analog, digital and pneumatic), links and protocols
 - Closed-loop driver card specifications, applications and installation
- Protection and Safety
 - Lightning and surge protection
 - Static damage
 - Minimisation of induced EMFs
 - Piping and instrumentation Drawings
 - IEC and ISO standards of protection
 - IEC and NEMA enclosure standards

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

<i>Process control</i> may include:	• continuous processes such as oil refining, paper manufacturing, chemical production, energy plants etc
<i>Process variables</i> may include:	• temperature, pressure, flow, chemical properties, level, density etc
<i>Instrumentation</i> may include, but is not limited to:	• instruments for measuring – temperature – pressure – flow – chemicals – level – density
<i>Communication links</i> such as:	• SAP • SCADA • Ethernet/IP • Distributive Control Systems • Wireless • PLC's • GPS

- CANBUS

Signal may include:

- pneumatic
- digital
- analog

Calculations may include:

- unit conversion
- integrated system harmonics
- calculation of (not inclusive)
 - ppm
 - Reynolds number
 - pressure elevation and suppression
 - relative gas density
 - energy conservation and efficiencies
 - loop dynamics (open versus closed) etc

Evidence Guide:

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- To be considered competent in this unit the candidate must provide evidence that they can achieve all of the elements of competency to the level specified by the associated performance criteria by using the required skills and knowledge
- Specifically they must provide evidence that they can:
 - Identify dangers and hazards associated with making measurements and adjustments to process control system variables
 - Select and apply an integrated fluid power closed-loop process control system to project specifications
 - Calculate an integrated fluid power process control systems dynamic performance profile against project specifications
 - Complete a data logging profile for an integrated fluid power process control system
 - Identify control variables
 - Select and use correct instrumentation
 - Set up and adjust control system hardware

Context of and specific resources for assessment

- Assessment should be conducted in a real or simulated workplace environment
- Where assessment occurs in a simulated environment the equipment, tools and processes used should reflect the workplace, as much as possible
- The resources required for assessment include access to:
 - a real or simulated workplace environment
 - instrumentation and control test specifications
 - equipment, tools, data loggers and software to complete the tasks in accordance with project specifications
 - safe and effective workplace procedures

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - Verbal/written questions
 - Use of instrumentation, data loggers, PLC's etc
 - Monitoring and adjusting transducers, sensors and valves
 - Calculations involving measured variables

VU21547 Select components for an integrated fluid power design project

Unit Descriptor This unit provides the knowledge and skills to enable participants to correctly select components for the design, modification and performance improvement of integrated fluid power systems. The unit requires the calculations, the sizing and the selection of components to meet design specifications. The components must be compatible with the integrated control system selected.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains Employability Skills.

Prerequisites MEM23006A Apply fluid and thermodynamic principles in engineering
VU21546 Monitor and adjust an integrated fluid power control system

Application of the Unit This unit would be applied by those involved in designing and modifying integrated fluid power systems. It involves the application of both system design and reverse engineering concepts.
It is suitable for people working as fluid power technicians or system designers, draftspersons, maintenance personnel and those pursuing careers and qualifications in engineering or related disciplines.

Element

Elements describe the essential outcomes of a unit of competency

Performance Criteria

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement.³ Assessment of performance is to be consistent with the evidence guide

1. Select hydraulic and pneumatic components	1.1 Suitable hydraulic and pneumatic components are chosen from manufacturer's catalogues using <i>relevant data</i> 1.2 The selection of the hydraulic and pneumatic components is verified to meet the system specifications and requirements 1.3 Components are selected in accordance with <i>specific criteria</i>
2. Address servo valve or proportional valve applications in the system	2.1 The <i>parameters</i> for the proportional and servo valves in the system are calculated 2.2 Servo and proportional valves are chosen from manufacturer's catalogues based on data sheets, performance curves and part number sheets 2.3 The selection of servo and proportional valve is verified to meet the system specifications and requirements

3. Determine the heat losses in the hydraulic system	3.1 The <i>heat load</i> in the hydraulic system is calculated 3.2 Methods for handling the heat load are investigated 3.3 Changes are made to the hydraulic system, as required, to reduce the heat load and to optimise energy conservation 3.4 The calculation of heat exchanger capacity, heat exchanger type and model, and its location within the circuit is specified 3.5 Environmental and system requirements that affect filtration selection are identified 3.6 The location and type of reservoir necessary to meet the system requirements are confirmed and documented 3.7 The needs of the reservoir and its related components are calculated and selected based on the system specifications
4. Determine the variables affecting pressure drops	4.1 A <i>range of data</i> is used to determine the variables affecting pressure drops in valves, lines and fittings 4.2 Suitable line velocities are selected on the basis of mitigating the effects of the pressure drop variables 4.3 Line sizes are calculated for all actuators on the basis of line velocity, fluid type and densities, taking into account both the pump and return flows
5. Confirm that the system reliability meets specification	5.1 System reliability is calculated based on manufacturer's information, system application and environmental variables 5.2 Recommendations are prepare to enable system reliability to meet design specifications 5.3 The system is modified, as required, to ensure that the reliability factor is met
6. Optimise the system to improve performance and/or reduce costs	6.1 System problems are identified where the design is cumbersome, expensive, inefficient and potentially unreliable 6.2 The system is improved by changing the design characteristics, if required 6.3 The optimum design is documented in accordance with enterprise/client requirements and industry best practice

Required Skills and Knowledge

This describes the essential skills and knowledge and their level, required for this unit

Required Skills:

- Writing specifications for fluid power systems
- Calculating various parameters from the system specifications
- Reading circuit diagrams and manufacturer's catalogues
- Analysing relevant data in order to make an appropriate selection of components
- Optimising the fluid power system
- Problem solving, in terms of modifying system design to reduce heat loads etc.
- Selecting suitable components for optimising the system performance
- Maintaining good customer relations

Required Knowledge:

- Relevant Occupational Health and Safety requirements
- Specifications for fluid power systems
- Calculations associated with the various parameters of a fluid power system
- Design philosophy
- Optimisation techniques for integrated fluid power systems
- Bernoulli's formula
- Moody diagram
- Energy conservation
- Proportional Integrative and Differential Servo/Proportional valve calculations
- All Gas Law's

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Relevant data may include:

- Data sheets
- Performance curves
- Nomographs
- Pressure drop curves
- Flow rate curves
- Part number sheets

Specific criteria includes:

- Client system performance specifications
- Specified system control parameters
- Application based environmental factors

Parameters may include:

- Natural frequency
- Response time
- Accuracy
- Loop gain

Heat load refers to:

- Heating of hydraulic fluid operation is caused by inefficiencies.
- Inefficiencies result in losses of input power, which are converted to heat.

- If the total input power lost to heat is greater than the heat dissipated, the hydraulic system will eventually overheat

Range of data may refer to:

- Bernoulli's formula
- Moody diagram
- Pressure drop formula
- Line velocities
- Line sizes
- Pump flows

Evidence Guide:

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- To be considered competent in this unit the candidate must provide evidence that they can achieve all of the elements of competency to the level specified by the associated performance criteria by using the required skills and knowledge.
- Specifically they must provide evidence that they can:
 - Write specifications for fluid power systems
 - Perform calculations of servo and proportional valve parameters from the specifications
 - Minimise heat load problems in hydraulic systems
 - Calculate pressure drops and flow rates in fluid power systems
 - Select appropriate components for the fluid power system using manufacturer's catalogues
 - Optimise the fluid power system performance

Context of and specific resources for assessment

- Assessment should be conducted in a real or simulated workplace environment
- Where assessment occurs in a simulated environment the equipment, tools and processes used should reflect the workplace, as much as possible
- The resources required for assessment include:
 - Access to a real or simulated workplace environment
 - Fluid power system specifications
 - Equipment and tools to complete the tasks
 - Safe and effective workplace procedures

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - Verbal/written questions
 - Design and drawing projects
 - Calculation tests

VU21548 Install and commission an integrated fluid power system

Unit Descriptor	This unit of competency sets out the knowledge and skills required to install and commission integrated fluid power systems. This includes working safely; applying knowledge and interpreting technical data to perform installation, commissioning, optimisation, testing, and repair/replacement of integrated fluid power systems and/or sub assembly-systems. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.
Employability Skills	This unit contains Employability Skills.
Application of the Unit	The unit would be applied to those involved in agricultural/ forestry/civil/mechanical engineering, mining and extractive industries, manufacturing or processing environments. This equipment requires installation, commissioning and optimisation, maintenance, testing and/or replacement within integrated fluid power systems. It is suitable for people working as fluid power technicians or system designers, draftspersons and maintenance personnel, and those pursuing careers and qualifications in engineering or related disciplines.
Pre-Requisites	VU21270VIC Implement control processes using PLC's MEM23006A Apply fluid and thermodynamics principles in engineering VU21547 Select components for an integrated fluid power design project

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Prepare to install and commission an integrated fluid power system.	1.1 <i>OH&S requirements and environmental requirements</i> for a given work area are obtained and understood. 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation for the work area. 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with <i>appropriate personnel</i>.

	1.4	The requirements for installation, commissioning or replacement, are determined from relevant data .
	1.5	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site.
	1.6	Tools, equipment , data logging instruments, needed to install, commission and/or replace fluid power components and sub assembly-systems are obtained in accordance with enterprise procedures .
	1.7	All tools, equipment, data logging instruments are checked for correct operation and safety prior to use.
	1.8	Integrated fluid power systems, sub assembly-systems and components are identified, confirmed against project documentation and BOM's and installed.
2	Install commission and optimise fluid power systems.	2.1 OH&S requirements for carrying out the work are followed.
	2.2	Circuits/machines/plant is checked as being isolated where necessary in strict accordance with OH&S requirements and enterprise procedures.
	2.3	Installation, commissioning, or component replacement is performed to meet pre-determined criteria and design specifications
	2.4	Data logging and supporting test equipment are installed to enable the integrated fluid power system to be pre-commissioned and initialised for commissioning.
	2.5	Optimisation methods are applied to integrated fluid power installations using data logging and the measurement of operating parameters; referring to the system operational design specifications.
	2.6	Decisions for dealing with unexpected situations are made with reference to appropriate personnel, project specifications and performance requirements.
	2.7	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
	2.8	Fluid power system and component installation/commissioning and optimising/testing/ replacement activities are carried out efficiently without unnecessary waste.
3	Complete and report installation and maintenance of fluid power system.	3.1 OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with established safety procedures and returned to normal operating conditions.
	3.3	Fluid power system maintenance/testing/replacement is documented in accordance with enterprise procedures ..

- 3.4 Appropriate personnel are notified, in accordance with enterprise procedures, that the fluid power system installation/maintenance/testing/replacement is complete.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- reading specification statements, diagrams and information
- determining and estimating operating parameters
- using tools, equipment and testing devices
- selection and application of data logging equipment and related software: as examples – pressure, flow, velocity, temperature, vibration, noise and viscosity
- making measurements on operational and non-operational components to determine if replacement is required
- applying logical inspection and testing methods
- selecting appropriate replacement components
- performing fluid power component/system replacement and restoring system to operational standard
- carrying out installation/maintenance/testing/replacement
- constructing control circuits from diagrams
- locating and correcting faults without damage or loss of system integrity
- establishing and maintaining a safe work environment
- communicating technical requirement to others
- working with others
- client liaison
- adapting to changes in work
- control system integration options and their application

Required knowledge:

- hydraulic and pneumatic laws and principles
- safe and effective commissioning and optimisation procedures
- integrated fluid power system component relationships and functionalities
- operation and application of hydraulic, pneumatic and electro components and systems
- interpretation of manufacturers equipment specifications
- integrated fluid power circuits
- analog and digital control
- closed-loop control theory and practices
- instrumentation methods
- report writing and presentation techniques
- component parts catalogue interpretation
- product/component performance specification and graphs interpretation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment

depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts

OH&S requirements include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Relevant data may include:

- reports
- data logging findings
- relevant documentation
- discussion with appropriate personnel

Equipment may include:

- hand and power tools
- test equipment and instruments
- data logging equipment and related software
- electrical/electronic variable speed drives and controllers
- logic elements sub-assembly's
- fluid power system diagnostic tools
- removal/installation tools and equipment
- equipment manuals and documentation
- hydraulic, pneumatic and electro components, circuits and systems
- consumables
- PLC's, SCADA and Distributive Control Systems (DCS)
- proportional element control
- integral element control
- derivative element control

Enterprise procedures may include:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures
- project management capabilities

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- To be considered competent in this unit the candidate must provide evidence that they can achieve all of the elements of competency to the level specified by the associated performance criteria by using the required skills and knowledge.
- Specifically they must provide evidence that they can:
 - Identify dangers and hazards associated with electro-fluid power systems
 - Apply risk assessment and risk mitigation tools for the installation and commissioning of electro-fluid power systems
 - Interpret specifications and bill of materials (BOM's)
 - Install and replace hydraulic, pneumatic and electro components in accordance with specifications and set guidelines
 - Operate and commission an integrated fluid power system control circuit
 - Establish procedures to install and commission both open-loop and closed-loop integrated fluid power systems
 - Apply problem solving and fault identification strategies during the installation and commissioning task
 - Select and apply data-logging equipment and related software in accordance with specifications, set guidelines and safe work practices
 - Document and report installation and commissioning task outcomes against specifications and set guidelines
 - Effectively inform all relevant personnel of installation and commissioning outcomes
 - Manage installation and commissioning site environmental practices to recognised site and industry standards

- Restore the system and work site to operational standard

Context of and specific resources for assessment

- Assessment should be conducted in a real or simulated workplace environment
- Where assessment occurs in a simulated environment the equipment, tools and processes used should reflect the workplace, as much as possible
- The resources required for assessment include:
 - Access to a real or simulated workplace environment
 - Electro-fluid power circuits and specifications
 - Equipment and tools to complete the tasks
 - Safe and effective workplace procedures

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - Verbal/written questions
 - Use of tools, equipment and testing procedures
 - Selection and replacement of components
 - System and site restoration

VU21549 Conduct a feasibility study for an integrated fluid power system

Unit Descriptor	This unit provides the knowledge and skills to enable participants to produce a feasibility study for an integrated fluid power system using a combination of hydraulic, pneumatic and PLC/electrical/electronic principles and system design concepts. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.		
Employability Skills	This unit contains Employability Skills.		
Prerequisites	VU21546	Monitor and adjust an integrated fluid power control system	
	VU21547	Select components for an integrated fluid power design project	
	VU21548	Install and commission an integrated fluid power system	
	VU21270	Implement control processes using PLCs	
	MEM23006A	Apply fluid and thermodynamics principles in engineering	
Application of the Unit	This unit would be applied by those involved in investigating the feasibility of an integrated fluid power system for a particular application. It involves the application of system design concepts. It is suitable for fluid power system and automation designers and maintenance personnel, and those advancing engineering or related qualifications and careers.		
Element	Performance Criteria		
<i>Elements describe the essential outcomes of a unit of competency</i>	<i>Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide</i>		
1. Develop a specification for an integrated fluid power system	1.1	<i>Customer requirements</i> are determined and considered when designing the integrated fluid power system.	
	1.2	The mechanical variables which must be considered in the design are identified	
	1.3	The actuator forces and torques are calculated over the whole speed range from the customer specification, taking into account the <i>variables</i>	
	1.4	The plant specifications are documented in accordance with established procedures	

	1.5	The details of the final product affecting the system design are confirmed with customer requirements
2. Select the design parameters to suit the customer requirements	2.1	Integrated fluid power catalogues are referred to, to select component and sub-assembly options the quality of components required for the integrated fluid power system
	2.2	Working pressures are determined in relation to specified system dynamics to enable the design to meet the reliability and life requirements and cost related factors of the system
3. Determine the actuators required, based on the system specification and design parameters	3.1	The <i>actuators</i> sizes are calculated using forces or torques and working pressures
	3.2	Actuators are selected where there is high speed, low force/low torque or low speed, high force/high torque during the cycle
	3.3	The actuators are selected using standard sizes from manufacturer's catalogues
	3.4	The maximum working pressure is re-calculated for each actuator selected
	3.5	Flow rates are calculated based on actuator sizes and speeds
	3.6	The power required to supply the flows and pressures for the system is calculated to meet the specified cycle time
4. Determine the type of system that best suits the pressures and flows of the design	4.1	Flows, power levels, size of components and circuit requirements are compared using different design methods
	4.2	The most suitable design method is selected to meet the system requirements
5. Optimise the system to reduce flows, pressures and power	5.1	Pressure, flows, energy conservation and energy consumption are calculated for different cycle times and methods of operation
	5.2	Changes are made to the design parameters, cycle times or methods of operation, as required
	5.3	The most suitable parameters are selected to optimise the system design
6. Determine the control requirements for the system	6.1	The preliminary operational parameters determining the control requirements for the system are identified
	6.2	The <i>control circuit</i> needs are confirmed in accordance with the structural requirements, performance design characteristics and environmental factors for the system
	6.3	The <i>control circuit</i> inputs and outputs required for the system are identified, concept tested and confirmed
	6.4	An input/output chart is drawn to confirm the system's functionality

- 6.5 Logic statements are written that will allow the *control circuit* programme to be documented
7. Summarise the system design
- 7.1 Step/time and flow/time diagrams are produced and confirmed for the system against specifications
- 7.2 All *calculations* are documented in accordance with established procedures
- 7.3 A component list is established in the project data base and a supporting bill of materials (BOMs) is prepared.
- 7.4 The feasibility of the design in meeting the specification and design parameters is confirmed against customer requirements
- 7.5 A feasibility report is prepared and submitted to the customer

Required Skills and Knowledge

This describes the essential skills and knowledge and their level, required for this unit

Required Skills:

- Writing specifications for integrated fluid power systems
- Determining customer requirements for integrated fluid power systems
- Calculating various parameters from the system specifications
- Identifying risks associated with the integrated fluid power system
- Selecting design parameters and systems to suit the user
- Charting summaries of calculations for the integrated fluid power system
- Optimising the integrated fluid power system
- Determining control requirements for the integrated fluid power system
- Documenting the integrated fluid power system design

Required Knowledge:

- Relevant Occupational Health and Safety requirements
- Specifications for integrated fluid power systems
- Dangers associated with integrated fluid power systems
- Instrumentation, control and data logging support equipment
- Calculations associated with the mechanical parameters of a integrated fluid power system
- Design philosophy
- Closed Loop control principles
- Comparison methods such as:
 - High-low
 - Regenerative
 - Accumulator
 - Single pump
 - Multi pump
 - Kicker cylinder
- Optimising techniques for integrated fluid power systems
- Control requirements for integrated fluid power system
- Instrumentation, control and data logging support equipment

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Customer requirements may include:

- Cost
- Life of the machine
- Safety
- Type of control
- Proposed location of the system
- On line system reliability
- Design for maintainability

Variables may include:

- Acceleration
- Deceleration
- Proportional element control
- Integral element control
- Derivative element control
- Open-loop versus closed-loop control parameters
- Energy conservation and waste minimisation
- Components of forces
- Moments of forces
- Ratios and efficiencies of mechanical drives

Actuators refers to:

- Linear actuators (cylinders)
- Rotary actuators (motors)
- Semi rotary actuators

Control Circuit refers to:

- Programmable logic controller (PLC)
- SAP
- SCADA
- Ethernet/IP
- Distributive Control Systems
- Wireless
- GPS
- CANBUS

Calculations may involve:

- Forces
- Times
- Strokes
- Pressures
- Flow rates
- Actuator sizes

Evidence Guide:

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- To be considered competent in this unit the candidate must provide evidence that they can achieve all of the elements of competency to the level specified by the associated performance criteria by using the required skills and knowledge.
- Specifically they must provide evidence that they can:
 - Determine the customer requirements for a integrated fluid power system
 - Apply a philosophy of integrated fluid power system design that meets customer, industry standards, environmental and efficiency guidelines
 - Justify feasibility study design recommendations
 - Write specifications for the integrated fluid power system
 - Perform calculations of all machine parameters from the specifications
 - Select appropriate components for the integrated fluid power system from manufacturer's catalogues
 - Optimise the integrated fluid power system output
 - Liaise with relevant industry personnel and customers
 - Produce a feasibility study in accordance with client specifications and recognised industry best practice

Context of and specific resources for assessment

- Assessment should be conducted in a real or simulated workplace environment
- Where assessment occurs in a simulated environment the equipment, tools and processes used should reflect the workplace, as much as possible
- The resources required for assessment include:
 - Access to a real or simulated workplace environment
 - Integrated fluid power system specifications
 - Equipment and tools to complete the tasks
 - Safe and effective workplace procedures

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - Verbal/written questions
 - Design and drawing projects
 - Calculation tests

VU21270 Implement control processes using PLCs

Unit Descriptor

This unit of competency sets out the knowledge and skills required to program Programmable Logic Controllers (PLCs) within an industrial setting.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit applies to engineering manufacturing enterprises that use PLCs to control manufacturing processes.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Plan PLC application

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and understood
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
- 1.3 PLC application is determined from documentation, job sheets or discussions with **appropriate personnel**.
- 1.4 Measurements and data required are identified and appropriate control system components selected.
- 1.5 **Resources and equipment** needed for the task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.
- 1.6 Implementation of the control system is analysed and optimum approach selected, planned for and checked against requirements
- 1.7 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site.

2. Design PLC program outline

- 2.1 OH&S requirements for carrying out the work are followed.

	2.2	Ladder control circuits or logical flow of the application are drawn, if required.
	2.3	Ladder control circuits are converted to ladder logic, if required.
3. Program PLC for the application	3.1	OH&S requirements for carrying out the work are followed.
	3.2	PLC is programmed according to manufacturers' specifications and job requirements.
	3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	3.4	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
4. Test and document PLC program	4.1	OH&S requirements for completing the work are followed.
	4.2	The PLC program is function tested and its operation verified.
	4.3	Equipment and machinery is checked as being isolated where necessary during testing process.
	4.4	Work site is made safe in accordance with established safety procedures.
	4.5	PLC program and function test is documented according to enterprise procedures.
	4.6	Work completion is notified to appropriate personnel according to enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Identify and follow relevant OH&S procedures
- Produce logic flow diagram
- Write, test and debug PLC program code
- Modify program online
- Locate hardware and software faults
- Document program

Required Knowledge:

- Programmable Controller
 - input rack

- output rack
 - central Processor Unit (CPU)
 - power supply
 - special units (e.g. motor control, A/D, D/A)
 - programmer
- Control Logic
 - relay logic circuit (revision)
 - series circuits
 - parallel circuits
 - combination of series and parallel
 - interlocking
 - programmable logic
 - ON state instruction
 - series equivalent circuits
 - parallel equivalent circuits
 - combination series/parallel
 - OFF state instruction
 - control relay logic conversion
 - relay to logic programmable logic
 - programmable logic to relay logic
- Fail safe
 - identifying need for fail safe
 - programming fail safe
 - hardware fail safe
- Program editors
 - grafcet
 - statement list
 - ladder
 - graphical
- Memory devices
 - terminology (RAM, ROM, EPROM, etc.)
 - volatile, non-volatile, static
 - dynamic
 - I/O image registers
 - applications program
 - scratchpad area
 - timer/counter preset/acc registers
 - data tables
- Advanced logic concepts
 - word logic operations
 - merge (word AND)
 - mask (word OR)

- complement (word complement)
- Counters & timers
 - timing diagrams
 - edge sensitive (leading and trailing)
 - level sensitive
 - interpreting timing diagrams
 - software timing functions
 - delay on timer (DOE)
 - delay off timer (DDE)
 - interval timer
 - time related software functions
 - one shot
 - time base generators
 - time clock
- Advanced control instructions
 - general operations
 - master control function
 - subroutine function
 - input differentiation function
 - temporary relay function
 - bistable control function
 - sequencer control function
 - drum controller function
 - conditional branch function
 - labels and rung comments
 - math operations
 - addition, subtraction, division, multiplication, square, compare
 - conversions BIN to BCD to BIN
 - matrix, arithmetic shift left and right
 - block operations
 - block – move, compare, set, reset
 - word transfer
 - bit operations
 - carry – set, reset
 - shift left and right
 - rotate left and right
- Hardware fault location
 - importance of documentation
 - field I/O devices and wiring
 - CPU diagnostic indicators
 - I/O module cards and status indicators
 - watch dog timer

- Software fault location and rectification
 - programming console as diagnostic tool
 - override/force functions (safety considerations)
 - diagnostic/error code registers

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include, but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Resources and equipment may include, but are not limited to:

- computer software
- software reference documentation
- internet access
- network access
- relevant standards
- suitable computer work station
- PLCs
- variety of input devices
- variety of output devices
- printer
- PLC interface units
-

Enterprise procedures may include, but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to successfully program PLCs within an industrial setting on more than one occasion and in different contexts.
 - Test and document PLC programs

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21339 Set up and commission programmable logic controllers

Unit Descriptor

This unit of competency sets out the knowledge and skills required to set up and commission programmable logic controllers. This includes selecting PLCs suitable for a given control application, determining interfacing requirements, performing installation and/or maintenance tasks, and setting up, testing and making adjustments as per specifications.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills,

Application of the Unit

The unit applies to enterprises where programmable logic controllers are used in integrated control processes in support of manufacturing or process control operations.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- Prepare for set up and commissioning of programmable logic controllers.

- 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 System requirements for programmable logic controllers are analysed from documentation, job brief or discussions with appropriate personnel.
- 1.6 **Equipment**, resources, and testing devices needed to carry out the task are obtained and checked for correct operation and safety.
- 1.7 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.

2

- 2.1 OH&S requirements for carrying out the work are followed.

Set up and commission programmable logic controllers.	2.2	Programmable logic controllers are installed according to manufacturers' specifications and enterprise procedures , if required.
	2.3	Programmable logic controllers are set up, programmed and adjusted according to specifications.
	2.4	Appropriate methods and tools are used to test and verify programmable logic controllers operations.
	2.5	Any faults and anomalies are identified and rectified.
	2.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3 Document set up and commissioning.	3.1	OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with established safety procedures.
	3.3	Set up and commissioning task is documented in accordance with enterprise procedures.
	3.4	Appropriate personnel are notified, in accordance with enterprise procedures, that the task has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- reading specification statements, diagrams, programs and information
- installing, connecting and testing programmable logic controllers
- using test equipment effectively
- adjusting PLC programs to specifications
- troubleshooting faulty programmable logic controllers
- producing appropriate documentation
- communicating technical requirement to others
- working with others
- adapt to changes in work.

Required knowledge:

- measurement and monitoring principles
- types of programmable logic controllers
- PLC program modification and downloading
- programmable logic controllers interface requirements

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel for example:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- hand and power tools
- test equipment and instruments
- equipment manuals and documents
- mechanical/electrical control devices/systems
- programmable logic controllers
- consumables

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets, programs, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to:
 - Install, program and adjust PLCs
 - test and commission programmable logic controllers. This must include a variety of PLCs operating on different mechanical/electrical systems.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment should include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21087 Write programs for programmable logic controllers

Unit Descriptor

This unit of competency sets out the knowledge and skills required to write, test and modify programs for programmable logic controllers (PLCs). This includes working safely, applying knowledge of control systems, program control functions, develop and test control programs using a range of programming language approaches developed for PLCs.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills,

Application of the Unit

The unit applies to engineering environments where programmable logic controllers are used for automating processes in manufacturing, process control, building services, laboratories etc.

This unit of competency is intended for courses at Certificate IV levels or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1 Prepare to develop a PLC program.

- 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 Control program and input/output interfacing requirements are determined from job specifications of the process/plant/machine to be controlled, and through consultation with appropriate personnel.
- 1.5 **Equipment**, software and testing devices needed to carry out the work are obtained and checked for correct operation and safety.
- 1.6 Installation of programmable controller is checked for compliance safety requirements and job specification.

2	Develop, write and test control program	2.1 OH&S requirements for carrying out the work are followed.
		2.2 Circuits/machines/plant are checked as being isolated where necessary in accordance OH&S requirements and procedures.
		2.3 Control solutions are developed and documented based on the specified control mode and using acceptable methods for designing control systems.
		2.4 Developed control system is converted to an appropriate form, such as flow, state and ladder diagrams, using a person computer and software applicable to the programmable controller into which the program is to be entered.
		2.5 Program is entered into the programmable control using a personal computer and appropriate software.
		2.6 Entered instructions and settings are tested as meeting those specified in by the control system scenario.
		2.7 Appropriate methods and tools are used to test control systems and operating faults and anomalies are identified and rectified.
		2.8 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3	Finalize control program	3.1 OH&S requirements for completing the work are followed.
		3.2 Program is transferred from a programmable controller to an external medium for storage.
		3.3 Control system specification and program are documented in accordance with enterprise procedures .
		3.4 Work completion is reported and appropriate personnel notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- reading specification statements, diagrams and information
- interpreting project briefs to develop programs for control applications
- writing, testing, monitoring and debugging PLC programs
- saving and retrieving program code/data using external storage
- using a development environment efficiently
- setting up and checking hardware operations
- producing appropriate documentation for control programs
- communicating technical requirement to others;
- working with others;
- adapting to changes in work.

Required knowledge:

- PLC programming methods
 - ladder diagram
 - sequential function chart
 - structure language programming
- program control structures
- program structures
- I/O programming
- diagnostic indicators
- documentation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements for example:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel such as:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- personal computer station, preferably networked
- PLCs
- PLC programming and auxiliary software
- interfacing hardware

- transducers and actuators
- hand tools
- consumables

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.
- In particular this will incorporate evidence that shows a candidate is able to demonstrate writing programs for PLCs on more than one occasion and in different contexts. The demonstration of competence must show:
 - writing programs using a wide range of programming features for a given PLC;
 - I/O programming;
 - use of internal flags, counters and timers;
 - complex program structures using nested subroutines;
 - a program design that has a high degree of maintainability.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation

must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment should include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21086 Develop, enter and verify programs in SCADA systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to develop, install and test programs for supervisory control and data acquisition. This includes working safely, process analysis, developing database of process conditions, developing Human-Machine Interface (HMI), using dedicated SCADA software packages and documenting programs.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills,

Application of the Unit

The unit applies in enterprises that use automated control, processes through acquisition and analysis of process data, and adjustment of process variables for controlling plant and associated facilities.

This unit of competency is intended for courses at AQF 4 level or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

- 1 Prepare to develop programs for supervisory control and data acquisition systems.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 ***OH&S requirements*** and ***environmental requirements*** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
- 1.4 The extent of the SCADA system is determined from design brief and process specifications.
- 1.5 Process data are analysed for development of graphical design/mimic diagrams.
- 1.6 PLC analogue and digitised addresses are related to tag database.
- 1.7 Tag data types are configured in the database.
- 1.8 Graphic objects are created and added to a graphic library.
- 1.9 ***Equipment***, software and testing devices needed to carry out the work are obtained and checked for correct operation and safety.

2	Develop and enter programs using dedicated supervisory control and data acquisition software.	2.1 OH&S requirements for carrying out the work are followed. 2.2 SCADA software is used to develop human-machine interface (HMI) of processes. 2.3 Control functions, data acquisition components and automated tasks are programmed using SCADA software. 2.4 Complex data is manipulated using the SCADA software. 2.5 Alarms and limits for process variables are identified and programmed accordingly. 2.6 Trends for process variables and limits are programmed accordingly. 2.7 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3	- Monitor, verify and document programming activities	3.1 OH&S requirements for completing the work are followed. 3.2 Device operation is tested in strict accordance OH&S requirements and enterprise procedures . 3.3 Entered objects and settings are tested as meeting those specified in the design brief. 3.4 SCADA software tools are used to test and monitor programs and operating faults, anomalies are identified and rectified. 3.5 SCADA system specification and program are documented in accordance with enterprise procedures. 3.6 Work completion is reported and appropriate personnel notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

Required skills:

- reading specification statements, diagrams and information
- interpreting project briefs to develop SCADA system for given application
- configuring tag type data
- creating graphic objects
- adding graphic objects to a library
- developing a HMI for an application
- incorporating alarms, trends and limits for process variables
- rectifying operating faults and anomalies
- communicating technical requirement to others;
- working with others;
- adapt to changes in work.

Required knowledge:

- SCADA system networking

- minics and animated graphics
- trending
- alarm logging
- recipes and scheduling
- data collection and basing
- SCADA software packages
- application of SCADA
- networking SCADA systems
- Human – Machine interface

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel such as:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- a SCADA system consisting of master terminal unit, remote terminal units, communications equipment and SCADA software
- printer(s);

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication

- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - demonstrate essential knowledge and skills as described in this unit;
 - demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment;
 - demonstrate developing, entering and verifying SCADA system more than one occasion and in different contexts.
 - The demonstration of competence must show:
 - collecting and analysing data correctly;
 - converting data to an appropriate database;
 - creating graphic objects and adding them to the library;
 - developing an effective HMI;
 - programming SCADA functions and data acquisition components correctly;
 - correcting programming faults and anomalies;
 - documenting SCADA systems.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team.
- The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment should include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21572 Install and maintain induction motors

Unit Descriptor

This unit of competency sets out the knowledge and skills required to install and maintain induction motors. This includes working safely; applying knowledge and interpreting technical data to perform maintenance, testing, installation and replacement of single phase and 3 phase induction motors.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills,

Application of the Unit

The unit applies to engineering, manufacturing or processing environments where induction motors are used and where this equipment requires installation, maintenance, testing and/or replacement.

This unit of competency is intended for courses at Certificate IV or higher.

It is recommended that participants have knowledge of single and 3 phase AC supply systems prior to commencement of this unit.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

- 1 Prepare to install and maintain induction motors.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 ***OH&S requirements*** and ***environmental requirements*** for a given work area are obtained and understood.
- 1.2 Established ***OH&S requirements*** and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
- 1.4 The need for installation, maintenance or replacement is determined from reports and other documentation and from discussion with appropriate personnel.
- 1.5 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site.

	1.6	Tools, equipment and testing devices needed to install, maintain or replace induction motors are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2	Install and maintain induction motors.	2.1 OH&S requirements for carrying out the work are followed. 2.2 The need to test or measure live is determined in strict accordance with OH&S requirements and when necessary conducted within established safety procedures. 2.3 Circuits/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements and enterprise procedures. 2.4 Maintenance methods are applied to induction motor installations employing tests and measurements of operating parameters referenced to system operational requirements. 2.5 Installation or replacement is performed to meet determined motor performance criteria. 2.6 The requirement for installation or replacement is identified and appropriately competent persons are engaged to perform the installation or replacement where it is outside the scope of the motor system. 2.7 Induction motor protection systems are identified and installed. 2.8 Installed motor is tested to verify operation is as intended and system is restored to specified requirements. 2.9 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and job specifications and requirements. 2.10 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes. 2.11 Motor installation/maintenance/testing/replacement activities are carried out efficiently without unnecessary waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3	Complete and report installation and maintenance of induction motors.	3.1 OH&S requirements for completing the work are followed. 3.2 Work site is made safe in accordance with established safety procedures. 3.3 Motor installation/maintenance/testing/replacement is documented in accordance with enterprise procedures.

- 3.4 Appropriate personnel are notified, in accordance with enterprise procedures, that the motor installation/maintenance/testing/replacement is complete.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- reading specification statements, diagrams and information
- determining and estimating operating parameters
- using tools, equipment and testing devices
- making measurements on operational and non-operational components to determine if replacement is required
- applying logical inspection and testing methods
- performing motor replacement and restoring system to operational standard
- carrying out installation/maintenance/testing/replacement without damage or loss of system integrity
- establishing and maintaining a safe work environment
- communicating technical requirement to others
- working with others
- adapting to changes in work.

Required knowledge:

- construction of single phase and polyphase induction motors
- operating principles of single phase and polyphase induction motors
- speed-torque relationships in induction motors
- induction motor performance testing
- induction motor starters
- reduced voltage starting
- speed control of induction motors
- braking of induction motors
- motor protection
- motor selection
- induction motor maintenance/repair

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts

OH&S requirements for example:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust

- excessive energy and water use
- excessive noise

Appropriate personnel may include, but is not limited to:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- hand and power tools
- test equipment and instruments
- induction motor system diagnostic tools
- removal/installation tools and equipment
- equipment manuals and documentation
- single phase induction motor systems
- 3 phase induction motor systems
- consumables

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - demonstrate essential knowledge and skills as described in this unit;
 - demonstrate a representative body of performance criteria within a timeframe typically expected of the

discipline, work function and industrial environment;

- demonstrate the application of induction motor installation or induction motor maintenance methods on more than one occasion and in different contexts;
- The demonstration of competence must show:
 - logical inspection/testing methods
 - system restoration procedures
 - documentation of installation/maintenance.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment should include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21550 Evaluate performance of electrical machines

Unit Descriptor This unit of competency sets out the knowledge and skills required to evaluate the performance of electrical machines across their load range. This includes working safely, setting up and conducting evaluation measurements, evaluating performance from measured parameters and documenting results and recommending any resulting corrective actions.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains employability skills,

Application of the Unit The unit applies to engineering, manufacturing or processing environments where electrical machines are used and where this equipment requires performance evaluation

It is recommended that participants have knowledge of the principles of operation of AC and DC machines prior to commencement of this unit.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

1 Prepare to evaluate electrical machines.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 ***OH&S requirements*** and ***environmental requirements*** for a given work area are obtained and understood.
- 1.2 Established *OH&S requirements* and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
- 1.4 The need for machine evaluation is determined from reports and other documentation and from discussion with appropriate personnel.
- 1.5 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site.
- 1.6 Tools, ***equipment*** and testing devices needed to evaluate the performance of electrical machines are obtained in accordance with ***enterprise procedures*** and checked for correct operation and safety.

2	Evaluate electrical machines.	2.1	OH&S requirements for carrying out the work are followed.
		2.2	The need to test or measure live is determined in strict accordance with OH&S requirements and when necessary conducted within established safety procedures.
		2.3	Circuits/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements and enterprise procedures.
		2.4	Machine examination and tests are set up in accordance with established test methods and procedures for each particular parameter under scrutiny.
		2.5	Machine protection systems are identified and evaluated.
		2.6	Machine inspection and tests are carried out methodically with results and comments systematically noted.
		2.8	The system is restored to specified requirements after evaluation.
		2.9	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and job specifications and requirements.
		2.10	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
		2.11	Machine evaluation and tests are carried out efficiently without unnecessary waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3	Complete work, document evaluation and make recommendations.	3.1	OH&S requirements for completing the work are followed.
		3.2	Work site is made safe in accordance with established safety procedures.
		3.3	Machine evaluation and tests are documented in accordance with enterprise procedures.
		3.4	Appropriate personnel are notified, in accordance with enterprise procedures, that the performance evaluation is complete.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- reading specification statements, diagrams and information
- using tools, equipment and testing devices
- testing the physical, electrical and mechanical condition of machine components, attachments and ancillaries.
- interpreting vibration analysis information

- determining the operating efficiency
- inspecting and testing wiring systems and electrical protection systems
- verifying the operation of machine cooling components and systems
- providing advice on machine condition and possible need for repair or replacement
- restoring system to operational standard after evaluation
- carrying out machine evaluation without damage or loss of system integrity
- establishing and maintaining a safe work environment
- communicating technical requirement to others
- working with others
- adapting to changes in work.

Required knowledge:

- operating principles of electrical motors and generators
- construction of electrical machines
- machine parameters and performance requirements
- how to read and apply standards
- machine safety and efficiency standards
- regulations governing machine safety and operation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- hand and power tools
- test equipment and instruments
- equipment manuals and documentation
- electrical machines such as AC and DC motors and generators
- electrical machine diagnostic tools
- consumables

Enterprise procedures for example:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - demonstrate essential knowledge and skills as described in this unit;
 - demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment;
 - demonstrate the application of electrical and mechanical safety and performance evaluation of electrical machines on more than one occasion and in different contexts.
- The demonstration of competence must show:
 - setting up and conducting measurements
 - evaluating performance from measured parameters
 - documentation of measurements and evaluation
 - making recommendations on corrective actions.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21551 Test and monitor fluid power circuits

Unit Descriptor

This unit of competency sets out the knowledge and skills required to apply fluid power principles in engineering settings. This includes working safely, applying knowledge of fluids to the operation and testing of fluid power components, interpreting fluid system circuit diagrams and monitoring flow in fluid power circuits.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills,

Application of the Unit

The unit applies to engineering, manufacturing or processing environments where fluid circuits are used.

It is recommended that participants have skills and knowledge in reading drawings/diagrams and dismantling/assembling mechanical components.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1 Prepare to test and monitor fluid power circuits.

- 1.1 ***OH&S and environmental requirements*** for a given work area are obtained and understood.
- 1.2 Established ***OH&S requirements*** and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
- 1.4 The need for testing and monitoring fluid components and systems is determined from reports and other documentation and from discussion with ***appropriate personnel***.
- 1.5 ***Appropriate personnel*** are consulted to ensure the work is co-ordinated effectively with others involved on the work site.
- 1.6 Tools, ***equipment*** and testing devices needed to test and monitor fluid components and systems are obtained in accordance with ***enterprise procedures*** and checked for correct operation and safety.

- 2

- 2.1 ***OH&S requirements*** for carrying out the work are followed.

Test and monitor fluid power circuits.	2.2 The need to test or measure live is determined in strict accordance with OH&S requirements and when necessary conducted within established safety procedures. 2.3 Circuits/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements and enterprise procedures. 2.4 Testing and monitoring fluid power circuits is performed to meet determined circuit performance criteria. 2.5 Testing and monitoring is applied to fluid power installations by employing tests and measurements of operating parameters referenced to system operational requirements. 2.6 The requirement for testing and monitoring is identified and appropriately competent persons are engaged to perform the testing and monitoring where it is outside the scope of the fluid power system. 2.7 Fluid power safety/ protection systems are identified. 2.8 Testing and monitoring is performed and system is restored to specified requirements. 2.9 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and job specifications and requirements. 2.1 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes. 2.1 Testing and monitoring activities are carried out efficiently without unnecessary waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3 Complete and report testing and monitoring of fluid power system.	3.1 OH&S requirements for completing the work are followed. 3.2 Work site is made safe in accordance with established safety procedures. 3.3 Fluid power circuit testing and monitoring is documented in accordance with enterprise procedures. 3.4 Appropriate personnel are notified, in accordance with enterprise procedures, that the testing and monitoring is complete.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- reading specification statements, diagrams and information
- determining and estimating operating parameters
- using tools, equipment and testing devices
- making measurements on operational and non-operational components
- applying logical inspection and testing methods
- carrying out testing and monitoring without damage or loss of system integrity
- establishing and maintaining a safe work environment
- communicating technical requirement to others
- working with others
- adapting to changes in work.

Required knowledge:

- basic properties of fluids
- fluid power components
- fluid statics
- fluid flow
- fluid forces and fluid power
- fluid circuits
- fluid circuit instruments

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand

- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

Equipment including:

- hand and power tools
- fluid power components and systems
- fluid power circuit testing and monitoring hardware/software tools and instruments
- equipment manuals and documentation
- consumables

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - demonstrate essential knowledge and skills as described in this unit;
 - demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment;
 - demonstrate the application of fluid power principles to testing and monitoring circuits on more than one occasion and in different contexts;
- The demonstration of competence must show:
 - logical testing/monitoring methods

- system restoration procedures
- documentation of testing/monitoring.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21609 Install and maintain hydraulic/pneumatic systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to install and maintain hydraulic and pneumatic systems. This includes working safely; applying knowledge and interpreting technical data to perform maintenance, testing, installation and repair/replacement of hydraulic and pneumatic systems.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills,

Application of the Unit

The unit applies to engineering, manufacturing or processing environments where hydraulic and pneumatic systems are used and where this equipment requires installation, maintenance, testing and/or replacement.

It is recommended that participants have skills and knowledge in reading drawings/diagrams and dismantling/assembling mechanical components.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1 Prepare to install and maintain hydraulic and pneumatic systems.

- 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 The need for installation, maintenance or replacement is determined from reports and other documentation and from discussion with appropriate personnel.
- 1.5 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site.
- 1.6 Tools, **equipment** and testing devices needed to install, maintain or replace hydraulic and pneumatic systems and components are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.

2 Install and maintain hydraulic and pneumatic systems.	2.1	OH&S requirements for carrying out the work are followed.
	2.2	The need to test or measure live is determined in strict accordance with OH&S requirements and when necessary conducted within established safety procedures.
	2.3	Circuits/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements and enterprise procedures.
	2.4	Installation or replacement is performed to meet determined hydraulic and pneumatic system performance criteria.
	2.5	Maintenance methods are applied to hydraulic and pneumatic installations by employing tests and measurements of operating parameters referenced to system operational requirements.
	2.6	The requirement for installation or replacement is identified and appropriately competent persons are engaged to perform the installation or replacement where it is outside the scope of the hydraulic and pneumatic system.
	2.7	Hydraulic and pneumatic systems and components are identified and installed.
	2.8	Installed hydraulic and pneumatic systems and components are tested to verify operation is as intended and system is restored to specified requirements.
	2.9	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and job specifications and requirements.
	2.10	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
	2.11	Hydraulic and pneumatic system and component installation/maintenance/testing/replacement activities are carried out efficiently without unnecessary waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3 Complete and report installation and maintenance of induction motors.	3.1	OH&S requirements for completing the work are followed.
	3.2	Work site is made safe in accordance with established safety procedures.
	3.3	Hydraulic and pneumatic system installation/maintenance/testing/replacement is documented in accordance with enterprise procedures.

- 3.4 Appropriate personnel are notified, in accordance with enterprise procedures, that the hydraulic and pneumatic system installation/maintenance/testing/replacement is complete.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- reading specification statements, diagrams and information
- determining and estimating operating parameters
- using tools, equipment and testing devices
- making measurements on operational and non-operational components to determine if replacement is required
- applying logical inspection and testing methods
- selecting appropriate replacement components
- performing hydraulic and pneumatic component/system replacement and restoring system to operational standard
- carrying out installation/maintenance/testing/replacement
- constructing circuits from control diagrams
- locating and correcting faults
- without damage or loss of system integrity
- establishing and maintaining a safe work environment
- communicating technical requirement to others
- working with others
- adapting to changes in work.

Required knowledge:

- hydraulic and pneumatic laws and principles
- operation and application of hydraulic and pneumatic components and systems
- interpretation of manufacturer's equipment specifications
- fluid power circuits
- analog and digital control
- fluid instrumentation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements

such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- hand and power tools
- test equipment and instruments
- hydraulic and pneumatic system diagnostic tools
- removal/installation tools and equipment
- equipment manuals and documentation
- hydraulic and pneumatic components, circuits and systems
- consumables

Enterprise procedures for example:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;

- demonstrate essential knowledge and skills as described in this unit;
- demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment;
- demonstrate the application of hydraulic and pneumatic system installation maintenance methods on more than one occasion and in different contexts;
- The demonstration of competence must show:
 - logical inspection/testing methods
 - system restoration procedures
 - documentation of installation/maintenance.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

- Assessment should reinforce the integration of the Key Competencies.

VU21084 Set up electronically controlled robotically operated complex systems

Unit Descriptor	This unit of competency sets out the knowledge and skills required to set up, adjust, maintain and modify electronically controlled robotically operated complex systems. This includes working safely; applying knowledge of both electronic control and robotic components to set up an integrated system, collecting and analysing data, problem solving and documenting set up and modification. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.
Employability Skills	This unit contains employability skills,
Application of the Unit	The unit applies to engineering, manufacturing or processing environments where electronically controlled robotic systems are used and where this equipment requires setting up, adjustment, maintenance or modification. It is recommended that participants have knowledge of the principles of electronic control and robotic components and systems prior to commencement of this unit.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1	Prepare to set up electronically controlled robotically operated systems.	1.1 OH&S requirements and environmental requirements for a given work area are obtained and understood. 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed. 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel. 1.4 The specification of the system to be set up is determined from system briefs and other documentation and from discussion with appropriate personnel. 1.5 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site.

	1.6	Tools, equipment and configuration software needed to set up electronically controlled robotically operated systems are obtained in accordance with enterprise procedures and checked for correct operation and safety.	
2	Set up electronically controlled robotically operated systems.	2.1	OH&S requirements for carrying out the work are followed.
		2.2	Parameters, specifications and performance requirements for electronic control of robotic devices are obtained in accordance with enterprise procedures.
		2.3	The need to test or measure live is determined in strict accordance with OH&S requirements and when necessary conducted within established safety procedures.
		2.4	Circuits/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements and enterprise procedures.
		2.5	Robotic system components are actuated manually and correct performance verified.
		2.6	Electronic control devices are exercised to verify correct operation.
		2.7	Digital/computer control of robotic components is verified by running control modules or subroutines.
		2.8	System control program or software is set up to achieve integrated robotic system functionality according to specification.
		2.9	System performance is analysed and adjustment, maintenance or modification is carried out to achieve specified performance in accordance with enterprise procedures.
		2.10	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and job specifications and requirements.
	2.1	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.	
	2.2	Set up of electronically controlled robotically operated system is carried out efficiently without unnecessary waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.	
3	Complete work, documentation.	3.1	OH&S requirements for completing the work are followed.
		3.2	Work site is made safe in accordance with established safety procedures.
		3.3	Set up, adjustment, maintenance or modifications are documented in accordance with enterprise procedures.
		3.4	Appropriate personnel are notified, in accordance with enterprise procedures, that the set up is complete.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- reading specification statements, diagrams and information
- using tools, equipment and testing devices
- testing robotic and electronic control components
- carrying out machine evaluation without damage or loss of system integrity
- establishing and maintaining a safe work environment
- communicating technical requirement to others
- working with others
- adapting to changes in work.

Required knowledge:

- operating principles and setting up electronically controlled robotic systems
- operation and adjustment of robotic devices and systems
- parameters and performance requirements of robotic components/systems and electronic control systems
- reading and interpreting diagrams, charts and equipment manuals
- robotic safety and efficiency standards
- regulations governing safe operation of robotic systems

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman

- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- hand and power tools
- test equipment and instruments
- equipment manuals and documentation
- robotic components and systems
- electronic control devices and systems
- consumables

Enterprise procedures for example:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - demonstrate essential knowledge and skills as described in this unit;
 - demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment;
 - demonstrate the application of electrical and mechanical safety and performance evaluation of electronically controlled robotically operated systems on more than one occasion and in different contexts
- the demonstration of competence must show:

- setting up and confirming correct operation
- making required adjustments and modifications
- documentation of performance checks and measurements
- making recommendations on the need for maintenance.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21083 Test and commission transducers and sensors

Unit Descriptor

This unit of competency sets out the knowledge and skills required to select and commission transducers and sensors for control systems. This includes selecting transducers and sensors suitable for a given control application, determining interfacing requirements, perform installation and/or maintenance tasks, and setting up, testing and adjusting them as per specifications.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills,

Application of the Unit

The unit applies to enterprises where transducers and sensors are used in integrated control processes in support of manufacturing or process control operations.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Select appropriate transducers and sensors

- 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 System requirements for **transducers and sensors** are analysed from documentation, job brief or discussions with appropriate personnel.
- 1.5 Transducer and sensors specifications are compared with system requirements and selections are made based on previously defined selection criteria.
- 1.6 Equipment, resources, and testing devices needed to carry out the task are obtained and checked for correct operation and safety.
- 1.7 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.

2	Test, commission , maintain and adjust transducers and sen- sors	2.1 OH&S requirements for carrying out the work are followed.
		2.2 Transducers and sensors are installed according to manu- facturers' specifications and enterprise procedures , if re- quired
		2.3 Transducers and sensors are tested and adjusted according to specifications.
		2.4 Appropriate methods and tools are used to test and verify transducer and sensor operations.
		2.5 Any faults and anomalies are identified and rectified.
		2.6 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3	Document commission- ing or maintenance task	3.1 OH&S requirements for completing the work are followed.
		3.2 Work site is made safe in accordance with established safety procedures.
		3.3 Testing and commissioning task is documented in accord- ance with enterprise procedures.
		3.4 Appropriate personnel are notified, in accordance with en- terprise procedures, that the task has been completed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- reading specification statements, diagrams and information
- installing, connecting and testing transducers and sensors
- using test equipment effectively
- adjusting transducers and sensors to specifications
- troubleshooting faulty transducers and sensors
- producing appropriate documentation
- communicating technical requirement to others;
- working with others;
- adapt to changes in work.

Required knowledge:

- measurement principles
- transducer and sensor classification and specifications
- types of transducers and sensors
- transducers and sensors interface requirements
- detection of:
 - light and radiation
 - temperature
 - flow and pressure

- motion and force
- moisture and humidity

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Transducers and sensors including:

- transducers
 - electrochemical
 - electromechanical
 - electroacoustic
 - photoelectric
 - electromagnetic
 - electrostatic
 - thermoelectric
- sensors
 - thermal
 - electromagnetic
 - mechanical
 - chemical
 - optical and radiation
 - acoustic

Enterprise procedures for example:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - demonstrate essential knowledge and skills as described in this unit;
 - demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment;
 - demonstrate the ability to test and commission transducers and sensors on more than one occasion and in different contexts.
- the demonstration of competence must include a variety of transducers and sensors operating on different physical principles.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation

must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21082 Set up electronically controlled mechanically operated complex systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to set up, adjust, maintain and modify electronically controlled robotically operated complex systems. This includes working safely; applying knowledge of both electronic control and robotic components to set up an integrated system, collecting and analysing data, problem solving and documenting set up and modification.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills,

Application of the Unit

The unit applies to engineering, manufacturing or processing environments, where electronically controlled mechanical systems are used and where this equipment requires setting up, adjustment, maintenance or modification.

It is recommended that participants have knowledge of the principles of electronic control and mechanical components and systems prior to commencement of this unit.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1 Prepare to set up electronically controlled mechanically operated systems.

- 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures for preparation of the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 The specification of the system to be set up is determined from system briefs and other documentation and from discussion with appropriate personnel.
- 1.5 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site.

	1.6	Tools, equipment and configuration software needed to set up electronically controlled mechanically operated systems are obtained in accordance with enterprise procedures and then checked for correct operation and safety.
2	Set up electronically controlled mechanically operated systems.	2.1 OH&S requirements for carrying out the work are followed. 2.2 Parameters, specifications and performance requirements for electronic control of mechanical devices are obtained in accordance with enterprise procedures. 2.3 The need to test or measure live is determined in strict accordance with OH&S requirements and when necessary conducted within established safety procedures. 2.4 Circuits/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements and enterprise procedures. 2.5 Mechanical system components are actuated manually and correct performance verified. 2.6 Electronic control devices are exercised to verify correct operation. 2.7 Digital control of mechanical components is verified by running control modules or subroutines. 2.8 System control program or software is set up to achieve integrated mechanical system functionality according to specification. 2.9 System performance is analysed and adjustment, maintenance or modification is carried out to achieve specified performance in accordance with enterprise procedures. 2.10 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and job specifications and requirements. 2.11 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes. 2.12 Set up of electronically controlled mechanically operated system is carried out efficiently without unnecessary waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3	Complete work, document evaluation and make recommendations.	3.1 OH&S requirements for completing the work are followed. 3.2 Work site is made safe in accordance with established safety procedures. 3.3 Set up, adjustment, maintenance or modifications are documented in accordance with enterprise procedures.

- 3.4 Appropriate personnel are notified, in accordance with enterprise procedures, that the set up is complete.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- reading specification statements, diagrams and information
- using tools, equipment and testing devices
- testing mechanical and electronic control components
- carrying out machine evaluation without damage or loss of system integrity
- establishing and maintaining a safe work environment
- communicating technical requirement to others
- working with others
- adapting to changes in work.

Required knowledge:

- operating principles of electrical motors and generators
- construction of electrical machines
- machine parameters and performance requirements
- how to read and apply standards
- machine safety and efficiency standards
- regulations governing machine safety and operation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- hand and power tools
- test equipment and instruments
- equipment manuals and documentation
- electrical machines such as AC and DC motors and generators
- electrical machine diagnostic tools
- consumables

Enterprise procedures for example:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - demonstrate essential knowledge and skills as described in this unit;
 - demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment;
 - demonstrate the application of electrical and mechanical safety and performance evaluation of electrical machines on more than one occasion and in different contexts;

- the demonstration of competence must show:
 - setting up and conducting measurements
 - evaluating performance from measured parameters
 - documentation of measurements and evaluation
 - making recommendations on corrective actions.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage students.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21573 Diagnose and rectify faults in AC motor drive systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to diagnose and rectify faults in AC motor control systems. This includes working safely; applying knowledge of AC motor control systems and operating parameters to logical fault finding processes, implementing fault rectification, safety and functional testing and interpreting technical data.

If the work requires access to electrical plant and equipment that is fixed wired into relevant domestic, commercial and industrial electrical installations supplied at low voltage or above, the practice of the skills described in this unit are subject to the requirements of the Victorian Electricity Safety Act.1998 and Electricity Safety (Installation) Regulations.

Employability Skills

This unit contains employability skills.

Application of the Unit

The unit applies to engineering, manufacturing or processing environments where AC motor control systems are used to control processes and where this equipment requires maintenance and adjustments.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Prepare to diagnose and rectify faults.

- 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 The extent of faults is determined from reports and other documentation and from discussion with appropriate personnel.
- 1.5 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site.
- 1.6 Tools, **equipment** and testing devices needed to diagnose faults are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.

2	Diagnose and rectify faults.	2.1	OH&S requirements for carrying out the work are followed.
		2.2	The need to test or measure live is determined in strict accordance with OH&S requirements and when necessary conducted within established safety procedures.
		2.3	Circuits/machines/plant are checked as being isolated, where necessary, in strict accordance with OH&S requirements and enterprise procedures.
		2.4	Logical diagnostic methods are applied to diagnose AC motor control system faults employing measurements and estimations of system operating parameters referenced to system operational requirements.
		2.5	Suspected fault scenarios are tested as being the source of system problems.
		2.6	Causes of the faults are identified and appropriately competent persons are engaged to rectify the fault, where it is outside the scope of the control system.
		2.7	Faults in the control components of the system are corrected to restore AC motor control system to its operational standard.
		2.8	System is tested to verify that operation is as intended and to specified requirements.
		2.9	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and job specifications and requirements.
		2.10	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
		2.11	Fault diagnosis and rectification activities are carried out efficiently without unnecessary waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3	Complete fault diagnosis and rectification activities	3.1	OH&S requirements for completing the work are followed.
		3.2	Work site is made safe in accordance with established safety procedures.
		3.3	Rectification of faults is documented, in accordance with enterprise procedures.
		3.4	Appropriate personnel are notified that the system faults have been rectified, in accordance with enterprise procedures

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- reading specification statements, diagrams and information
- determining and estimating operating parameters
- using tools, equipment and testing devices to diagnose faults
- making measurements on suspect components to determine failure
- applying logical diagnostic methods
- rectifying faults and restoring system to operational standard
- carrying out fault diagnosis and fault rectification without damage or loss of system integrity
- establishing and maintaining a safe work environment
- communicating technical requirement to others
- working with others
- adapting to changes in work
- recommissioning AC motor control systems.

Required knowledge:

- AC motor operation and faults
- typical drive components and fault identification
- control system behaviour and typical faults
- AC motor control methods, devices and terminology
- AC motor control system faults, symptoms and causes
- potential danger of charged HV capacitors
- effects of line output filtering malfunction
- inspection and testing of AC motor control systems

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste

- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- hand tools
- test equipment and instruments
- equipment manuals and documentation
- AC motor control systems
- programming and fault diagnosis software
- AC motor control system simulation software
- controller test routines
- consumables

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit, as specified by the associated performance criteria incorporating the required skills and knowledge.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
 - complete work within a timeframe typically expected of the discipline, work function and industrial environment;

- diagnose and rectify faults in AC motor control systems.
- apply logical fault finding processes and implement fault rectification on more than one occasion and in different contexts
- the demonstration of competence must show:
 - rectifying faults and verifying system operation;
 - documenting fault rectification.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations and a variety of conditions.
- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required and be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration or practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21574 Diagnose and rectify faults in DC motor drive systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to diagnose and rectify faults in DC motor control systems. This includes working safely; applying knowledge of DC motor control systems and operating parameters to logical fault finding processes, implementing fault rectification, safety and functional testing and interpreting technical data.

If the work requires access to electrical plant and equipment that is fixed wired into relevant domestic, commercial and industrial electrical installations supplied at low voltage or above, the practice of the skills described in this unit are subject to the requirements of the Victorian Electricity Safety Act.1998 and Electricity Safety (Installation) Regulations.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

The unit applies to engineering, manufacturing or processing environments where DC motor control systems are used to control processes and where this equipment requires maintenance and adjustments.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Prepare to diagnose and rectify faults.

- 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in the preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 The extent of faults is determined from reports and other documentation and from discussion with appropriate personnel.
- 1.5 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site.
- 1.6 Tools, **equipment** and testing devices needed to diagnose faults are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.

2	Diagnose and rectify faults.	2.1	OH&S requirements for carrying out the work are followed.
		2.2	The need to test or measure live is determined in strict accordance with OH&S requirements and when necessary conducted within established safety procedures.
		2.3	Circuits/machines/plant are checked as being isolated, where necessary, in strict accordance with OH&S requirements and enterprise procedures.
		2.4	Logical diagnostic methods are applied to diagnose DC motor control system faults employing measurements and estimations of system operating parameters referenced to system operational requirements.
		2.5	Suspected fault scenarios are tested as being the source of system problems.
		2.6	Causes of the faults are identified and appropriately competent persons are engaged to rectify the fault where it is outside the scope of the control system.
		2.7	Faults in the control components of the system are rectified to restore the DC motor control system to its operational standard.
		2.8	System is tested to verify that operation is as intended and to specified requirements.
		2.9	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and job specifications and requirements.
		2.10	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
		2.11	Fault diagnosis and rectification activities are carried out efficiently without unnecessary waste of materials or damage to apparatus and the surrounding environment or services using sustainable energy practices.
3	Complete fault diagnosis and rectification activities	3.1	OH&S requirements for completing the work are followed.
		3.2	Work site is made safe in accordance with established safety procedures.
		3.3	Rectification of faults is documented, in accordance with enterprise procedures.
		3.4	Appropriate personnel are notified that the system faults have been rectified, in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- reading specification statements, diagrams and information
- determining and estimating operating parameters
- using tools, equipment and testing devices to diagnose faults
- making measurements on suspect components to determine component failure
- applying logical diagnostic methods
- rectifying faults and restoring system to operational standard
- carrying out fault diagnosis and fault rectification without damage or loss of system integrity
- establishing and maintaining a safe work environment
- communicating technical requirement to others
- working with others
- adapting to changes in work recommissioning DC motor control systems

Required knowledge:

- DC motor control methods, devices and terminology
- the role of microcontrollers in DC motor control
- DC motor operation faults
- typical drive components and fault identification
- control system behaviour and typical faults.

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman

- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- hand tools
- test equipment and instruments
- equipment manuals and documentation
- DC motor control systems
- programming and fault diagnosis software
- DC motor control system simulation software
- controller test routines
- consumables

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria using the required skills and knowledge.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices, including the use of risk control measures, as specified in the performance criteria and range;
 - complete work within a timeframe typically expected of the discipline, work function and industrial environment;
 - diagnose and rectify faults in DC motor control systems.
 - apply logical fault finding processes and implement fault rectification on more than one occasion and in different contexts
- the demonstration of competence must show:
 - rectifying faults and verifying system operation;

- documenting fault rectification.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations and a variety of conditions.
- The assessment environment should not disadvantage the candidate.
- The candidate will have access to all tools, equipment, materials and documentation required and be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU20913 Apply basic fabrication techniques

Unit Descriptor

This unit of competency sets out the knowledge and skills required to basic fabrication tasks under supervision. This involves using appropriate machinery and applying associated fabrication and assembly techniques to the fabrications process

License to practice

The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships and traineeships

Employability Skills

This unit contains employability skills.

Co-requisite unit

It is advisable that *VU21153 Produce basic engineering sketches and drawings* is assessed as a co-requisite with this competency.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 2 or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. *Plan and set up fabrication operations*

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement¹. Assessment of performance is to be consistent with the evidence guide.

- 1.1 The fabrication work is determined through request, work orders or equivalent and clarified with the **appropriate personnel**.
- 1.2 **Occupational health & safety requirements**, relevant Australian standards, codes of practice, manufacturer's specifications, environmental requirements and **enterprise procedures** are identified and adhered to.
- 1.3 **Resources** required are identified, obtained and checked as fit for purpose.
- 1.4 Relevant plans, drawings and instructions are identified, interpreted and understood.
- 1.5 A work plan is prepared showing the correct sequence of operation.

2. *Conduct fabrication operations*
- 1.6 **Fabrication** operation is set up by selecting appropriate techniques and tools for the task required.
- 2.1 Basic marking out techniques are used where required.
- 2.2 **Fabrication equipment** is used in a manner that optimises efficiency.
- 2.3 Fabrication is conducted without damage to any component and system.
- 2.4 Specific safety requirements are met throughout the task and can be explained.
- 2.5 Work plan is followed during fabrication process.
- 2.6 Work output is inspected for compliance with specifications and requirements.
- 2.7 Product is tagged and stored according to work plan.
- 2.8 Unexpected situations are dealt with safely and reported to the appropriate personnel.
3. *Complete work requirements*
- 3.1 Completed work is reported to appropriate personnel according with enterprise procedures.
- 3.2 Work area is cleared of waste, cleaned and secured following enterprise procedures.
- 3.3 Equipment and work area are cleaned and inspected for serviceable conditions following enterprise procedures.
- 3.4 Machinery and tooling is maintained in accordance with manufacturers' specifications and enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required skills:

- identify resources, drawings and fabrication techniques
- prepare a work plan
- mark out work
- use fabrication machinery
- deal with unexpected situations
- restore work area
- maintain machines and tools

Required Knowledge:

- Production processes
 - techniques
 - forming
 - fabricating

- shaping
 - extrusions
- Materials
 - ferrous
 - non-ferrous
 - non-metallic
- Joining methods
 - fasteners
 - bolts, nuts, washers, rivets
 - adhesives
 - soldering
 - welding
- Fabrication machinery
 - shearing and fixed mechanical cutting
 - nibblers
 - shears, guillotines
 - universal plate workers
 - rolling
 - pyramid and pinch rolls
 - folding and pressing
 - press-brakes, presses, cramp and pan brakes
 - bench folders
 - mechanical saws
- Fabrication techniques
 - interpretation of drawings
 - marking
 - cutting
 - forming
 - assembly
 - workshop environment/safety

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 in the Performance Criteria is detailed below.

The following variables may be present and may include, but are not limited to the examples listed.

Appropriate personnel
may include:

- supervisor
- leading hand
- foreman
- trainer
- teacher

Occupational health & safety requirements *may include:*

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operating procedures
- awards provisions

Enterprise procedures

- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards
- follow confined spaces procedures
- first aid.

Resources *may include:*

- work requests/sheets
- personal protective equipment
- plans, drawings and sketches
- marking out equipment
- measuring equipment
- ferrous and non-ferrous materials
- tools
- machinery
- consumables

Fabrication *may involve:*

- marking
- cutting
- forming
- fastening
- glueing
- assembling

Fabrication equipment
may include:

- nibblers
- metal shears
- guillotines
- pedestal drills
- power saws
- rivet fastening equipment
- pan brake
- press brake
- universal metal working machine

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- To be considered competent in this unit the participant must be able to demonstrate the achievement of all of the elements of competency to the level defined by their associated performance criteria and incorporating the required skills and knowledge.
- Specifically they must be able to:
 - Perform each element on at least two occasions
 - Implement relevant Occupational Health and Safety workplace procedures and practices including the use of risk control measures
 - Demonstrate application of the Required Skills and Knowledge at a level and within timeframes appropriate to the workplace.

Context of and specific resources for assessment

- This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must include demonstration of the practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.
- Competent performance with inherent safe working practices is expected. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.
- It is suggested that this unit be assessed in conjunction with other units that form part of a job role.

VU21095 Apply electrotechnology principles in an engineering work environment

Unit Descriptor

This unit of competency sets out the knowledge and skills required to select, set-up and use a range of test equipment to measure voltage, current and resistance. This involves testing for continuity, insulation and identifying commonly used electrical/electronic devices for the supply of power and for the control of machines and plant in an engineering environment

License to practice

The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships and traineeships.

Employability Skills

This unit contains employability skills.

Co-requisite unit

It is advisable that learners possess skills at least to a level described in *MEM12024A Apply basic computational principles in engineering work activities*.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 2 or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Use basic electrical principles to plan, conduct, or complete engineering tasks.
2. Determine electrical requirements when planning engineering tasks.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement¹. Assessment of performance is to be consistent with the evidence guide.

- 1.1 Basic electrical units, terms and symbols are recognised and used correctly.**
- 1.2 Basic electrical diagrams are interpreted and the operation of the circuit explained to appropriate personnel in the work place**
- 1.3 Potential electrical hazards are identified and reported according to enterprise procedures**
- 2.1 Appropriate electrical measurement devices are used to measure basic electrical quantities in simple DC and AC circuits.**
- 2.2 Electrical measurements are interpreted correctly and sub-units of measurements are adjusted as required.**
- 2.3 Calculations are performed to obtain unknown electrical quantities not directly available through measurement**



3. Operate electrical equipment and devices to power and control engineering machinery.
 - 3.1 Occupational health & safety requirements, relevant Australian standards, codes of practice, manufacturers specifications, environmental requirements and enterprise procedures are identified and adhered to**
 - 3.2 Electrical equipment and devices are operated safely and only for the purpose intended according to manufacturers' operating instructions, specifications and any specific safety requirements**
 - 3.3 Electrical equipment and devices are operated that have been safety tested and appropriately tagged**
 - 3.4 The status of discrete and programmable controllers is assessed and reported correctly**
 - 3.5 Discrete and programmable controllers are operated correctly to instructions and enterprise procedures**
4. Identify and operate correctly major components of the electrical distribution in an engineering work environment.
 - 4.1 The location of protection devices for electrical circuits and equipment is identified**
 - 4.2 The purpose of protection devices is known and can be explained**
 - 4.3 Subsections of the electrical distribution are isolated and made safe**

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required skills:

- Plan activities
- Interpret diagrams and schematics
- Operate electrical devices and equipment

Required Knowledge:

- Basic electricity
 - electrical concepts of emf current and resistance
 - power dissipation
 - conductors, semi-conductors and insulators
 - direct and alternating current
 - potential dangers of working with electricity
- Simple practical circuits
 - terms 'circuit', 'load', 'source', 'short circuit', 'open circuit', and 'overload'
 - circuit operation
 - switches and protection devices
 - Ohm's Law
- Series, parallel and series-parallel DC circuits
 - (no more than three resistors)
 - circuit connection
 - series, parallel, series-parallel circuit laws
 - measuring resistance, voltage and current
 - calculation of resistance, voltage, current and power
- Electrical distribution in buildings and premises
 - single and three phase systems
 - distribution components:
 - mains,
 - sub-mains,
 - final sub-circuits,
 - main switchboards,
 - distribution boards,
 - main switches
 - isolators
 - purpose of :
 - main switchboards,
 - distribution boards
 - power ratings of typical appliances
 - equipment
 - importance of earthing
- Electrical/electronic systems
 - system level functions of power and control devices



- controllers – function and application

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 in the Performance Criteria is detailed below.

The following variables may be present and may include, but are not limited to the examples listed.

Basic electrical units and terms *includes:*

- voltage
- current
- resistance
- power
- DC and AC
- conductor
- insulator

Appropriate personnel *may include:*

- supervisor
- leading hand
- foreman
- trainer
- teacher

Enterprise procedures *include:*

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Appropriate electrical measurement devices *include:*

- analog
 - voltmeter,
 - ammeter
 - ohm meter
 - watt meter
- digital
 - voltmeter,
 - ammeter
 - ohm meter
 - watt meter
- cathode ray oscilloscope

Simple DC and AC circuits *include:*

- circuits with up to three resistors: in series, in parallel, in series/parallel
- one switch
- one fuse

Sub-units of measurements *include:*

Conversion between prefixes of:

- Mega
- kilo
- unit
- milli
- micro

Occupational health & safety requirements *may include:*

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operating procedures
- award provisions

Electrical equipment and devices *include:*

Single phase or three phase connected:

- grinders
- drills
- lathes
- mills
- planers
- hand operated power tools
- extension leads

Specific safety requirements *include:*

- *working safely around machinery*
- *working safely with tools and equipment*
- *risk and hazard recognition*
- *emergency procedures*
- *awareness of electrical hazards*
- *follow confined spaces procedures*
- first aid.

Protection devices *include:*

- fuses
- limit switches
- proximity switches
- detectors
- sensors
- contactors
- overload devices
- isolators
- push buttons

Electrical distribution includes:

- main switch boards
- sub switch boards
- fuse boxes
- fixed and non-fixed cabling

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- To be considered competent in this unit the participant must be able to demonstrate the achievement of all of the elements of competency to the level defined by their associated performance criteria and incorporating the required skills and knowledge.
- Specifically they must be able to:
 - Perform each element on at least two occasions
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range statement
 - Demonstrate application of the Required Skills and Knowledge at a level and within timeframes appropriate to the workplace.

Context of and specific resources for assessment

- This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must include demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.

VU21203 Apply hydraulic principles in engineering

Unit Descriptor

This unit of competency sets out the knowledge and skills required to apply hydraulic principles in engineering. It involves the operation, maintenance and construction of hydraulic system and machine control circuitry.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit applies to industrial engineering enterprises where the application of hydraulic principles forms part of production of goods or services.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Apply hydraulic principles to plan, conduct, or complete engineering tasks

2. Determine hydraulic requirements when planning engineering tasks

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 *Applications of hydraulics to engineering activities are provided*
- 1.3 *Hydraulic units, terms and symbols are recognised and used correctly.*
- 1.4 *Hydraulic circuit diagrams are interpreted and the operation of the circuit explained to **appropriate personnel**.*
- 1.5 *Concept/principles of hydraulic transmission and circuit design are applied as appropriate to the given engineering task.*
- 1.6 *Potential hydraulic hazards are identified and reported according to **enterprise procedures**.*
- 1.7 *Safety and risk control measures are applied when working with hydraulics.*
- 2.1 *OH&S requirements for carrying out the work are followed.*
- 2.2 *Hydraulic circuits, transmission systems and operating parameters are developed and constructed for the given engineering task.*



2.3	Hydraulic transmission, fluid conveying and control components are selected from manufacturers' catalogues and other relevant documentations to suit the operating parameters of the system.
2.4	Hydraulic requirements for the engineering task are confirmed as required with appropriate personnel.
2.5	Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2.6	Appropriate measurement devices are used to measure hydraulic pressure and flow.
2.7	Hydraulic measurements and calculations are performed and interpreted correctly
2.8	Unexpected situations are resolved with appropriate personnel, and in accordance with enterprise procedures.
-
3.	Operate and test hydraulic equipment and devices	3.1	Occupational health & safety requirements, relevant Australian Standards, codes of practice, manufacturer's specifications, environmental requirements and enterprise procedures are identified and adhered to.
		3.2	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site.
		3.3	Hydraulic equipment and devices are operated safely and only for the purpose intended according to manufacturers' operating instructions, specifications and any specific safety requirements.
		3.4	Routine maintenance and fault tracing on hydraulic and electro-hydraulic components and systems is performed in a safe manner.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Identify and follow relevant OH & S procedures
- Interpret circuit diagrams
- Construct Hydraulic circuits and transmission systems
- Perform hydraulic pressure and flow measurements
- Perform calculations
- Operate hydraulic equipment and devices
- Perform fault tracing and maintenance

Required Knowledge:

- Components
 - control valves
 - direction



- pressure
- flow
- actuators
- cylinders
- manifolds
- electro-hydraulic controls
- fluid conductors
- pumps and reservoirs
- motors
- Hydrostatic transmission
 - circuits
 - concepts
 - output characteristics(pump/motor)
- Hydraulic circuitry
 - machine control circuits
 - symbol identification
 - circuit interpretation
 - operating parameters
- Servicing
 - routine maintenance requirements
 - testing and fault tracing

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 in the Performance Criteria is detailed below.

OH&S requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager



- site engineer
- trainer
- mentor
- teacher
- team member

Enterprise procedures may include but are not limited to:

- *the use of tools and equipment*
- *instructions, including job sheets,, plans, drawings and designs*
- *reporting and communication*
- *manufacturers' specifications and operational procedures*

Hydraulic transmission, fluid conveying and control components including:

- *control valves*
- *direction*
- *pressure*
- *flow*
- *actuators*
- *cylinders*
- *manifolds*
- *electro-hydraulic controls*
- *fluid conductors*
- *pumps and reservoirs*
- *motors*

Resources and equipment may include but are not limited to:

- tools and equipment
- testing equipment
- measurement devices
- components and parts
- circuit diagrams and other reference documents

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range



- Demonstrate the required knowledge and skills as described in this unit;
- Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
- Demonstrate the ability to apply hydraulic principles to plan, conduct, or complete engineering tasks on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21172 Apply instrumentation principles to industrial control systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to apply instrumentation principles to industrial control systems. This includes selecting, installing, maintaining, monitor and calibrating instrumentation, sensors and transducers within an industrial control system

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit of competency is relevant to an engineering process control environment where instrumentation is used to control a variety of variables that form part of the process to a set of given specifications.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Prepare application of instrumentation task

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and understood
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
- 1.3 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 **Instrumentation task** requirements are determined from documentation, work requests or discussions with appropriate personnel.
- 1.5 Appropriate instrumentation solution is selected from documentation, work requests or discussions with appropriate personnel to fit task requirement, if required.
- 1.6 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site.



	1.7	Resources and equipment to carry out instrumentation task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2. Carry out instrumentation task	2.1	OH&S requirements for carrying out the work are followed.
	2.2	Equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements.
	2.3	Instrumentation task is carried out in accordance with requirements to specifications and according to enterprise procedures.
	2.4	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	2.5	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3. Complete and document instrumentation task	3.1	OH&S requirements for carrying out the work are followed.
	3.2	Work site is made safe in accordance with established safety procedures
	3.3	Instrumentation work is tested for correct operation within given specifications and enterprise procedures.
	3.4	Instrumentation task is documented and completion reported to appropriate personnel.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Identify and follow relevant OH&S procedures
- Read and understand documentation
- Perform instrumentation tasks
- Carry out operational tests
- Verify results
- Prepare documentation and submit reports

Required Knowledge:

- Process control systems
 - principles of control
 - control variables
 - process control systems (examples)
 - control system topologies



- multivariable schemes
- on-off control, multi-step, PID control
- lag
- inherent regulation
- communication links
- transducers
- sensors
- valves
- signal types
- Measurement of control variables
 - temperature
 - pressure
 - flow
 - level
 - density
- Detection of control variables
 - temperature
 - pressure
 - chemical
 - level
 - density
- Protection and safety
 - lightning and surge
 - static
 - standards and codes of practice
- Instrumentation field practice
 - maintenance
 - hazardous atmospheres
 - personal safety
 - wiring
 - enclosures and barriers
 - mounting
 - tubing and piping
 - calibration
 - documentation

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code



- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Instrumentation task may include, but is not limited to:

in relation to instrumentation, transducers and sensors

- selection
- installation
- maintenance
- monitoring
- troubleshooting
- calibration

Resources may include, but are not limited to:

- engineering drawings
- documentation
- manufacturers' specifications
- standards
- test and calibration reports
- assorted wires and cables
- tubing and piping
- barriers and enclosures
- mounts
- spares and consumables

Equipment may include, but is not limited to:

- hand and power tools
- test instrumentation
- calibration equipment



- range of instruments, transducers and sensors
- data readout equipment

Enterprise procedures may include, but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate application of instrumentation principles to industrial control systems by selecting, installing, maintaining, monitoring and calibrating instrumentation, sensors and transducers on more than one occasion and in different contexts.
 - Complete and document instrumentation tasks

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables



- Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21173 Interface control systems using Supervisory Control and Data Acquisition (SCADA) systems

Unit Descriptor This unit of competency sets out the knowledge and skills required to interface control equipment to computers using supervisory control and data acquisition (SCADA) systems.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills This unit contains employability skills.

Application of the Unit This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit applies to engineering manufacturing enterprises that use SCADA software to program hardware such as PLCs or commercial hardware modules to control manufacturing processes.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Plan for the application of a SCADA system

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan for the application of a SCADA system	1.1 OH&S and environmental requirements for a given work area are obtained and understood 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area. 1.3 SCADA system requirements are determined from documentation, design briefs, job sheets or discussions with appropriate personnel. 1.4 Process parameters and associated information relevant to the SCADA system implementation are identified and analysed. 1.5 Optimum implementation option is chosen and checked against requirements. 1.6 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site. 1.7 Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety
2.	2.1 OH&S requirements for carrying out the work are followed.



Configure a SCADA system for an industrial process	2.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel.
	2.3 Development software is used to configure SCADA system including graphical editor, data base configuration tool, scripting language and Application Program Interface (API).
	2.4 Configured SCADA system is tested for functionality ensuring that equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements.
	2.5 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
3. Use SCADA system to monitor and control and industrial process	3.1 OH&S requirements for carrying out the work are followed.
	3.2 SCADA information is monitored, analysed and evaluated in accordance with enterprise procedures.
	3.3 Inefficient uses of SCADA system are identified and rectified.
	3.4 SCADA system is interrogated to obtain current, historical or predicted information if required.
	3.5 Support is provided to others in the use of the SCADA system in accordance with enterprise procedures.
	3.6 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes and in consultation with appropriate personnel.
4. Document and maintain SCADA system	4.1 OH&S requirements for carrying out the work are followed.
	4.2 A library of SCADA objects and templates is maintained and updated according to enterprise procedures if required.
	4.3 Operating and response instructions for SCADA system are documented, maintained and updated and approved by appropriate personnel.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Identify and follow relevant OH&S procedures
- Use graphical design aids
- Acquire data



- Analyse data
- Interpret alarm logging
- Compile and manage a database
- Use SCADA programming software
- Set up hardware and software
- Implement a SCADA system within a process environment
- Present a report
 - produce reports for different groups involved in the process
 - categorise information required to produce individual reports
 - analyse data fields to produce reports using word-processing packages

Required Knowledge:

- SCADA systems
 - applications
 - uses in industry
 - commercial packages (e.g. LabView, Citec, Procon, Wizcon, Control View, Siemens, etc.)
 - comparison of applications in industry
 - hardware requirements
 - PLC interface requirements
 - networking requirements
- Graphical design
 - basic concepts (review)
 - balance of layout
 - analysis of data required for mimic diagrams
 - uses of a suitable software package
- Data analysis
 - conversion of raw data
 - manipulation of complex data within the SCADA software
 - trending
 - graphical representation
- Alarm logging
 - selected limits and specification for alarm logging
 - corrective action for alarm status
- Database
 - variables, limits and specifications
- Programming language
 - function within the SCADA software
 - type and method of program language used to automate tasks within the software package
- SCADA systems within a process environment
 - limitations of SCADA systems (i.e. physical and environmental limitations)
 - applications for SCADA systems
 - networking used for SCADA systems
 - types

- main frame networking
- factory networking
- advantages/disadvantages of different networking systems
- PC set up
 - operating systems (e.g. UNIX, LINUX, Windows, DOS, Solaris, etc.)
 - terminology
 - advantages/disadvantages
 - PC operating environment (e.g. noise immunity, temperature, vibration, dirt, etc.)
 - PC hardware
 - Networking requirements
 - Data storage medium
 - Security access (e.g. user passwords, firewalls, etc.)
- Data acquisition
 - hardware requirements
 - serial port: RS232, RS422, RS485
 - USB
 - parallel printer port
 - PCI BUS
 - modem
 - network cards
 - commercial systems (e.g. LabView, HP)
 - software requirements
 - drivers
 - specialist programs
 - OLE and DLE

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include, but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise



Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Resources and equipment may include, but are not limited to:

- computer software
- software reference documentation
- internet access
- network access
- relevant standards
- computer (minimum pentium 3)
- variety of input devices
- variety of output devices
- printer
- SCADA system
 - training package
 - software package
- appropriate computer hardware
- variety of input devices
- variety of output devices
- printer
- SCADA system
 - training package
 - software package

Enterprise procedures may include, but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

SCADA objects and templates

- PLCs
- devices
- subsystems
- scripts and sequences
- interactive displays
- alarms



- library
- report generator

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to successfully interface control systems and industrial hardware devices on more than one occasion and in different contexts.
 - Document and maintain SCADA system

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures



- oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21204 Apply pneumatic principles in engineering

Unit Descriptor

This unit of competency sets out the knowledge and skills required to apply pneumatic principles in engineering. It involves the operation, maintenance and construction of pneumatic system and machine control circuitry.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit applies to industrial engineering enterprises where the application of hydraulic principles forms part of production of goods or services.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Apply pneumatic principles to plan, conduct, or complete engineering tasks

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S and environmental requirements** for a given work area are obtained and understood.
- 1.2 Applications of pneumatics to engineering activities are provided, as required
- 1.3 Pneumatic units, terms and symbols are recognised and used correctly.
- 1.4 Pneumatic circuit diagrams are interpreted and the operation of the circuit explained to **appropriate personnel** in the work place.
- 1.5 Concept/principles of pneumatics and circuit design are applied as appropriate to the given engineering task.
- 1.6 Potential pneumatic hazards are identified and reported according to **enterprise procedures**.
- 1.7 Safety and risk control measures are applied when working with pneumatics.

2. Determine pneumatic requirements when planning engineering tasks	2.1 <i>OH&S requirements for carrying out the work are followed.</i> 2.2 <i>Pneumatic circuits and operating parameters are developed and constructed for the given engineering task.</i> 2.3 Pneumatic plant, fluid conveying and control components are selected from manufacturer catalogues and other relevant documentations to suit the operating parameters of the system. 2.4 <i>Pneumatic requirements for the engineering task are confirmed as required with appropriate personnel.</i> 2.5 Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety. 2.6 <i>Appropriate measurement devices are used to measure pneumatic pressure and flow.</i> 2.7 <i>Pneumatic measurements and calculations are performed and interpreted correctly.</i> 2.8 <i>Unexpected situations are resolved with appropriate personnel, and in accordance with enterprise procedures.</i>
3. Operate and test pneumatic equipment and devices	3.1 Occupational health & safety requirements, relevant Australian Standards, codes of practice, manufacturers' specifications, environmental requirements and enterprise procedures are identified and adhered to. 3.2 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site. 3.3 Pneumatic equipment and devices are operated safely and only for the purpose intended according to manufacturers' operating instructions, specifications and any specific safety requirements. 3.4 Routine maintenance and fault tracing on pneumatic components and systems is performed in a safe manner.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Identify and follow relevant OH & S procedures
- Interpret pneumatic circuit diagrams
- Read and understand manufacturers' catalogues
- Use measuring devices
- Perform calculations
- Operate pneumatic equipment
- Perform maintenance and fault tracing



Required Knowledge:

- Pneumatic circuitry/plant
 - applications of pneumatics to engineering
 - cascade/stepper circuit design
 - machine control circuits
 - interpretation
 - construction
 - design
 - safety circuits
 - two hand start
 - guard interlock
 - workpiece location
 - emergency stop
- Special machines/equipment
 - integral machine circuits
 - drill/feed
 - rotary indexing table
 - strip feeder
 - production aids
 - air collets
 - air pallets
 - tactile devices
 - grippers
 - vacuum heads
 - surface preparation
 - shot blasting
 - spray painting
- System analysis
 - circuitry
 - layout
 - numbering
 - alphabetic designation
 - cascade/stepper circuitry
 - specified and actual air data
 - usage
 - pressure drop
 - loss/leakage
 - flow rates
- Circuit documentation
 - motion diagrams
 - displacement-step
 - displacement-time
 - control

- written forms
 - tabular listing
 - sequence chart
 - function chart
- Fluid logic componentry
 - elements
 - sequencers
 - sensors
- Fluid logic circuitry
 - development
 - interpretation
 - construction
- Design concepts
 - machine concept
 - control system concept
 - numerical systems
 - numerical codes
 - design process
 - control equation synthesis
 - signal flow
 - equation minimization
- Maintenance and servicing
 - maintenance requirements
 - preventative
 - overhaul
 - testing and fault tracing
 - maintenance documents
- Safety
 - hazards
 - risk control measures
 - treatment aids
 - machine safe operation
 - personal protective equipment and safety devices

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures



Environmental requirements

may include, but are not limited to:

- awards provisions
- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include, but are not limited to:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Enterprise procedures may include, but are not limited to:

- *the use of tools and equipment*
- *instructions, including job sheets, cutting lists, plans, drawings and designs*
- *reporting and communication*
- *manufacturers' specifications and operational procedures*

Pneumatic transmission, fluid conveying and control components may include, but are not limited to:

- *cylinders, actuators and switches*
- *control valves*
- *solenoid*
- *pneumatic*
- *mechanical*
- *automatic*
- *sensors*
- *filters, regulators and lubricators*
- *fluid conductors*
- *fittings*
- *grippers*
- *compressors, pumps and accumulators/reservoirs*

Resources and equipment may include' but are not limited to:

- tools and equipment
- testing equipment
- measurement devices
- components and parts



- circuit diagrams and other reference documents

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to apply pneumatic principles to plan, conduct, or complete engineering tasks on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:



- observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21239 Apply safe working practice when operating vacuum systems

Unit Descriptor

This competency unit sets out the knowledge and skills required to safely undertake operations using vacuum equipment. This involves being familiar with operating procedures for all the equipment being used, competent in use and precautions required for working with high levels of vacuum. Further, a competent knowledge of hazardous materials being used in a vacuum manufacturing process is required.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 4 or higher. This unit applies in a manufacturing environment where vacuum technology is used in the manufacturing process.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

- 1 Plan for operating vacuum equipment safely

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **Occupational health & safety requirements**, relevant Australian standards, codes of practice, manufacturers' specifications, **environmental requirements** and **enterprise procedures** are identified and adhered to.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 Operating procedures for planned **vacuum equipment** operation are obtained and understood and all equipment and materials required are listed.
- 1.5 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
- 1.6 **Resources and equipment** needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
- 2
 - 2.1 OH&S requirements for carrying out the work are followed.



<i>Conduct an operation using vacuum equipment</i>	2.2	Vacuum equipment is set up to perform a vacuum operation according to industry safe working procedures.
	2.3	All pre-operational equipment checks are performed prior to pumping the system, according to enterprise procedures.
	2.4	Vacuum pumping equipment is operated to achieve a required vacuum.
	2.5	Required operation is performed under vacuum conditions according to enterprise procedures.
	2.6	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, and implementation of risk management and enterprise procedures.
	3 Complete a vacuum operation in a safe manner	3.1
3.2		Work site is made safe in accordance with enterprise procedures.
3.3		Vacuum pump is isolated from the system and chamber and components returned to atmospheric pressure.
3.4		Visual and operational checks are conducted to validate the vacuum operation process/procedure.
3.5		Work completion is notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Follow OHS requirements
- Consult and communicate with others
- Obtain and understand procedural plans
- Set up vacuum equipment
- Operate vacuum pumping equipment

Required Knowledge:

- Safety requirements for vacuum operations.
 - Location and availability of equipment SOP's
 - vacuum protection procedures for toxic, biological or chemical hazards
 - Electrical isolation procedures for specific equipment
- Planning & setup a vacuum operation.
 - Vacuum gauge specifications
 - Pressure relief systems/devices
 - Hazardous chemicals in the vacuum systems
 - Hazardous chemicals used in production
 - Hazardous chemicals within gauges – mercury
 - Gauge protection devices (explosion/ implosion shields)
 - Flush volatile gases from vacuum chambers



- Isolation of high voltage ionization gauges
- Isolation of high voltage from manufacturing
- Flammable gases within gauges
- Thermal cut out devices on vacuum pump motors
- Guarding of mechanical components on pumps and vacuum equipment
- Oil vapour exhaust/ducting
- Inspection of glass vacuum chambers for chips or fractures prior to a vacuum being applied
- Installation of implosion guards
- Work in a safe manner using high voltage equipment or components
- Toxic compounds used in the system
- Employment of appropriate safety wear
- Competent knowledge and use of MSDS, EPA requirements and OH&S best practice
- Completing a vacuum operation.
 - Air admission procedures and processes in accordance with equipment operating manual & SOP's
 - Employ safe working practice when admitting air, safety with regard to hot and cold surfaces – burns and ignition
 - Air admission to be carried out in a controlled manner using SOP
 - Operating large vacuum chambers in a small rooms where air admittance may cause a drop in room pressure

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 in the Performance Criteria is detailed below.

Occupational health & safety requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operating procedures
- awards provisions

Environmental procedures may involve:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets & drawings
- reporting and communication
- manufacturers' specifications and operational procedures



Appropriate personnel may include but are not limited to:

- supervisor
- colleague
- foreman
- team leader
- supervising engineer
- teacher

Vacuum equipment may include but are not limited to:

- vacuum pumps
- roots
- dry
- rotary vane
- turbo
- diffusion
- vacuum measurement equipment
- gauges
- leak detectors
- flanges/feedthroughs
- pumping stations

Resources and equipment may include but are not limited to:

- computer access
- scientific calculator
- vacuum equipment data and manuals
- vacuum processes available
- materials to used in a vacuum operation

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;



- Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
- Demonstrate the ability to select equipment, materials and processes to perform a vacuum operation on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21240 Apply vacuum principles to advanced manufacturing

Unit Descriptor

This unit of competency sets out the knowledge and skills required to apply vacuum principles to advanced manufacturing. This involves a sound knowledge of vacuum characteristics and typical applications of vacuum components and equipment.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit applies in a manufacturing environment where vacuum technology is used in the manufacturing process

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Determine vacuum technology applicable to a given manufacturing task

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
- 1.3 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 Safe working procedures for setup and operation of vacuum processes and equipment are identified.
- 1.5 The requirements for the application of **vacuum technology** are determined from documentation, reports or clients and from discussions from appropriate personnel.
- 1.6 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site.
- 1.7 **Resources and equipment** needed for the task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.



2. Select and/or document appropriate vacuum materials for use in advanced manufacturing processes	2.1	OH&S requirements for carrying out the work are followed.
	2.3	Materials required for the vacuum process and/or manufacturing process are selected and/or documented according to enterprise procedures.
3. Apply vacuum technology to a manufacturing process	3.1	OH&S requirements for carrying out the work are followed.
	3.2	Equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements.
	3.3	The most effective process for the task is determined in accordance with enterprise procedures.
	3.4	Vacuum technology is applied to a manufacturing process and outcomes are monitored according to enterprise procedures.
	3.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	3.6	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
4. Verify and interpret results	4.1	OH&S requirements for completing the work are followed.
	4.2	Work site is made safe in accordance with enterprise procedures.
	4.3	Results are verified, interpreted and discussed with appropriate personnel.
	4.4	Results are recorded, where appropriate, according to enterprise procedures.
	4.5	Work completion is notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Select materials
- Apply vacuum technology manufacturing process
- Notify work completion

Required Knowledge:

- Gas characteristics & properties:
 - States of matter
 - Desorption



- Diffusion
- Permeation
- Vacuum spectrum:
 - Low or rough vacuum - 1013 mbar to a few mbar
 - Medium vacuum - a few mbar to 10^{-3} mbar
 - High vacuum - 10^{-3} mbar to 10^{-7} mbar
 - Ultra high vacuum – below 10^{-7} mbar
- Methods of lowering pressure
 - Displacement or transfer of gas
 - Sorption or condensation
- Applications of vacuum technology in industry
 - Vacuum coating
 - Freeze drying
 - Vacuum packaging
 - Vacuum leak testing
 - Semiconductor production
 - Research
 - Electron microscopes
 - Particle acceleration
 - Thermonuclear experiments
 - Storage rings for particle accelerators
 - Clean surface studies
 - Space simulation experiments

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 in the Performance Criteria is detailed below.

OH&S requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor



- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Vacuum technology includes:

- low or rough vacuum
- medium vacuum
- high vacuum
- ultra high vacuum

Resources and equipment may include but are not limited to:

- computer access
- scientific calculator
- vacuum equipment data and manuals
- vacuum processes available
- materials to used in a vacuum operation
- standard operating procedures for the workplace

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;



- Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
- Demonstrate the ability to apply the principles of vacuum technology to advanced manufacturing situation on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU20909 Develop an individual career plan for the engineering industry

Unit Descriptor This unit of competency sets out the knowledge and skills required to research careers and training opportunities in the Manufacturing and Engineering Industry and develop an individual career path plan. This involves examining the range of activities the industry covers, the types of occupations that are available and the training pathways that can lead to those occupations.

No licensing, legislative, regulatory or certification requirements apply to this unit of competency at the time of publication.

Employability Skills This unit contains Employability Skills.

Application of the Unit This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 3 or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1	Gather information about the engineering and manufacturing industry.	1.1	The role, diversity and structure of the <i>engineering and manufacturing industry</i> are identified.
		1.2	The <i>major types of occupations</i> within the industry are identified and described.
		1.3	The <i>major career paths</i> available in the industry are identified and described.
2	Develop a career path plan.	2.1	The individual's own skills and interests are assessed and described.
		2.2	The <i>training pathways</i> for entering a suitable occupational area are identified.
		2.3	A strategy for gaining access to a suitable occupational area is developed.
3	Review plan.	3.1	Feedback on the <i>career path plan</i> is obtained from <i>appropriate personnel</i> .
		3.2	The career path plan is amended as necessary

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- Collect information
- Develop a personal career plan
- Reflect on a personal career plan

Required knowledge:

- Major sectors of the industry
 - aerospace
 - automotive
 - electrical/electronics
 - fine trades
 - food
 - furnishing
 - heavy engineering
 - production manufacturing
 - maintenance and installation
 - metals
 - mineral products
 - plastics, rubber, cables
 - textiles, clothing and footwear
- Industry structure including
 - largest employers in Victoria
 - dominance of small business
 - main locations eg outer suburban Melbourne and large regional centres
 - nature of employment ie full time
- Pathways to occupations
 - VET in schools to:
 - traineeships
 - apprenticeships
 - diploma/advanced diploma
 - traineeships to:
 - apprenticeships
 - production
 - technicians
 - paraprofessionals
 - diploma/advanced diploma
 - apprenticeships to:
 - trades
 - diploma/advanced diploma
 - Diplomas/Advanced Diplomas to:
 - technicians
 - para-professionals



- degrees
- Degrees to:
 - professionals

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 in the Performance Criteria is detailed below.

Engineering and manufacturing industry may include:

- employer and employee associations
- government agencies
- industry bodies
- professional associations
- mainstream media
- industry training boards
- major sectors of the industry
- types of products manufactured
- types of materials used
- structure of the industry

Major types of occupations may include but are not limited to:

- production
- trades
- technicians
- para-professional
- professional
- administration
- sales/marketing

Training pathways may include:

- VET in Schools
- traineeships
- apprenticeships
- Diplomas/Advanced Diplomas
- Degrees

Career path plan may include but are not limited to:

- training plan
- work experience/work placements
- employment

Appropriate personnel may include but are not limited to:

- supervisor
- leading hand
- foreman
- trainer/coach
- teacher

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

The evidence on which competency in this unit is deemed should demonstrate consistent performance.

- A representative body of performance criteria demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:
- Demonstrate essential knowledge and associated skills as described in this unit; and
- Demonstrate an appropriate level of skills enabling employment

Context of and specific resources for assessment

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OH&S policy and work procedures and instructions.
- Access to workplace environment.
- Operational access to relevant machines, tools, materials and consumables
- Access to relevant plans, drawings and instructions
- Manufacture's specifications/manuals.
- In addition to the resources listed above, evidence should show competency working in realistic environment and a variety of conditions.

Method of assessment

This unit of competency will usually be assessed by the following methods:

- observation of processes and procedures
- oral and/or written questioning on required knowledge and skills
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.



Assessment should also reinforce the integration of employability skills.

Competent performance with inherent safe working practices is expected. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.

VU20914 Form, bend and shape engineering materials

Unit Descriptor

This unit of competency sets out the knowledge and skills required to produce a range of basic engineering components and products using basic fabrication techniques. This involves identifying the required manufacturing methods, planning the operations, preparing materials and equipment, producing components and assembling components.

The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships and traineeships.licensing, legislative.

Employability Skills

This unit contains Employability Skills.

Prerequisite Unit/s

VU20913 Apply basic fabrication techniques

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 3 or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan to form bend and shape engineering materials	1.1 <i>Documentation, task requirements</i> and specifications are determined through request, work orders or equivalent and clarified with the <i>appropriate personnel</i>. 1.2 <i>Occupational health and safety requirements</i>, relevant Australian standards, codes of practice, manufacturer's specifications, <i>environmental requirements</i> and <i>enterprise procedures</i> are identified and adhered to. 1.3 Relevant plans, drawings and instructions are identified, interpreted and understood. 1.4 A work plan is prepared for required operations showing optimal use of time and <i>resources</i>. 1.5 <i>Factors affecting performance</i> of the task are identified and accounted for where possible.
2. Prepare materials and equipment	2.1 <i>Materials</i> and <i>resources</i> are identified, obtained and checked as fit for purpose.



	2.2	Components are marked out with appropriate allowances and tolerances for cutting, machining, forming and assembly.
	2.3	Machine tooling and accessories are selected and prepared appropriate to the manufacturing task and according to relevant engineering principles and conditions.
	2.4	Forming and cutting equipment are set up for correct operation to produce required shapes and products .
3. Cut and form basic engineering components	3.1	Work is held or clamped correctly according to engineering principles and safe work practices.
	3.2	Forming equipment, cutting equipment and tooling are used in a manner that optimises tool life.
	3.3	Safe work practices and procedures are followed and hazard control measures implemented where practicable.
	3.4	Machine and equipment settings are selected correctly based on engineering principles and relevant calculations/formulae.
	3.5	Completed work piece is inspected for compliance with specifications and requirements.
	3.6	Unexpected situations are dealt with safely and reported to the appropriate personnel.
4. Assemble fabricated components	4.1	Assembly tools and equipment appropriate to the task are selected and prepared
	4.2	Components are assembled using basic assembly techniques to enterprise procedures.
	4.3	Assembly is checked for operational performance and compliance to specifications
5. Ensure quality of products and components	5.1	Elements of the enterprise quality control system that contribute to product quality are applied throughout manufacturing operation
	5.2	Efficient and effective manufacturing is achieved through application of basic fabrication principles
	5.3	Product quality problems are identified using enterprise quality improvement procedures and causes identified
6. Complete work requirements	6.1	Completed work is reported to appropriate personnel according with enterprise procedures.
	6.2	Work area is cleared of waste, cleaned and secured following enterprise procedures.
	6.3	Machines, tools and equipment are maintained and stored following enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- mark out materials



- bend allowance/neutral axis
- plan job and task sequence
- set feeds and speeds
- hold work for cutting and forming
- set up and operate cutting equipment
- set up and operate forming equipment
- apply joining methods
- apply quality procedures
- check conformance of work specifications
- read and interpret routine information on written job instructions, specifications and standard operating procedures
- follow oral instruction and standard procedures
- enter routine and familiar information onto proforma and standard workplace forms

Required knowledge:

- production techniques and processes
- forming, fabricating, shaping, extrusions
- marking out medium and tools
- marking out calculations
- fabrication methods/techniques
- machine capacities
- sequence of operations
- cut off machine types and operation
- assembly aids
- joining methods and materials

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 in the Performance Criteria is detailed below.

Documentation

- task lists
- instructions
- work procedures
- manufacturer manuals
- technical drawings and sketches

Task requirements

- timeframe for task
- tools and equipment
- working with others
- materials, parts and other resources
- specifications
- procedures
- special reporting requirements
- quality measures



<i>Appropriate personnel</i>	• supervisor • leading hand • foreman • trainer • teacher
<i>Occupational health & safety requirements</i>	• legislation • protective equipment • material safety management systems • hazardous substances and dangerous goods code • local safe operating procedures • award provisions
<i>Environmental requirements</i>	• solid waste • gas, fume, vapour, smoke emissions, including fugitive emissions • excessive energy use • excessive noise • proximity to other personnel
<i>Enterprise procedures</i>	• use of tools and equipment • instructions, including job sheets, cutting lists, plans, drawings and designs • reporting and communication • manufacturers' specifications and operational procedures
<i>Resources</i>	• work requests/sheets • personal protective equipment • plans, drawings and sketches • marking out equipment • measuring equipment • ferrous and non-ferrous sheet, plate, section and tube • tools • cutting and fabrication equipment • consumables
<i>Factors affecting task performance</i>	• wrong or damaged parts • unexpected or potential delays • environmental factors – weather, noise, dust etc. • hazards • insufficient or incorrect information • material shortages
<i>Materials</i>	• plate, section or sheet, including tube to 5mm • ferrous and non ferrous and non-metallic substances
<i>Forming equipment</i>	• universal plate workers • rolling • pyramid and pinch rolls • folding and pressing



Shapes and products

- press-brakes, presses, cramp and pan brakes
- bench folders
- brackets
- connections
- frames
- trays
- cylinders
- cones
- angles
- hoppers
- simple ductwork and piping runs & connections
- "square to round"
- simple "transitions" using regular shapes
- tubular shapes, including hand rails, reticulation pipework, mufflers

Cutting equipment

Fixed:

- band saw/power hack saw
- guillotine
- set of rolls
- folder/press
- shear crop and punch machine
- grinders
- drills

Hand held:

- nibbler
- nibblers/notchers
- punches
- shears
- grinders
- drills

Safe work practices and procedures

- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- first aid
- workshop safety
- housekeeping
- personnel - self, others.
- material handling

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.



Critical aspects for assessment and evidence required to demonstrate competency in this unit

A person who demonstrates competency in this unit must be able to safely handle engineering materials. Competency in this unit cannot be claimed until all prerequisites have been satisfied.

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.

In particular this shall incorporate evidence that shows a candidate is able to:

- Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range; and
- Demonstrate essential knowledge and associated skills as described in this unit; and
- Demonstrate an appropriate level of skills enabling employment

Context of and specific resources for assessment

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OH&S policy and work procedures and instructions.
- Access to workplace environment.
- Operational access to relevant machines, tools, materials and consumables
- Access to relevant plans, drawings and instructions
- Manufacture's specifications/manuals.

The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures
- oral and/or written questioning on required knowledge and skills
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.

Assessment should also reinforce the integration of employability skills.

Competent performance with inherent safe working practices is expected. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.

VU20911 Handle engineering materials

Unit Descriptor

This unit of competency sets out the knowledge and skills required to safely handle materials in accordance with occupational health and safety requirements and enterprise procedures. This involves using manual handling techniques, operating mechanical handling equipment and handling industrial chemicals and materials.

The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practise in this unit is subject to regulations directly related to occupational health and safety and, where applicable, contracts of training such as apprenticeships.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 3 or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan to lift and move materials	1.1 Lifting and moving requirements are identified and clarified with <i>appropriate personnel</i> . 1.2 <i>Resources</i> , safety and handling factors are identified and hazard control measures implemented where practicable. 1.3 Special handling procedures for <i>hazardous materials</i> and areas are identified and applied. 1.4 <i>Manual lifting techniques, mechanical aids, tools and material handling equipment</i> are selected appropriate to the <i>material properties</i> , task requirements, safety and handling factors. 1.5 Safety signs, symbols and labels are identified and interpreted correctly.
2. Move/shift materials	2.1 <i>Manual lifting techniques</i> and strategies are correctly applied. 2.2 Material is lifted, moved and placed/stored safely. 2.3 Handling equipment is operated and stored safely and correctly, taking account of <i>environmental considerations</i> . 2.4 Safe handling practices, procedures and directions are followed.
3. Apply emergency procedures	3.1 Emergency first aid procedures are applied in accordance with <i>occupational health and safety requirements</i> and <i>enterprise procedures</i> . 3.2 Emergency containment/protection procedures relating to specific materials are applied if applicable.



REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- safe operation of mechanical aids and lifting devices
- care and storage of mechanical aids and lifting devices
- cooperate in a team
- report verbally
- question and clarify information
- follow oral and written instructions

Required knowledge:

- manual lifting techniques and applications
- safe lifting and carrying
- material properties and handling properties
- legislation, acts and national occupational health and safety (NOHSC) guidelines
- labelling of dangerous materials
- material safety data sheets (MSDS)
- risk assessment and hazard control
- use of personal protective equipment and safety devices
- personal responsibilities
- types and selecting mechanical aids and lifting devices
- interpreting signs and symbols
- interpreting work instructions and procedures
- interpreting labels

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 in the Performance Criteria is detailed below.

Appropriate personnel may include but are not limited to:

- supervisor
- leading hand
- foreman
- trainer/coach
- teacher

Resources may include but are not limited to:

- work requests/sheets
- safety signs, symbols and labels
- material safety data sheets (MSDS)
- emergency procedures
- relevant codes
- personal protective equipment
- dedicated tools



- materials and objects for lifting/moving
- mechanical lifting aids
- mechanical lifting devices
- consumables

Hazardous materials may include but are not limited to:

- chemicals
- liquids and gases
- toxic and noxious materials

Manual lifting techniques and strategies such as:

- strategies
 - individual and team lifting
 - dividing load
 - re-packaging
- manual lifting techniques
 - lifting
 - carrying
 - lowering
 - pulling
 - pushing
 - storing
 - team lifting
- mechanical aids
 - blocks
 - wedges
 - ropes
 - containers
 - levers

Mechanical aids may include but are not limited to:

- levers and bars
- spreader bars
- slings and dogs
- wedges
- chain blocks
- cranes and hoists

Tools

- dedicated tools for attaching/removing mechanical lifting aids and safety equipment e.g. spanner

Mechanical handling equipment may include but are not limited to:

- hand trolleys and skates
- wheelbarrows
- hand pallet trucks (not sit on)
- hand carts
- other dedicated devices used for handling materials

Material properties may include but are not limited to:

- size
- mass
- shape
- structure
- chemical properties
- any specific property affecting handling operation

Environmental considerations may include but are not limited to:

- excessive noise
- proximity to other personnel
- hazardous materials and areas
- workplace layout

Occupational health & safety requirements may include but are not limited to:

- legislation, acts and National Occupational Health and Safety (NOHSC) guidelines
- personal protective equipment
- material safety management systems
- material safety data sheets (MSDS)
- hazardous substances and dangerous goods codes
- local safe operating procedures
- awards provisions
- assessment of risk
- hazard control measures

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets
- labelling and packaging
- material handling and storage
- safety procedures
- emergency procedures
- reporting and communication
- manufacturers' specifications and operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

A person who demonstrates competency in this unit must be able to safely handle engineering materials. Competency in this unit cannot be claimed until all prerequisites have been satisfied.

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.



In particular this shall incorporate evidence that shows a candidate is able to:

- Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range; and
- Demonstrate essential knowledge and associated skills as described in this unit; and
- Demonstrate an appropriate level of skills enabling employment
- Plan to lift and move a range of engineering materials, considering applicable safety and handling factors
- Safely lift and move materials using a range of mechanical handling aids and equipment
- Demonstrate hazard control and emergency procedures

Context of and specific resources for assessment

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OH&S policy and work procedures and instructions
- Access to workplace environment
- Operational access to relevant equipment, tools, materials and consumables
- Access to relevant plans, drawings and/or instructions
- Manufacturer specifications/manuals
- Evidence should show competency working in realistic environment and a variety of conditions. The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures
- oral and/or written questioning on required knowledge and skills
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- a portfolio of documentary evidence

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.



Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

Assessment should also reinforce the integration of employability skills.

VU21241 Identify & select vacuum components & materials

Unit Descriptor

This unit of competency sets out the knowledge and skills required to identify all commonly used vacuum components, their characteristics and appropriate applications in industry. This involves a sound underpinning knowledge of vacuum characteristics and typical applications of vacuum components and equipment.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 4 or higher. This unit applies in a manufacturing environment where vacuum technology is used in the manufacturing process.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Distinguish vacuum equipment and components

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **Occupational health & safety requirements**, relevant Australian standards, codes of practice, manufacturers' specifications, **environmental requirements** and **enterprise procedures** are identified and adhered to.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 Operating procedures for planned **vacuum equipment** operation are obtained and understood and all equipment and materials required are listed.
- 1.5 Characteristics for vacuum equipment and components are located and identified from manufacturers' specifications, manuals and technical data sheets.
- 1.6 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.

	1.7	Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2.	Determine the most appropriate vacuum process and suitable materials for a given applications	2.1 OH&S requirements for carrying out the work are followed. 2.2 The correct method of connecting vacuum components to perform the required process is selected and options are discussed with appropriate personnel. 2.3 The appropriate vacuum components are selected to achieve the required degree of vacuum. 2.4 The most appropriate materials are selected for the required task. 2.5 The most effective process for the vacuum equipment and components available are selected according to enterprise procedures. 2.6 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, and implementation of risk management and enterprise procedures.
3.	Verify selection of process and material	3.1 OH&S requirements for completing the work are followed. 3.2 The selection of vacuum process and materials is validated and checked off in conjunction with appropriate personnel. 3.3 Work completion is notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Follow OHS requirements
- Consult and communicate with others
- Select vacuum process
- Select vacuum materials and equipment

Required Knowledge:

- Gas characteristics & properties:
 - States of matter
 - Desorption
 - Diffusion
 - Permeation
- Vacuum spectrum:
 - Low or rough vacuum - 10¹³ mbar to a few mbar
 - Medium vacuum - a few mbar to 10⁻³ mbar
 - High vacuum - 10⁻³ mbar to 10⁻⁷ mbar
 - Ultra high vacuum – below 10⁻⁷ mbar



- Methods of lowering pressure
 - Displacement or transfer of gas
 - Sorption or condensation
- Applications of vacuum technology in industry
 - Vacuum coating
 - Freeze drying
 - Vacuum packaging
 - Vacuum leak testing
 - Semiconductor production
 - Research
 - Electron microscopes
 - Particle acceleration
 - Thermonuclear experiments
 - Storage rings for particle accelerators
 - Clean surface studies
 - Space simulation experiments
- Introduction to materials for use in vacuum
 - material property requirements
 - mechanical
 - thermal
 - gas loading
- Commonly used materials
 - metals for vacuum envelope
 - metals for demountable seals
 - plastics
 - elastomers
 - ceramics
 - glass
 - pumping fluids
 - high vacuum lubricants
 - epoxies and leak sealers
 - vacuum tapes

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 in the Performance Criteria is detailed below.

Occupational health & safety requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operating procedures
- awards provisions



Environmental procedures may involve:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets & drawings
- reporting and communication
- manufacturers' specifications and operational procedures

Appropriate personnel may include but are not limited to:

- supervisor
- colleague
- foreman
- team leader
- supervising engineer
- teacher

Vacuum equipment may include but is not limited to:

- vacuum pumps
 - roots
 - dry
 - rotary vane
 - turbo
 - diffusion
- vacuum measurement equipment
- gauges
- leak detectors
- flanges/feedthroughs
- pumping stations

Resources and equipment may include but are not limited to:

- computer access
- scientific calculator
- vacuum equipment data and manuals
- vacuum processes available
- materials to used in a vacuum operation
- standard operating procedures for the workplace

Materials may include but are not limited to:

- metals for vacuum envelope
- metals for demountable seals
- plastics
- elastomers



- ceramics
- glass
- pumping fluids
- high vacuum compatible lubricants
- vacuum compatible tapes

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to identify all commonly used vacuum components, their characteristics and appropriate applications in industry on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals





Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21170 Implement and maintain control systems for industrial processes

Unit Descriptor

This unit of competency sets out the knowledge and skills required to implement and maintain control systems for industrial processes in engineering. It includes the configuration and installation of a range of analog and digital electronic devices for controlling processes through the application of stored programs.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. The unit describes the competency required to configure, install, diagnose, fault-find and commission control systems for a range of industrial processes in engineering.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Determine control system requirements

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for implementing and commissioning a control system are identified.
- 1.2 Interfacing and programming requirements are established through requests, work orders or equivalent and clarified with the **appropriate personnel**.
- 1.3 Control system components are selected from applicable documents to meet the design specification and calculations and to satisfy cost, reliability and life requirements.
- 1.4 Expert advice is sought with respect to control system configuration and according to **enterprise procedures**, where appropriate.

2. Configure and install control system components and software

- 2.1 OH&S requirements for carrying out the work are followed.
- 2.2 Industry codes, regulations and technical data relevant to control systems are interpreted and understood.



	2.3	Control system parameters, tables and graphs are used to obtain computational data where appropriate.
	2.4	Sensors and actuators, including analog transducers and hardware signal conditioning devices are connected to computer interface.
	2.5	Signal conditioning and actuator driver cards and hardware sequencing devices are integrated as required.
	2.6	Resources and equipment required are identified, obtained and checked as fit for purpose.
	2.7	Signal paths are tested and confirmed using testing equipment appropriate to the task.
3.	Commission and maintain control system	
	3.1	OH&S requirements for carrying out the work are followed.
	3.2	Work area and equipment are made safe in accordance with established safety procedures.
	3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	3.4	Control system is tested and commissioned using computer automation and appropriate testing equipment as required.
	3.5	Compliance of control system is checked and confirmed against operational specification.
	3.6	Fine-tuning, including program editing is performed as necessary.
	3.7	Individual and multiple faults are diagnosed within given time constraints using appropriate problem solving techniques.
	3.8	Faults are rectified using appropriate testing equipment and techniques.
	3.9	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site.
4.	Verify and document control system	
	4.1	OH&S requirements for carrying out the work are followed.
	4.2	Results are verified and discussed with appropriate personnel.
	4.3	Results are graphed or charted where appropriate.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:



- Consult and communicate with others
- Identify and follow relevant OH&S procedures
- Read and understand technical data
- Use control system parameters, tables and graphs
- Connect sensors and actuators to a computer interface.
- Integrate signal conditioning and actuator driver cards and hardware sequencing devices
- Test signal paths
- Test and commission control system
- Carry out compliance tests
- Fine-tune performed
- Diagnose individual and multiple faults
- Rectify faults
- Verify and document results

Required Knowledge:

- Operating modes of BJT, FET and MOSFET devices
 - Cut – off
 - Saturation
 - Amplification (Analogue)
- Relay characteristics
 - Types
 - Ratings
- The relationships of operating modes to industrial control circuits and modules.
 - On/Off state resistance
 - Current sinking and sourcing
 - PNP type
 - NPN type
 - Analogue
- Voltage level shifting circuits and their applications
 - High to Low voltage
 - Low to High voltage
 - TTL and CMOS interfacing
- The 4-20mA current loop.
 - Range and span of operation
 - Applications with TT industrial control module
 - 4-20mA transmitter/Receiver IC's
- Specialty interfacing IC's
 - Opto-coupler IC's
 - RS232 transmitter/receiver IC's
 - High current driver IC's
- Control systems and terminology
 - closed and open loop control
 - control system block diagram
 - control modes
 - programming an industrial PID controller



- Final correcting devices
 - electromechanical relays
 - solid state relays
 - servo motors
 - stepper motors
- Industrial timers
 - revision of electronic
 - configuration of industrial timer modules
 - programming of industrial timer modules
- Data acquisition
 - ADCs and DACs
 - electrical noise, earth loops and shielding instrumentation amplifiers
 - cabling requirements
 - voltage and current standards
 - asynchronous and synchronous data transfer telemetry
- Computer control
 - revision of programmable controllers
 - survey of programmable controller advanced functions and systems
 - computer (XT/AT) familiarisation
 - digital I/O boards
 - analog I/O boards
 - high level languages
 - data acquisition software
 - data loggers
- Robotic control
 - robotic classifications and configurations
 - methods of actuation and motion
 - programming robotic systems
 - robotic sensors
 - industrial applications and safety
 - robotic safety
- PID Control
 - control algorithm
 - proportional control
 - integral control
 - derivative control
- Writing the program for closed loop control
 - ON-OFF control
 - PID control
- Tuning a PID control loop
 - choosing the proportional constant
 - choosing the integral constant

- choosing the derivative constant
- Digital Control
 - Sampling rates
 - Minimum sampling rates, Nyquist criterion
 - Factors that effect the sampling rate
 - Measuring the sampling rate

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include, but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Enterprise procedures may include, but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Resources and equipment may include, but are not limited to:

- signal conditioning & actuator driver cards
- analog transducers



- hardware sequencing device
- computer interface cards
- sensors and actuators
- solid state controller (PID)
- controller hardware
- power sources
- cabling and connectors
- equipment, parts and components
- PC controller and software
- Programmable Logic Controller
- microcontroller
- microprocessor
- hand and power tools
- drawing and reference documents
- testing and measuring equipment

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to implement and maintain control systems for industrial processes in engineering on more than one occasion and in different contexts.
 - Verify and document control systems

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered



by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21085 Integrate programmable logic controllers into industrial control processes

Unit Descriptor

- This unit of competency sets out the knowledge and skills required to integrate programmable logic controllers into industrial control processes. This includes working safely, integrating various sensors and transducers with PLC I/O modules, using A/D and D/A converters with industrial computer systems, interfacing requirements between electronic modules and other system components, signal conditioning and use of programming techniques for converting electronic hardware signals into appropriate data structures for subsequent processing.
- No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication, although the application of the unit necessitates adherence to relevant State or Territory electrical safety and regulatory requirements.

Employability Skills

- This unit contains employability skills,
-

Application of the Unit

- The unit applies to enterprises where programmable logic controllers are integrated into automated processes, mainly in manufacturing and process control applications.
- This unit of competency is intended for courses at AQF 4 or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

1 Plan integration of PLCs into process

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S requirements** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 Integration task is determined from documentation, job sheets or discussions with appropriate personnel.
- 1.5 Integration of PLCs into the control process is analysed and optimum approach selected, planned for and checked against requirements.
- 1.6 **Resources** and **equipment** needed for the task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.
- 1.7 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.



2	Integrate PLCs into an automated process	2.1 OH&S requirements for carrying out the work are followed.
		2.2 Circuits/machines/plant are checked as being isolated where necessary in accordance OH&S requirements and enterprise procedures.
		2.3 Required sensors and transducers are interfaced to control process and PLC according to job specifications.
		2.4 Control software and hardware is made ready for operation and checked against requirements.
		2.5 Any faults and anomalies are identified and rectified.
		2.6 Appropriate methods and tools are used to test and verify control process.
		2.7 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3	Document automated process	3.1 OH&S requirements for completing the work are followed.
		3.2 Work site is made safe in accordance with established safety procedures.
		3.3 Control system is documented in accordance with enterprise procedure.
		3.4 Appropriate personnel are notified, in accordance with enterprise procedures, that the control system is operational.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- reading specification statements, diagrams and information
- interpreting project briefs to develop programs for control applications
- writing, testing, monitoring and debugging PLC programs
- selecting sensors and transducers to suit an applications
- interfacing sensors and transducers into control systems
- using correct grounding and shielding techniques
- using electronic test equipment correctly and efficiently
- integrating sensors with PLCs
- producing appropriate documentation
- communicating technical requirement to others;
- working with others;
- adapt to changes in work.

Required knowledge:

- sensor types, e.g. temperature, pressure, force, light, chemical etc
- hardware interfacing techniques
- cables and connectors
- A to D and D to A converters



- signal conditioning
- electrical noise, grounding and shielding
- communications protocols
- data gathering techniques
- PLC operations and software
- PLC programming
- process control principles
- automated manufacturing systems
- fault finding methodologies

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements such as:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Resources including:

- relevant documentation and specifications
- cables and connectors



- appropriate hand and power tools
- consumables

Equipment including:

- programmable logic controllers including software
- variety of transducers and sensors
- test equipment
- a sample control process, e.g. assembly line or manufacturing cell

Enterprise procedures for example:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria. In particular this shall incorporate evidence that shows a candidate is able to:

- implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range;
- demonstrate essential knowledge and skills as described in this unit;
- demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment;
- demonstrate the integration of PLCs into industrial control processes on more than one occasion and in different contexts.
- The demonstration of competence must show:
 - writing, testing, monitoring and debugging PLC programs
 - selecting sensors and transducers to suit an applications

- interfacing sensors and transducers into control systems
- using correct grounding and shielding techniques
- using electronic test equipment correctly and efficiently
- integrating sensors with PLCs
- producing appropriate documentation

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Evidence can be gathered through a variety of ways including:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU21243 Maintain & repair vacuum systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to maintain & repair vacuum systems in a safe manner. This involves a sound underpinning knowledge of vacuum components and systems and operating characteristics.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit applies in a manufacturing environment where vacuum technology is used in the manufacturing process.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Test vacuum system

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
- 1.3 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 The requirements for testing are determined from documentation, reports, job sheets and from discussion with appropriate personnel.
- 1.5 Suitable test procedures are determined for the given **vacuum equipment**.
- 1.6 Test equipment is connected and tests are performed in accordance with manufacturers' specifications and **enterprise procedures**.
- 1.7 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site.
- 1.8 **Resources and equipment** needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety.



2.	Develop maintenance schedules for vacuum systems	2.1	OH&S requirements for carrying out the work are followed.
		2.2	A schedule of maintenance for components is prepared based on manufacturers' specifications and enterprise procedures.
		2.3	Maintenance schedule is verified with production schedule and adapted to match production requirements and discussed with appropriate personnel.
3.	Operate leak detection equipment.	3.1	OH&S requirements for carrying out the work are followed.
		3.2	Leak check is performed using appropriate equipment and gauges to determine leak and location of leak.
4.	Diagnose vacuum systems	4.1	OH&S requirements for carrying out the work are followed.
		4.2	Vacuum diagnostic equipment to determine performance is used correctly and efficiently.
		4.3	Diagnostic software to determine faults or under- performance of the system is used effectively.
		4.4	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
		4.5	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
5	Replace vacuum components	5.1	OH&S requirements for carrying out and completing the work are followed.
		5.2	Faulty vacuum system components are removed and replaced according manufacturers' specifications and enterprise procedures.
		5.3	Leaks in the vacuum system are repaired according to manufacturers' specifications and enterprise procedures, if required.
		5.4	Work site is made safe in accordance with enterprise procedures.
		5.5	Maintenance activity is document or recorded results according to enterprise procedures.
		5.6	Work completion is notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Connect test equipment and perform tests
- Prepare a maintenance schedule
- Operate leak detection equipment



- Use diagnostic equipment and software
- Determine faults
- Replace components
- Repair leaks

Required Knowledge:

- Leak detection methods
 - Bubble testing for pressurised components
 - Thermal conductivity – over pressure
 - Thermal conductivity – Pirani gauge
 - Spark testers – Tesla coils
 - Mass spectrometers – over pressure method
 - Mass spectrometers – Vacuum method
 - Virtual leaks
- Vacuum leak detection – response times
- Pump Characteristics
 - Trapped Rotary pumps
 - Sorption pumps
 - Mechanical booster pumps
 - Vapour booster pumps
- Pump Systems Characteristics
 - Turbo Molecular pump systems
 - Cryopump systems
 - Sputter-ion pump systems
 - Diffusion pump systems
- Planned maintenance
 - Cycle times
 - Oil replacement cycles
 - Gas replacement cycles
 - Seals and ring replacement cycles
 - System performance checks – regular programming
- Temporary repair and maintenance measures
 - Syroacrolate liquids – (Loctite)
 - Black wax
 - Vacuum grease

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 in the Performance Criteria is detailed below.

OH & S requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code



- local safe operating procedures
- awards provisions

Environmental requirements may involve:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Appropriate personnel may include but are not limited to:

- supervisor
- colleague
- foreman
- team leader
- supervising engineer
- teacher

Vacuum equipment may include but is not limited to:

- vacuum pumps
- roots
- dry
- rotary vane
- turbo
- diffusion
- vacuum measurement equipment
- gauges
- leak detectors
- flanges/feedthroughs
- pumping stations

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets & drawings
- reporting and communication
- manufacturers' specifications and operational procedures

Resources and equipment may include but are not limited to:

- computer access
- scientific calculator
- vacuum equipment data and manuals
- vacuum processes available
- materials to used in a vacuum operation
- standard operating procedures for the workplace



EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to maintain & repair vacuum systems in a safe manner on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures



- oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21242 Operate vacuum components and systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to operate vacuum components and systems in a safe manner. This may involve a sound underpinning knowledge of chemistry involved in some manufacturing operations conducted under vacuum conditions.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 4 or higher. This unit applies in a manufacturing environment where vacuum technology is used in the manufacturing process.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Select appropriate equipment to perform a required operation

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 ***Occupational health & safety requirements***, relevant Australian standards, codes of practice, manufacturers' specifications, ***environmental requirements*** and ***enterprise procedures*** are identified and adhered to.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
- 1.4 Safe working procedures for setup and operation of vacuum processes and equipment are identified.
- 1.5 The requirements for the application of vacuum technology are determined from documentation, reports or clients and from discussions from appropriate personnel.
- 1.6 The time required for the evacuation process is determined.
- 1.7 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site.



	1.8	Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety.
2. Prepare equipment to perform required vacuum operation	2.1	OH&S requirements for carrying out the work are followed.
	2.2	Vacuum equipment is set up to perform a vacuum operation according to industry safe working procedures.
	2.3	All pre-operational equipment checks are performed prior to pumping the system according to enterprise procedures.
	2.4	Leak checks on the vacuum system are performed according to manufacturers' specifications and enterprise procedures and rectified, if required.
3. Perform pump down sequence	3.1	OH&S requirements for carrying out the work are followed.
	3.2	Pump down sequence is followed to achieve required vacuum level according to enterprise procedures.
	3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
	3.4	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
4. Complete vacuum operation	4.1	OH&S requirements for completing the work are followed.
	4.2	Work site is made safe in accordance with enterprise procedures.
	4.3	Gas levels in vacuum chamber are measured and compared with specifications.
	5.4	Vacuum process is verified as conforming to specifications and recorded according to enterprise procedures.
	4.5	Vacuum pump is isolated from the system and chamber and components returned to atmospheric pressure.
	4.6	Any faulty or worn equipment is reported to appropriate personnel in accordance with enterprise procedures.
	4.7	Work completion is documented and notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Set up vacuum equipment
- Perform leak checks



- Perform pump down sequence
- Measure gas levels
- Return chamber and components to atmospheric pressure

Required Knowledge:

- Vacuum spectrum
 - Low or rough vacuum - 1013 mbar to a few mbar
 - Medium vacuum - a few mbar to 10^{-3} mbar
 - High vacuum - 10^{-3} mbar to 10^{-7} mbar
 - Ultra high vacuum – below 10^{-7} mbar
- Methods of lowering pressure
 - Displacement or transfer of gas
 - Sorption or condensation
- Pump Characteristics
 - Trapped Rotary pumps
 - Sorption pumps
 - Mechanical booster pumps
 - Vapour booster pumps
- Pump Systems
 - Turbo Molecular pump systems
 - Cryo pump systems
 - Diffusion pump systems
 - Sputter-ion pump systems
- Vacuum System connections, components & assembly
 - Joint and flanges
 - Demountable pipeline couplings
 - Handling and cleaning “O” rings
 - Demountable UHV joints
- Vacuum valves
 - Materials used in couplings and valves
 - Valves for rough to medium vacuum
 - Valves for medium to high vacuum
 - Gate valves
 - Baffle valves
 - UHV valves
 - Air or gas admittance valves

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 in the Performance Criteria is detailed below.

Occupational health & safety requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems



- hazardous substances and dangerous goods code
- local safe operating procedures
- awards provisions

Environmental procedures may include but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets & drawings
- reporting and communication
- manufacturers' specifications and operational procedures

Appropriate personnel may include:

- supervisor
- colleague
- foreman
- team leader
- supervising engineer
- teacher

Resources and equipment may include but are not limited to:

- computer access
- scientific calculator
- vacuum equipment data and manuals
- vacuum processes available
- materials to used in a vacuum operation
- standard operating procedures for the workplace

Vacuum equipment including:

- vacuum pumps
- roots
- dry
- rotary vane
- turbo
- diffusion
- vacuum measurement equipment
- gauges
- leak detectors
- flanges/feedthroughs
- pumping stations



EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to apply to operate vacuum components and systems in a safe manner on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures



- oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU20912 Perform basic machining processes

Unit Descriptor	This unit of competency sets out the knowledge and skills required to undertake basic machining operations under supervision. This involves setting up and machining components by using lathes, milling machines, cut off saws, pedestal grinders and fixed position drilling machines. Marking out skills are also included as necessary in the machining process. There are no prerequisite competencies to this unit. However, it is advisable that <i>VU20910 Produce basic engineering sketches and drawings</i> be assessed as a co-requisite with this competency. <i>No licensing, legislative, regulatory or certification requirements apply to this unit of competency at the time of publication.</i>
Employability Skills	This unit contains Employability Skills.
Application of the Unit	This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 3 or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1	Plan and set up machining operations	1.1 The machining work is determined through request, work orders or equivalent and clarified with the <i>appropriate personnel</i>. 1.2 <i>Occupational health and safety requirements</i>, relevant Australian standards, codes of practice, manufacturer's specifications, <i>environmental requirements</i> and <i>enterprise procedures</i> are identified and adhered to. 1.3 <i>Resources</i> required are identified, obtained and checked as fit for purpose. 1.4 Relevant plans, drawings and instructions are identified, interpreted and understood. 1.5 A work plan is prepared showing the correct sequence of operation. 1.6 Machining operation is set up by selecting appropriately sharpened <i>tools</i> for the task required.
2	Conduct machining operations	2.1 Basic marking out techniques are used where required. 2.2 Machining equipment is used in a manner that optimises tool life. 2.3 Work is held or clamped correctly throughout the entire machining operation.



	2.4	Specific safety requirements are met throughout the task and can be explained
	2.5	Machine feeds and speeds are selected correctly throughout the machining operation
	2.6	Correct cutting lubricant is selected and used correctly throughout the machining operation
	2.7	Completed work piece is inspected for compliance with specifications and requirements.
	2.8	Unexpected situations are dealt with safely and reported to the appropriate personnel .
3	Complete work requirements	3.1 Completed work is reported to appropriate personnel according with enterprise procedures.
		3.2 Work area is cleared of waste, cleaned and secured following.
	3.3	Machines , tools and equipments are maintained and/or stored following enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- using machines and handling materials safely
- turning, facing and boring using a lathe
- planning and sequencing a job
- marking out of materials using appropriate marking medium and tools
- selecting techniques for holding work
- cutting a range of materials
- reshaping, sharpening, cutting tools
- using common abrasives
- loading and glazing
- setting-up and operating a drill
- selecting drill bits and drilling speeds
- following instructions
- identifying worn or damaged cutting tools
- mounting and positioning cutting tools
- adjusting machine settings
- selecting and using lubricants

Required knowledge:

- safe work practices and procedures
- hazards and control measures
- machine types and operation
- job materials
- types of wheel dressers
- procedures for wheel dressing
- safe operation of tools and machines
- machine types: drilling, cutting, lathes

- methods of holding work
- basic marking out techniques
- selection of feeds and speeds
- techniques and tools for measuring materials

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 in the Performance Criteria is detailed below.

Appropriate personnel may include but are not limited to:

- *supervisor*
- *leading hand*
- *foreman*
- *trainer*
- *teacher*

Occupational health & safety requirements may include but are not limited to:

- *legislation*
- *protective equipment*
- *material safety management systems*
- *hazardous substances and dangerous goods code*
- *local safe operating procedures*
- *awards provisions*

Environmental requirements may include but are not limited to:

- *liquid waste*
- *solid waste*
- *gas, fume, vapour, smoke emissions, including fugitive emissions*
- *excessive energy and water use*
- *excessive noise*

Enterprise procedures may include but are not limited to:

- *the use of tools and equipment*
- *instructions, including job sheets, cutting lists, plans, drawings and designs*
- *reporting and communication*
- *manufacturers' specifications and operational procedures*

Resources may include but are not limited to:

- *work requests/sheets*
- *personal protective equipment*
- *plans, drawings and sketches*
- *marking out equipment*
- *measuring equipment*
- *ferrous and non-ferrous materials*
- *tools*

- *machinery*
- *consumables*

Specific safety requirements may include but are not limited to:

- *working safely around machinery*
- *working safely with tools and equipment*
- *risk and hazard recognition*
- *emergency procedures*
- *awareness of electrical hazards*
- *follow confined spaces procedures*
- *first aid.*

Tools may include but are not limited to:

- *screwdriver*
- *spanners*
- *hammers*
- *files*
- *jigs*
- *cutting tools*
- *scribers*
- *chisels*
- *centre punches*
- *measurement instruments*
- *gauges*

Machines include:

- *cut off machines*
- *surface grinders*
- *drills*
- *lathes,*
- *mills,*
- *planers*

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

Before the critical aspects of evidence are considered all pre-requisite requisite shall be met.

The evidence on which competency in this unit is deemed should demonstrate consistent performance.

- A representative body of performance criteria demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:



	• Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range; and • Demonstrate essential knowledge and associated skills; and • Demonstrate an appropriate level of skills enabling employment
Context of and specific resources for assessment	This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include: • OH&S policy and work procedures and instructions. • Access to workplace environment. • Operational access to relevant machines, tools, materials and consumables • Access to relevant plans, drawings and instructions • Manufacture's specifications/manuals. • Evidence should show competency working in realistic environment and a variety of conditions.
Method of assessment	This unit of competency will usually be assessed by the following methods: • observation of processes and procedures • oral and/or written questioning on required knowledge and skills • testimony from supervisors, colleagues, clients and/or other appropriate persons • inspection of the final product or outcome • a portfolio of documentary evidence. Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons. Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency. Assessment should also reinforce the integration of employability skills. Competent performance with inherent safe working practices is expected. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.



VU20915 Perform basic welding and thermal cutting processes to fabricate engineering structures

Unit Descriptor

This unit of competency sets out the knowledge and skills required to perform:

- basic welding using manual metal arc welding (MMAW)
- basic welding using gas metal arc welding (GMAW)
- basic thermal cutting using fuel gas equipment

This involves identifying the welding/cutting requirements, preparing materials and equipment, welding and cutting components. Welding is routine and where the welding quality is not required to meet an Australian Standard or equivalent. Fillet and butt welds would typically be performed on low carbon/mild steels. Thermal cutting is manual straight line cutting.

The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships and traineeships.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 3 or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan welding and thermal cutting tasks

- 1.1 ***Documentation, task requirements*** and specifications are determined through request, work orders or equivalent and clarified with the ***appropriate personnel***.
- 1.2 ***Occupational health and safety requirements***, relevant Australian standards, codes of practice, manufacturer's specifications, ***environmental requirements and enterprise procedures*** are identified and adhered to.
- 1.3 Weld requirements are identified from job instructions and ***resources*** are identified.
- 1.4 ***Factors affecting performance*** of the task are identified and accounted for where possible.
- 1.5 Locations of welds are identified in accordance with ***enterprise procedures*** and job specifications.



	1.6	Safe work practices and procedures are followed and hazard control measures implemented.
2. Prepare materials and equipment for welding and thermal cutting	2.1	Materials are cleaned and prepared according to task and process requirements.
	2.2	Welding and thermal cutting equipment is set up correctly.
	2.3	Settings and consumables are selected to suit given application.
3. Perform routine welding using MMAW and GMAW	3.1	Safe welding practices are applied.
	3.2	Equipment adjustments are made correctly using standard operating procedures.
	3.3	Materials are welded to job requirements.
	3.4	Welds are cleaned according to standard operating procedures.
	3.5	Completed work piece is checked for conformance to specifications and requirements.
	3.6	Unexpected situations are dealt with safely and reported to the appropriate personnel.
4. Perform thermal cutting	4.1	Cutting process and/or procedure appropriate for material is selected.
	4.2	Equipment adjustments are made correctly using standard operating procedures.
	4.3	Appropriate cutting allowances are made.
	4.4	Material is used in the most economical way.
5. Complete work requirements	5.1	Completed work is reported to appropriate personnel according to enterprise procedures.
	5.2	Work area is cleared of waste, cleaned and secured following enterprise procedures.
	5.3	Tools and equipment are maintained and stored following enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- plan jobs and task sequences
- identify and clarify task requirements
- identify specifications and required resources
- plan the steps required to weld and cut components
- check plan against requirements
- review and revise outcomes against task objectives and requirements
- identify reasons why it was/was not met
- determine how the task could be done better
- adjust welding equipment to operating specifications



- weld with MMAW and GMAW
- make cutting allowances
- economise material and minimise wastage
- identify cutting defects and take corrective action
- heat and cut materials to specifications
- adjust heating and cutting equipment

Required knowledge:

- materials and process preparation
- hand and power tools
- properties and characteristics of materials and consumables
- equipment set-up and pre-start checks
- MMAW and GMAW processes, features and applications
- fuel gas properties and applications
- safe equipment operation
- different current and voltage settings, electrodes and other variable to suit typical situations
- different current and voltage settings, gas flow rates, wire diameters, wire feed speed and other variables to suit typical situations
- weld characteristics
- post-welding treatments
- cutting processes appropriate to material and conditions
- tools, equipment, accessories and techniques
- assembling procedures for equipment and accessories
- cutting allowances and reasons for applying them
- procedures for minimising waste material
- cutting defects and their causes

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 in the Performance Criteria is detailed below.

Documentation may include:

- task lists
- instructions
- work procedures
- manufacturer manuals
- technical drawings and sketches

Task requirements may include but are not limited to:

- timeframe for task
- tools and equipment
- working with others
- materials, parts and other resources
- specifications



- procedures
 - special reporting requirements
 - quality measures
- Appropriate personnel** may include but are not limited to:
- supervisor
 - leading hand
 - foreman
 - trainer
 - teacher
- Occupational health & safety requirements** may include but are not limited to:
- legislation
 - protective equipment
 - material safety management systems
 - hazardous substances and dangerous goods code
 - local safe operating procedures
 - award provisions
- Environmental requirements** may include but are not limited to:
- solid waste
 - gas, fume, vapour, smoke emissions, including fugitive emissions
 - excessive energy use
 - excessive noise
 - proximity to other personnel
- Enterprise procedures** may include but are not limited to:
- the use of tools and equipment
 - instructions, including job sheets, cutting lists, plans, drawings and designs
 - reporting and communication
 - manufacturers' specifications and operational procedures
- Resources** may include but are not limited to:
- work requests/sheets
 - personal protective equipment
 - plans, drawings and sketches
 - marking out equipment
 - measuring equipment
 - ferrous and non-ferrous sheet, plate, and bar
 - tools
 - MMAW and GMAW welding equipment
 - thermal cutting equipment
 - consumables
- Factors affecting task performance** may include but are not limited to:
- wrong or damaged parts
 - unexpected or potential delays
 - environmental factors – weather, noise, dust etc.
 - hazards
 - insufficient or incorrect information
 - material shortages
- Safe work practices and procedures** may include but are not limited to:
- working safely around machinery
 - working safely with tools and equipment

	• risk and hazard recognition • emergency procedures • first aid
Material	• low and mild carbon steel or similar
Preparation	• preheating, cleaning, setting up jigs, fixtures, clamps, joint preparation
Welding and thermal cutting equipment including:	• hoses, welding leads, gas shrouds, gas regulators, liners, contact tips (GMAW) • welding leads, welding machines, electrode holder etc. (MMAW) • fuel gas and hand held thermal cutting equipment (thermal cutting)
Consumables including:	• filler wire, shielding gas, electrodes
Cleaned	• slag and spatter

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

A person who demonstrates competency in this unit must be able to fabricate engineering structures using basic welding and thermal cutting processes. Competency in this unit cannot be claimed until all prerequisites have been satisfied.

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.

In particular this shall incorporate evidence that shows a candidate is able to:

- Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range; and
- Demonstrate essential knowledge and associated skills as described in 6.1 of this unit; and
- Demonstrate an appropriate level of skills enabling employment

Context of and specific resources for assessment

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:



- OH&S policy and work procedures and instructions.
- Access to workplace environment.
- Operational access to relevant machines, tools, materials and consumables
- Access to relevant plans, drawings and instructions
- Manufacture's specifications/manuals.

The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures
- oral and/or written questioning on required knowledge and skills
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.

Assessment should also reinforce the integration of employability skills.

VU20904 Perform cutting, grinding and turning operations

Unit Descriptor

This unit of competency sets out the knowledge and skills required to produce a range of basic engineering components and products by cutting, grinding and turning techniques. This involves identifying the required manufacturing methods, planning the operations, preparing materials and equipment, producing components and assembling components. The unit is intended to develop the basic skills and techniques attained through the pre-requisite machining, drawing interpretation, materials handling and OHS units.

The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships and traineeships.

Employability Skills

This unit contains Employability Skills.

Prerequisite Units

VU20912 Perform basic machining processes

Application of the Unit

This unit would be applied by entry level engineering workers required to undertake a range of well-defined cutting, grinding and turning activities.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan to cut, turn and grind engineering materials	1.1 <i>Documentation, task requirements and specifications</i> are identified and clarified with the <i>appropriate personnel</i>. 1.2 <i>Safe work practices and procedures</i> are identified and followed and hazard control measures implemented where practicable. 1.3 Required <i>materials</i> and <i>resources</i> are identified. 1.4 <i>Machines</i> and processes appropriate to the given task are selected. 1.5 A work plan is prepared including sequence of operations taking into account <i>environmental requirements</i>. 1.6 <i>Factors affecting performance</i> of the task are identified and accounted for where possible.
2. Prepare materials and equipment	2.1 Materials and <i>resources</i> are obtained and checked as fit for purpose.



	2.2	Components are marked out with appropriate allowances and tolerances for cutting, grinding or machining
	2.3	Machine tooling and accessories are selected appropriate to the manufacturing task and according to relevant engineering principles and conditions.
	2.4	Tooling is manufactured and/or prepared as appropriate to manufacturing operation and based on engineering principles.
	2.5	Machine, accessories and workpiece are set up for correct operation
3.	Perform cutting, turning and grinding operations	
	3.1	Work and tooling is held/clamped and aligned or trued correctly according to engineering principles, manufacturer recommendations and safe work practices.
	3.2	Machines and tooling are used and maintained in a manner that optimises tool life.
	3.3	Operations are performed safely, utilising all guards, safety procedures and personal protective clothing and equipment.
	3.4	Machining parameters are selected correctly based on engineering principles and relevant calculations/formulae.
	3.5	Work piece is inspected for conformance to specifications and task requirements using the appropriate measuring equipment .
	3.6	Unexpected situations are dealt with safely and reported to the appropriate personnel.
4.	Complete work requirements	
	4.1	Completed work is reported to appropriate personnel according with enterprise procedures.
	4.2	Work area is cleared of waste, cleaned and secured following enterprise procedures.
	4.3	Machines, tooling and accessories are cleaned, maintained and stored according to enterprise procedures and accepted engineering practice.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required skills:

- plan and sequence operations
- mark out work to meet specified tolerances
- complete calculations
- select and prepare machines and accessories for use
- set up and operate cutting machines, grinding machines and lathes
- cut/machine materials to specified dimensions and tolerances
- hold work for cutting, grinding or turning
- maintain mechanical cutting machines, grinding machines and lathes



- calculate work speeds and feed rates
- apply recommend tool angles from charts/tables for different material types
- overcome cutting tool failure
- apply quality procedures
- read and interpret routine information on written job instructions, procedures, specifications, charts, lists, drawings
- follow oral instructions and standard procedures
- check and clarify task related information
- enter routine and familiar information onto proforma and standard workplace forms
- check conformance of work to specifications
- measure to specified tolerances and dimensions

Required knowledge:

- factors influencing cutting machine, grinding machine and centre lathe selection
- machine capacities
- marking out tools and techniques
- safe work practices and procedures
- hazards and control measures
- functions of the major parts of cutting machines, grinding machines and centre lathe
- factors influencing feeds and speeds and depth of cut or material removal
- cutting fluids and coolants
- cutting tool materials
- principles of chip formation and control
- standard grinding wheel shapes, grades, composition and relevant applications
- cutting machine, grinder and lathe maintenance

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 in the Performance Criteria is detailed below.

Documentation may include:

- task lists
- instructions
- work procedures
- manufacturer manuals
- technical drawings and sketches

Task requirements may include:

- timeframe for task
- tools and equipment
- working with others
- materials, parts and other resources
- specifications
- procedures



- special reporting requirements
- quality measures

Specifications may include but are not limited to:

- dimensions and tolerances
- tool geometry
- surface finish

Appropriate personnel may include but are not limited to:

- supervisor
- leading hand
- foreman
- trainer
- teacher

Safe work practices and procedures may include but are not limited to:

- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition and control
- emergency procedures
- first aid
- housekeeping
- personnel - self, others
- protective equipment
- material safety management systems
- local safe operating procedures
- award provisions

Materials

- ferrous and non ferrous bar, section, plate and sheet

Resources may include but are not limited to:

- work requests/sheets
- personal protective equipment
- plans, drawings and sketches
- marking out equipment
- **measuring equipment**
- ferrous and non-ferrous materials
- tools
- cutting and grinding equipment
- consumables

Machines including:

Cutting

- band saw/power hack saw
- guillotine
- shear crop and punch machine
- bench grinders
- cold saws



- band saws
- pedestal and radial drills

Turning

- centre lathe

Grinding

- surface
- cylindrical
- centreless

Environmental requirements

may include but are not limited to:

- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy use
- excessive noise
- proximity to other personnel

Factors affecting performance

- wrong or damaged parts
- unexpected or potential delays
- environmental factors – weather, noise, dust etc.
- hazards
- insufficient or incorrect information
- material shortages

Tooling and accessories may include but are not limited to:

- high speed steel, carbide tips cutting tools, boring bars
- drills
- blades
- reamers
- thread chasers
- tapping heads, taps etc.,
- chucks and arbors
- live and dead centres,
- face plate
- steadies
- cross slide
- tailstock
- measuring devices
- abrasive wheels
- coolant

Operations may include but are not limited to:

- parallel cutting, drilling, knurling, boring, reaming, single start thread cutting, parting off, internal and external grinding

Machining parameters

- speeds, feeds, depth of cut, stops, coolant and cutting lubricants etc.

Measuring equipment may include but are not limited to:

- verniers, inside/outside micrometers, dial indicators, telescopic gauges, etc.

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

A person who demonstrates competency in this unit must be able to safely handle engineering materials. Competency in this unit cannot be claimed until all prerequisites have been satisfied.

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.

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- In particular this shall incorporate evidence that shows a candidate is able to:
- Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range; and
- produce a range of basic engineering components and products by cutting, grinding and turning techniques
- use the required manufacturing methods
- plan operations and prepare materials and equipment.

Context of and specific resources for assessment

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OH&S policy and work procedures and instructions.
- Access to workplace environment.
- Operational access to relevant machines, tools, materials and consumables
- Access to relevant plans, drawings and instructions
- Manufacture's specifications/manuals.

Evidence should show competency working in realistic environment and a variety of conditions.



The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

-

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures
- oral and/or written questioning on required knowledge and skills
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.

Assessment should also reinforce the integration of employability skills.

VU20903 Produce basic engineering components and products using fabrication and machining

Unit Descriptor	This unit of competency sets out the knowledge and skills required to produce a range of basic engineering components and products using basic fabrication and machining techniques. This involves identifying the required manufacturing methods, planning the operations, preparing materials and tooling, producing components and assembling components. <i>The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships and traineeships.</i>
Employability Skills	This unit contains Employability Skills.
Prerequisite Unit(s)	VU20912 Perform basic machining processes VU20913 Apply basic fabrication techniques
Application of the Unit	This unit would be applied by entry level engineering workers required to undertake a range of well-defined fabrication and machining activities.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan to produce basic engineering components	1.1 <i>Task requirements</i> and specifications are determined through request, work orders or equivalent and clarified with the <i>appropriate personnel</i>. 1.2 <i>Occupational health and safety requirements</i>, relevant Australian standards, codes of practice, manufacturer's specifications, <i>environmental requirements</i> and <i>enterprise procedures</i> are identified and adhered to. 1.3 Relevant plans, drawings and instructions are identified, interpreted and understood. 1.4 A work plan is prepared for required operations showing optimal use of time and <i>resources</i>. 1.5 Required <i>cutting and fabrication equipment, fabrication techniques</i> and <i>assembly and joining techniques</i> are identified as appropriate for the task.



2. Prepare materials and equipment	2.1 Materials and resources are identified, obtained and checked as fit for purpose. 2.2 Components are marked out with appropriate allowances and tolerances for cutting, machining, forming and assembly. 2.3 Machine tools and accessories are selected and prepared appropriate to the manufacturing task and according to relevant engineering principles and conditions. 2.4 Machines and equipment are set up for correct operation
3. Cut, machine and form basic engineering components	3.1 Work is held or clamped correctly according to engineering principles and safe work practices. 3.2 Machines and tooling are used in a manner that optimises tool life. 3.3 Specific safety requirements and procedures are followed and hazard control measures implemented where practicable. 3.4 Machine and equipment settings are selected correctly based on engineering principles and relevant calculations/formulae. 3.5 Completed work piece is inspected for compliance with specifications and requirements. 3.6 Unexpected situations are dealt with safely and reported to the appropriate personnel.
4. Assemble basic engineering components	4.1 Assembly tools and equipment appropriate to the task are selected and prepared. 4.2 Components are assembled using basic assembly and joining techniques to enterprise procedures. 4.3 Assembly is checked for operational performance and compliance to specifications
5. Ensure quality of products and components	5.1 Elements of the enterprise quality control system that contribute to product quality are applied throughout manufacturing operation 5.2 Efficient and effective manufacturing is achieved through application of basic machining and fabrication techniques. 5.3 Product quality problems are identified using enterprise quality improvement procedures and causes identified.
6. Complete work requirements	6.1 Completed work is reported to appropriate personnel according with enterprise requirements. 6.2 Work area is cleared of waste, cleaned and secured following enterprise procedures. 6.3 Machines, tools and equipment are maintained and stored following enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required skills:

- plan and sequence a job
- follow instructions
- use machines and handle materials safely
- mark out materials using appropriate marking medium and tools
- select techniques for holding work
- cut a range of materials
- identify worn or damaged cutting tools
- reshape and/or sharpen cutting tools
- use common abrasives
- set-up and operate cutting, grinding, drilling, turning and milling machines
- turn, face and bore using a lathe
- select drill bits and cutting/shaping tools
- select cutting speeds and feeds
- mount and position work and cutting tools
- adjust machine settings
- select and apply lubricants

Required knowledge:

- safe work practices and procedures
- hazards and control measures
- basic marking out techniques
- techniques and tools for measuring materials
- properties of materials
- safe operation of tools and machines
- machine types, operation and maintenance for cutting, grinding, drilling turning and milling
- methods of holding work
- selection of feeds and speeds
- cutting tool materials

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 in the Performance Criteria is detailed below.

Task requirements may include:

- timeframe for task
- tools and equipment
- working with others
- materials, parts and other resources
- specifications



- procedures
- special reporting requirements
- quality measures

Appropriate personnel may include but are not limited to:

- supervisor
- leading hand
- foreman
- trainer/coach
- teacher

Occupational health & safety requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operating procedures
- awards provisions

Environmental requirements may include but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise
- proximity to other personnel

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Resources may include but are not limited to:

- work requests/sheets
- personal protective equipment
- plans, drawings and sketches
- marking out equipment
- measuring equipment
- ferrous and non-ferrous sheet, plate, and bar
- tools
- machinery
- thermal cutting equipment
- consumables

Specific safety requirements may include but are not limited to:

- working safely around machinery
- working safely with tools and equipment
- risk and hazard recognition
- emergency procedures
- awareness of electrical hazards
- follow restricted spaces procedures
- first aid

Cutting equipment includes:

mechanical

- cut off machines
- surface grinders
- drills
- lathes,
- mills,
- planers

thermal

- fuel gas cutting torch

Fabrication techniques may include but are not limited to:

- *marking*
- *cutting*
- *forming*
- *fastening*
- *glueing*
- *assembling*

Fabrication equipment may include but are not limited to:

- nibblers
- metal shears
- guillotines
- pedestal drills
- power saws
- rivet fastening equipment
- pan brake
- press brake
- universal metal working machine

Assembly and joining techniques

- fasteners
- bolts, nuts, washers, rivets
- adhesives
- soldering
- welding

Tools may include:

- screwdriver
- spanners



- hammers
- files
- jigs
- cutting tools
- scribes
- chisels
- centre punches
- measurement instruments
- gauges

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

A person who demonstrates competency in this unit must be able to safely handle engineering materials. Competency in this unit cannot be claimed until all prerequisites have been satisfied.

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.

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- In particular this shall incorporate evidence that shows a candidate is able to:
- Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
- Produce a range of basic engineering components and assemble to produce products
- Use fabrication and machining technique
- Undertake planning, preparing materials and tooling

Context of and specific resources for assessment

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OH&S policy and work procedures and instructions.
- Access to workplace environment.
- Operational access to relevant machines, tools, materials and consumables
- Access to relevant plans, drawings and instructions



- Manufacture's specifications/manuals.
- Evidence should show competency working in realistic environment and a variety of conditions.

The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures
- oral and/or written questioning on required knowledge and skills
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.

Assessment should also reinforce the integration of employability skills.

VU20910 Produce basic engineering sketches and drawings

Unit Descriptor

This unit of competency sets out the knowledge and skills required in the identification, selection and interpretation of a drawing or sketch, and the preparation of sketches and drawings.

The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships and traineeships.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 3 or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Identify and select correct sketches or drawings to plan, conduct, or complete engineering tasks.	1.1 Required sketches or drawings are obtained from documentation, files systems or local sources in accordance with enterprise procedures. 1.2 Sketches and drawings are checked for containing all necessary information related to job requirements. 1.3 Notes, drawing versions and dates for sketches or drawings are assessed as appropriate. 1.4 Communications with others involved in the work is maintained to ensure efficient progress and completion of tasks and that safety is maintained at all times.
2 Interpret sketch or drawing details to plan, conduct or complete engineering tasks.	2.1 Objects and items are identified correctly from sketches and drawings. 2.2 Views and projections are correctly interpreted to reconstruct a 3D image of components, assemblies and structures. 2.3 Elementary drawing and product/production symbols, dimensions and tolerances are interpreted correctly and applied to the work task. 2.4 Materials requirements for work tasks are obtained correctly from sketches and drawings. 2.5 Insufficient sketch/drawing details are identified and reported to the appropriate personnel in accordance with enterprise procedures.

3	Prepare sketches or drawings to plan, conduct, or complete engineering tasks.	3.1 Objects are sketched and/or drawn to ensure clear communications of requirements and in accordance with Australian drawing standards. 3.2 Sketches and drawings are prepared to present the required information with minimal complexity. 3.3 Dimension, tolerances and notes are added to fully describe requirements in accordance with enterprise procedures. 3.4 Completed sketches and drawings are checked for compliance with requirements and reviewed with the appropriate personnel.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required skills:

- use geometric construction methods and applications
- draw angles 0° to 180°
- divide circles, construction of across flats (AF) and (AC) hexagons
- construct tangents and tangential arcs
- use freehand sketching skills to produce detail drawing in 3rd angle orthogonal and isometric projection

Required knowledge:

- types and functions of technical drawings
- drafting methods for preparing original drawings
- drawing reproduction methods
- drawing standards and conventions
- Technical drawing standards, conventions and specifications to AS 1100, Part 101 with strong emphasis on interpretation

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 in the Performance Criteria is detailed below.

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Sketches and drawings may include but are not limited to:

- free hand
- computer assisted
- manual
- in one, two or three projections
- to scale or not-to-scale
- for selecting, preparing, or assembling components or products



Objects and items may include but are not limited to:

- those typically used by learners' at their work site and/or their industry
- of metal or non-metal materials

Elementary symbols may include but are not limited to:

- lines types
- outlines (visible/hidden)
- dimensioning lines
- centre lines
- electrical set
- mechanical set
- fabrication set

Appropriate personnel may include but are not limited to:

- supervisor
- leading hand
- foreman
- trainer
- teacher

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

The evidence on which competency in this unit is deemed should demonstrate consistent performance.

- A representative body of performance criteria demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:
- Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range; and
- Demonstrate essential knowledge and associated skills as described in this unit; and
- Demonstrate an appropriate level of skills enabling employment.

Context of and specific resources for assessment

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OH&S policy and work procedures and instructions.
- Access to workplace environment.
- Operational access to relevant machines, tools, materials and consumables



Method of assessment

- Access to relevant plans, drawings and instructions
- Manufacturer's specifications/manuals.
- Evidence should show competency working in realistic environment and a variety of conditions.
- This unit of competency will usually be assessed by the following methods:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.

Assessment should also reinforce the integration of employability skills.

Competent performance with inherent safe working practices is expected. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.

1. Plan for programming robotics system
 - 1.1 **OH&S requirements and environmental requirements** for a given work area are obtained and understood.
 - 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
 - 1.3 Routine tasks that may be performed by a robotics system are analysed, documented and programming solutions are discussed with **appropriate personnel**.
 - 1.4 **Robotic system** programming requirements are determined from documentation, job sheets and discussions with appropriate personnel.
 - 1.5 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved at the work site.
 - 1.6 **Resources and equipment** needed for the task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.
2. Program robotics system
 - 2.1 OH&S requirements for carrying out the work are followed.
 - 2.2 Equipment/machines/plant are checked as being isolated where necessary in strict accordance with OH&S requirements.
 - 2.3 Program code is developed in accordance to requirements, manufacturers' specifications and enterprise procedures.
 - 2.4 Program code is downloaded to robotic system and system is tested according to specifications and enterprise procedures.
 - 2.5 If required, programming bugs are identified, rectified and robotics system retested according to enterprise procedures.
 - 2.6 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
 - 2.7 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.

3.	Verify and document programming a robotics system	3.1	OH&S requirements for carrying out the work are followed.
		3.2	Work site is made safe in accordance with established safety procedures.
		3.3	Robotic system's program overall function and requirements are verified, documented and information stored according to enterprise procedures.
		3.4	Appropriate personnel are informed of the completion of work and, if required, provided with a demonstration of the operation of the program for a robotics system.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge, and their level, required for this unit.

Required knowledge:

- Flowchart symbols
- Flowchart decisions and logic
- Program code including input statements; output statements; logical operators (AND, OR, NOT, XOR, shift); mathematical operators; flow control (IF THEN, FOR, WHILE); program modules (CALL, RETURN)
- Code download including programming interfaces; isolation; programming mode; operational mode

Required skills:

- Use tools and equipment correctly
- Follow enterprise OHS procedures
- Read and interpret equipment manuals
- Complete workplace documentation
- Make decisions within a limited range of options
- Plan a procedure
- Install and configure integrated programming environments (IPE)
- Save, edit, document and compile code
- Define and document a basic robotic task including requirement list; task steps; input requirements; output requirement; logic states
- Test code including systematic fault finding and documentation; debuggers and simulation; fault isolation; input checking; output checking; diagnostic code

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

OH&S requirements may include	• legislation • protective equipment



	• material safety management systems • hazardous substances and dangerous goods code • local safe operation procedures • awards provisions
Environmental requirements may include	• liquid waste • solid waste • gas, fume, vapour, smoke emissions, including fugitive emissions • excessive energy and water use • excessive noise
Appropriate personnel may include	• supervisor • leading hand • foreman • manager • site engineer • trainer • mentor • teacher • team member
Enterprise procedures may include	• <i>the use of tools and equipment</i> • <i>instructions, including job sheets,, plans, drawings and designs</i> • <i>reporting and communication</i> • <i>manufacturers' specifications and operational procedures</i>
Resources and equipment may include	• appropriate tools • appropriate spare parts • cables and connectors • test equipment • consumables • appropriate software licences • manufacturers' specifications and manuals • diagnostics software • personal computer • programming tools
Robotic system may include	• mobile robots • autonomous robots • robotic arms

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Assessors must be satisfied that the candidate can competently and consistently perform



to demonstrate competency in this unit

all elements of the unit as specified by the criteria, including required knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment. Assessment should also reinforce the integration of the Employability Skills.

In particular this will incorporate evidence that shows a candidate is able to:

- (i) implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria;
- (ii) demonstrate essential knowledge and associated skills as described in this unit;
- (iii) demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
- (iv) demonstrate the ability to program a small robotic system to perform basic tasks such as pick and place, motion and navigation on more than one occasion and in different contexts.

Context of and specific resources for assessment

Evidence should show competency working in realistic environment and a variety of conditions.

- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

This unit could be assessed in conjunction with any other units covering programming applications or other units requiring the exercise of the skills and knowledge covered by this unit.

Method of assessment

• Evidence can be gathered through a variety of ways including:

- observation of processes and procedures;
- oral and/or written questioning on required knowledge and skills;
- testimony from supervisors, colleagues, clients and/or other appropriate persons;
- inspection of the final product or outcome;
- a portfolio of documentary evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.

Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21174 Program control systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to program an industrial control system.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit applies to engineering manufacturing enterprises that use control systems to control manufacturing processes.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Plan for implementing a control system.

2. Program and test control system

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work area.
- 1.3 The control system requirements are determined from documentation, design briefs, job sheets or discussions with appropriate personnel.
- 1.4 Measurements and data required are identified and appropriate control system components are selected.
- 1.5 Implementation of the control system is analysed, the optimum implementation solution chosen and checked against requirements.
- 1.6 **Resources and equipment** needed for the task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.
- 1.7 **Appropriate personnel** are consulted to ensure the work is co-ordinated effectively with others involved at the work site.
- 2.1 OH&S requirements for carrying out the work are followed.
- 2.2 Appropriate dimensional computations are performed to suit the application.



	2.3	Control program is developed for given environment using design and manufacturers' specifications.
	2.4	Efficient software interfaces are created between programmable device(s) and peripheral devices.
	2.5	The control system is tested for functionality and against specification and faults are rectified, if required.
	2.6	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures.
3.	Commission and document the control system	
	3.1	OH&S requirements for completing the work are followed.
	3.2	Equipment and machinery is checked as being isolated where necessary during commissioning process.
	3.3	Control system is tested 'live' and all appropriate safety precautions are taken according to enterprise procedures.
	3.4	The control system is documented and documentation is stored in accordance with enterprise procedures.
	3.5	Work completion is notified to appropriate personnel according to enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Identify and follow relevant OH&S procedures
- Read and understand design briefs
- Identify input/output devices
- Navigate appropriate software
- Perform dimensional computations
- Create efficient software interfaces between programmable device(s) and peripheral devices
- Develop a control program
- Test control system functionality against specification
- Identify safety concerns
- Test control system 'live' and adhere to all appropriate safety precautions
- Rectify faults
- Verify and document results

Required Knowledge:

- Input/output devices
 - types of input/output devices
 - limitations of input/output devices (e.g. speed/range)
 - linearization methods



- commercial examples
- means of connection (e.g. network, PCI, serial, USB, etc.)
- **Control system software**
 - control language
 - history
 - advantages/disadvantages
 - types of control languages
 - C
 - *Ladder*
 - *Grafcet*
 - *Linux*
 - commercial packages (e.g. LabView, Citec, Procon)
 - PC to PLC interfaces
 - control structure
 - sequential
 - repetition
 - selection
 - software debugging
 - fault finding techniques (i.e. troubleshooting)
- **Dimensional calculations**
 - mathematical functions
 - 7 SI fundamental units
 - gas quantities (gauge or absolute, etc.)
 - order of magnitude
 - dimensions
 - scientific and engineering notations (correct SI unit prefixes)
- **Measurement and control terminology**
 - range, accuracy, linearity, hysteresis, repeatability, offset
 - bias, sensitivity, drift, noise, electrical calibration, smart instruments, traceability, shielding, grounding, temperature compensation, intrinsic safety, barriers, current loop, HART, IP65, NEM44, gain
 - turndown, lag, lead, deadline, first order system, second order system, overdamped, underdamped, natural frequency, marginal, stability, rise time, overshoot, decay ratio, dynamic gain, proportional band, relay action, reset action, PID action, pre-filtering
 - ratio, cascade, master, slave, local/remote, manual/auto, wind-up, bumpless transfer, tracking, self-tuning, adaptive control, closed loop, open loop, feedback, feed-forward, set-point, servo, regulator, performance, quarter decay, stability
- **Safety concerns**
 - software reliability
 - noise immunity
 -

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 in the Performance Criteria is detailed below.



OH&S requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Resources and equipment may include but are not limited to:

- computer software
- software reference documentation
- internet access
- network access
- relevant standards
- appropriate computer work station
- programmable devices
- variety of input devices
- variety of output devices
- printer

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.



Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to successfully implement control systems on more than one occasion and in different contexts.
 - Commission and document the control system

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome



- a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21207 Set up advanced manufacturing systems (AMS)

Unit Descriptor

This unit covers the skills and knowledge required to develop introductory knowledge and skills associated with the programming and setup requirements of individual items of equipment and the interfacing of these to create a flexible manufacturing environment.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit applies to engineering manufacture where advanced manufacturing systems (AMS) are used in the production process.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Identify the most suitable applications for AMS in a manufacturing environment

2. Apply the principles involved in the development of AMS

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 **Manufacturing requirements** are identified and clarified with **appropriate personnel**.
- 1.4 **Functional specifications and conditions** suited to AMS are identified.
- 1.5 Given a variety of manufacturing system configurations, the most suitable applications for an AMS are identified.
- 1.6 Applications are selected based on relevant scientific principles, manufacturing requirements, functional specifications/factors and discussions with appropriate personnel.
- 1.7 Resources and equipment needed for the task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.
- 2.1 Relevant OH&S requirements for carrying out the work are followed.
- 2.2 Principles and features of AMS are applied to a variety of work tasks



	2.3	Factors relevant to AMS implementation are analysed in relation to given application.
	2.4	Relevant OH&S and environmental considerations for a given application are documented according to enterprise procedures.
3. Select the components of an AMS cell for given applications	3.1	Relevant OH&S requirements for carrying out the work are followed.
	3.2	Component parts of the AMS cell are selected based on economic and functional utilisation of given production method.
	3.3	Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved.
4. Implement AMS	4.1	Relevant OH&S requirements for carrying out the work are followed.
	4.2	Component set-up and location is checked to ensure conformance to specifications.
	4.3	Machines and equipment are configured to meet production specifications.
	4.4	Controllers are linked for integration. (Expand further)
	4.5	Programmable controller programs are run, checked and measured for conformance with specifications.
	4.6	Final adjustments to components and control systems, including program editing are performed as necessary.
	4.7	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, and implementation of risk management and enterprise procedures.
5. Monitor implementation	5.1	Relevant OH&S requirements for carrying out and completing the work are followed.
	5.2	Implementation results are compared against the expected outcomes and performance differences identified.
	5.3	AMS features/components are modified to improve outcomes.
	5.4	Procedures are documented to reflect the change in accordance with established procedures.
	5.5	Changes are audited at agreed period/cycle and actions taken to correct any deviations.
	5.6	Work completion is notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Identify suitable AMS configuration
- Communicate and consult with others
- Analyse information
- Select components
- Configure AMS machines
- Monitor AMS implementation

Required Knowledge:

- Planning
 - sequencing operations
 - identifying factors influencing process selection
 - materials and process preparation
 - properties and characteristics of materials and consumables
 - identifying and clarifying application requirements
 - identifying specifications and required resources
 - reviewing and revising outcomes against task objectives and requirements
- Communication
 - researching and interpreting information and specifications
 - categorising AMS methods and components
 - developing enterprise procedures
 - calculations relating to engineering processes within the scope of this unit
 - accessing and using information sources using a variety of methods
 - use of equipment suppliers' printed data and websites
 - accessing and using alternative information sources
 - documenting of methods, processes & construction techniques and manufacturing requirements
- AMS applications
 - applications, features and principles of AMS
 - components of AMS
 - advantages and disadvantages of AMS in relation to conventional manufacturing systems
 - principles involved in the development of a flexible manufacturing system
- AMS implementation
 - scientific principles relevant to AMS
 - factors relevant to AMS implementation
 - component parts AMS cells
 - component selection criteria, including economic considerations
 - locating and configuring AMS components
 - regulations, standard procedures and MSDS specifications
 - manufacturing requirements
 - principles of TQM, JIT and Competitive (lean manufacturing

- testing and adjusting controller programs
- identifying and implementing AMS deviations and improvements
- OH&S requirements
 - legislation
 - protective equipment
 - material safety management systems
 - hazardous substances and dangerous goods code
 - local safe operation procedures
 - awards provisions
- Environmental considerations
 - liquid waste
 - solid waste
 - gas, fume, vapour, smoke emissions, including fugitive emissions
 - excessive energy and water use
 - excessive noise

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 in the Performance Criteria is detailed below.

OH&S requirements may include but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Manufacturing requirements may include but are not limited to:

- continuous, mass, batch jobbing or prototype production
- sequential or cellular manufacture and assembly
- utilising JIT, TQM (QA + QC + Quality Improvement) and competitive (lean) manufacturing principles

Appropriate personnel may include but

- supervisor



are not limited to:

- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Functional specifications and conditions may include but are not limited to:

- any other project limitations
- location
- design requirements
- safety requirements
- space
- utilities
- quantities/economies of scale
- enterprise requirements
- costs/budget/economy
- equipment integration
- total quality management considerations
- competitive manufacturing practices

Enterprise procedures may include but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, cutting lists, plans, drawings and designs
- reporting and communication
- manufacturers' specifications and operational procedures

Factors relevant to AMS implementation may include but are not limited to:

- high volume
- repetitive
- group technology methods
- environmental aspects
- workplace considerations
- small batch quantities
- flexibility
- quality management
- advantages/disadvantages of AMS
- productivity
- reliability
- conformability
- improved use of resources



- changeover factors
- cost effectiveness
- initial cost
- specialised personnel
- pressures
- material requirements
- machine dedication

Component parts of AMS cell may include but are not limited to:

- part loading/unloading devices
- pick and place devices
- automated manufacturing devices
- transfer devices
- control systems

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to select the components of an AMS cell for given applications and monitor and modify implementation to achieve specifications on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.



- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21219 Set up mechatronics engineering systems

Unit Descriptor

This unit of competency sets out the knowledge and skills required to plan and construct a mechatronics engineering system and interface it with a standard industrial programmable controller for a complete operating system. It includes all wiring and programming to achieve automation together with commissioning and troubleshooting requirements.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher. This unit applies to industrial engineering enterprises where mechatronics is applied to form part of production of goods or services.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Identify principal mechatronics applications within the manufacturing and engineering industry
2. Plan the implementation of a mechatronics system

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S and environmental requirements** for a given work area are obtained and understood and specific applications can be given.
- 1.2 Principal mechatronics applications in manufacturing and engineering are identified, as required.
- 1.3 Principles and features of mechatronics are provided, as required.
- 1.4 Advantages and disadvantages of mechatronics for given manufacturing applications are identified.
- 2.1 OH&S requirements for carrying out the work are followed.
- 2.2 **Specifications, installation and set up requirements** are determined from enterprise documentation and discussion with **appropriate personnel**.
- 2.3 Stages and activities required for implementation are identified and documented according to **enterprise procedures**.



	2.4	Resources, components and equipment needed for the installation are selected and sourced according to design specification and enterprise procedures.
	2.5	Mechatronics principles and associated calculations are applied as required to plan the installation.
	2.6	Procedures for the operation of mechatronics system are developed.
	2.7	The plan is reviewed to improve outcomes and overcome possible problems.
	2.8	OHS and environmental requirements are identified and risk control measures are incorporated into the implementation plan.
3. Construct mechatronics systems	3.1	OH&S requirements for carrying out the work are followed.
	3.2	Resources, components and equipment are obtained and coordinated in accordance with enterprise procedures.
	3.3	Component set-up and location is checked to ensure conformance to specifications.
	3.4	Implementation activities are managed/coordinated in accordance with implementation plan and enterprise procedures.
	3.5	Machines and equipment are set up/configured to meet specifications.
	3.6	Unexpected situations are resolved with appropriate personnel and with reference to applicable documentation and enterprise procedures.
4. Program system controllers	4.1	OH&S requirements for carrying out the work are followed.
	4.2	Sensors and actuators are interfaced to PLC and checked for correct operation.
	4.3	Logic sequence for the integrated system is prepared, indicating all actions and decision points.
	4.4	Programming requirements are analysed and documented.
	4.5	Program is constructed in accordance with manufacturer guidelines and enterprise procedures.
	4.6	Program is downloaded and tested for conformance with operational specifications.
5. Commission mechatronics system	5.1	OH&S requirements for carrying out the work are followed.
	5.2	Compliance of system is checked against operational specification.

	5.3	Faults are diagnosed and rectified using appropriate testing equipment and techniques.
	5.4	Final adjustments to components and control systems, including program editing are performed as necessary.
6. Monitor implementation of mechatronics system	6.1	OH&S requirements for carrying out the work are followed.
	6.2	Implementation results are compared against the expected outcomes and performance differences identified.
	6.3	Adjustments are made to improve outcomes, where required.
	6.4	Procedures are documented to reflect the change
	6.5	Changes are audited at agreed period/cycle and actions taken to correct any deviations.
	6.6	Documentation is completed and work completion notified according to enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Consult and communicate with others
- Identify and follow relevant OH & S procedures
- Develop a plan for mechatronics system implementation
- Set up and configure machines and equipment
- Develop downloaded and test programs
- Commission a mechatronics system
- Diagnose and rectify faults

Required Knowledge:

- Digital sensors
 - optical
 - capacitive
 - inductive & magnetic
 - electromagnetic
- Actuation (non-proportional)
 - mechanical actuators
 - electrical actuators
 - energisers & accumulators
 - linkages & transmissions
- Cabling and connectors
 - cable types, colour codes, specification
 - shielding requirements
 - connector systems & terminations
- Signal conditioning
 - use of switching transistors



- resistor & capacitor calculations
 - simple DC amplification
 - buffers & operational amplifiers
- Logic analysis
 - broad description of task
 - flow charts
 - detailed step analysis
- Programming
 - input/output designators
 - latching
 - timers & counters
 - special functions
 - illegal functions
 - program structure
- Commissioning
 - mechanical adjustment
 - pre-commissioning tests
 - housekeeping precautions
 - accumulated energy safety awareness
 - desirable start sequence
- Troubleshooting
 - problem solving techniques
 - during commissioning
 - under time pressure
- Sourcing components
 - buy/manufacture split
 - selecting supply source
 - manufacturing in-house items
- Planning
 - manual or computer techniques
 - select progress display type
 - continued progress monitoring
 - Project construction
 - assemble base or foundation
 - preliminary layout
 - complete sub-assemblies
 - full assembly
 - check for functionality
 - finishing
- Feedback
 - for design correction
 - for component supplier

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include, but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions
- excessive energy and water use
- excessive noise

Specifications, installation and set up requirements may include, but are not limited to:

- system design and features
- layout
- space
- components
- operational capabilities
- mechanical, electrical and other environmental performance requirements
- materials
- cost/budget/economy
- required/available resources
- timeframe
- specific customer requirements
- hazards and risks
- enterprise requirements
- quality standards
- any other project limitations

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer



- mentor
- teacher
- team member

Enterprise procedures may include, but are not limited to:

- *the use of tools and equipment*
- *instructions, including job sheets,, plans, drawings and designs*
- *reporting and communication*
- *manufacturers' specifications and operational procedures*

Resources, components and equipment may include, but are not limited to:

- sensors and actuators
- programmable logic controllers
- electrical and fluid power sources
- cabling and connectors
- equipment, parts and components
- high profile desktop PC's with TurboCAD or similar
- plotter and printer
- machine shop equipment
- hand and power tools
- drawings and reference documents

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and to be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and
 - Demonstrate the ability to construct and set up a mechatronics system on more than one occasion and in different contexts. This includes interfacing it with a standard industrial programmable controller for a complete operating system; and program and commission the system.



Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21096 Use basic engineering concepts to plan the manufacture of engineering components

Unit Descriptor

This unit of competency sets out the knowledge and skills required to plan the fabrication of engineering components. This involves defining the problem, identifying and reviewing specifications, determining resources, production sequence and schedules.

License to practice

The skills and knowledge described in this unit do not require a licence to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and, where applicable, contracts of training such as apprenticeships and the like.

Employability Skills

This unit contains employability skills.

Application of the Unit

This unit of competency is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level II or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

1. Identify task requirements

2. Plan to manufacture engineering components

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement¹. Assessment of performance is to be consistent with the evidence guide.

1.1 Task outcomes and **task requirements** are identified and clarified, if necessary, with **appropriate personnel**.

1.2 Relevant **documentation** to plan and carry out the task is interpreted.

1.3 **Factors affecting performance** of the task are identified and accounted for where possible.

2.1 Steps and activities required to fabricate engineering components are identified and ordered to ensure efficient and effective use of resources.

2.2 **Resources needed** for the task are identified.

2.3 **Enterprise work procedures** are identified and included in the plan where necessary.

2.4 The plan is checked for accuracy against task requirements and specifications.

3. *Review plan*

3.1 *Outcomes are identified and compared with (planned) objectives, task instructions, specifications and task requirements.*

3.2 *The plan is revised to better meet objectives and task requirements, if necessary*

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- Communication skills
 - cooperating in a team
 - verbal reporting
 - questioning and clarifying information
 - following oral and written instructions
 - analysing elements of a task
 - preparing a written work plan
- interpreting sketches and drawings
- planning skills to:
 - identify task requirements, relevant documentation, factors affecting performance and outcomes
 - identify needed resources and appropriate work procedures
 - check plan accuracy against specification
 - compare and revise outcomes against specification and plan

Required Knowledge:

- Occupational Health and Safety
 - workplace safety procedures
 - risk assessment and hazard control
 - personal protective equipment and safety devices
 - personal responsibilities
- Document interpretation
 - work instructions and procedures
 - reference manuals and catalogues
 -

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 in the Performance Criteria is detailed below.

Task requirements include:

- problem definition
- identification of and reviewing specifications
- determination of resources, production sequences and schedules

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- work colleagues
- trainer/coach
- teacher

Documentation may include:

- task lists
- instructions
- work procedures
- manufacturer manuals
- wiring diagrams and schematics
- technical drawings and sketches
- parts lists
- computer records

Factors affecting task performance may include:

- wrong or damaged parts
- unexpected or potential delays
- environmental factors – weather, noise, dust etc.
- hazards
- insufficient or incorrect information
- material shortages

Resources needed may include:

- work orders and cutting lists
- specifications and reference documents
- work procedures
- job samples
- tools and equipment
- materials, parts and consumables
- measuring devices
- safety equipment

Enterprise work procedures may include:

- instructions, including job sheets
- safety procedures
- emergency procedures
- reporting and communication
- manufacturers' specifications and operational procedures
- quality procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- To be considered competent in this unit the participant must be able to demonstrate the achievement of all of the elements of competency to the level defined by their associated performance criteria and incorporating the required skills and knowledge.
- **Specifically they must be able to:**
 - perform each element on at least two occasions
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range statement
 - demonstrate application of the Required Skills and Knowledge at a level and within timeframes appropriate to the workplace.
 - plan the routine manufacture of engineering components.

Context of and specific resources for assessment

- **This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace**
- **Resources required for assessment include:**
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant equipment, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence might include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.



- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning should be undertaken in such a manner as is appropriate to the language and literacy levels of the candidate and to the requirements of the unit of competency.
- Competent performance with inherent safe working practices is expected. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.
- It is suggested that this unit be assessed in conjunction with other units that form part of a job role.

VU21176 Utilise digital electronics for control applications

Unit Descriptor

This unit of competency sets out the knowledge and skills required to utilize digital electronics for applications requiring simple control of engineering and manufacturing processes. This unit is confined to hardwired digital control systems and/or basic programmable control logic only. The application of complex digital control and processing theory is not required.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains employability skills.

Application of the Unit

- The unit applies to engineering and manufacturing environments where digital electronics is used to control a wide variety of processes.
- This unit of competency is intended for courses at diploma level or higher.
-

ELEMENT

Elements describe the essential outcomes of a unit of competency. Elements describe actions or outcomes that are demonstrable and assessable.

- 1 Prepare application of digital electronics to control task

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element – they identify the standard for the element. Where bold/italicised text is used, further information or explanation is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 **OH&S** and **environmental requirements** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures are followed in preparation of the work.
- 1.3 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with **appropriate personnel**.
- 1.4 Digital control task requirements are determined from documentation, work requests or discussions with appropriate personnel.
- 1.5 Appropriate instrumentation solution is selected from documentation, work requests or discussions with appropriate personnel to fit task requirement, if required.
- 1.6 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site.

- 1.7 **Resources** and **equipment** to carry out digital control task are obtained in accordance with **enterprise procedures** and checked for correct operation and safety.
- | | | |
|---|--------------------------------|--|
| 2 | Carry out digital control task | 2.1 OH&S requirements for carrying out the work are followed. |
| | | 2.2 Equipment/machines/plant are checked as being isolated, where necessary, in strict accordance with OH&S requirements. |
| | | 2.3 Digital control task is carried out in accordance with requirements to specifications and according to enterprise procedures. |
| | | 2.4 Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures. |
| | | 2.5 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes. |
-
3	- Complete and document digital control task	3.1 OH&S requirements for carrying out the work are followed.
		3.2 Work site is made safe in accordance with established safety procedures.
		3.3 Digital control work is tested for correct operation within given specifications and enterprise procedures.
		3.4 Digital control task is documented and completion reported to appropriate personnel.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level required for this unit.

Required Skills:

- identifying and following relevant OH&S procedures;
- interpreting and evaluating documentation, specifications, manufacturers' manuals and drawings;
- testing digital controllers for functionality;
- applying safe component handling techniques;
- determining operation of digital controllers from diagrams and tables;
- interpreting and applying testing protocols;
- drawing up test plans;
- interfacing digital controller hardware;
- troubleshooting digital circuits;
- selecting appropriate test methods and equipment;
- undertaking required tests efficiently;
- working in teams;



- communicating technical requirements.

Required Knowledge:

- fundamental digital concepts;
- logic functions and operators;
- binary arithmetic;
- number systems;
- Boolean algebra
- electronic implementation of logic functions and operators;
- combinational digital circuits;
- sequential digital circuits;
- digital troubleshooting;
- interfacing;
- memory;
- reconfigurable hardware;
- programming hardware.

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 in the Performance Criteria is detailed below.

OH&S requirements may include, but are not limited to:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements may include, but are not limited to:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member



Resources may include, but are not limited to:

- manufacturer's specifications and documentation
- circuit diagrams
- reference texts and tables
- appropriate safety equipment
- computer work station with appropriate software/hardware to program programmable logic
- consumables such as connectors, cables, appropriate integrated circuits, electronic components, transducers and actuators

Equipment may include, but is not limited to:

- multimeters
- logic probes
- oscilloscope
- appropriate hand tools
- various types of leads, connectors and probes

Enterprise procedures may include, but are not limited to:

- the use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Elements, Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the Accreditation Submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria, including required skills and knowledge, and be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Specifically they must be able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range
 - Demonstrate the required knowledge and skills as described in this unit;
 - Demonstrate a representative body of performance criteria within a timeframe typically expected of the discipline, work function and industrial environment; and

- Demonstrate the ability to utilise simple digital controllers on more than one occasion and in different contexts.

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.
- Resources required for assessment include:
 - OH&S policy and work procedures and instructions.
 - Access to workplace or work real environment and a variety of conditions
 - Operational access to relevant machines, tools, materials and consumables
 - Access to relevant plans, drawings and instructions and manufacturer's specifications/manuals

Methods of assessment

- For valid and reliable assessment of this unit, evidence should be gathered through a range of methods to indicate consistent performance.
- Evidence must involve demonstration of practical skills and may also include:
 - observation of processes and procedures
 - oral and/or written questioning on required knowledge and skills
 - testimony from supervisors, colleagues, clients and/or other appropriate persons
 - inspection of the final product or outcome
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21087 Write programs for programmable logic controllers

Unit Descriptor

This unit of competency sets out the knowledge and skills required to write, test and modify programs for programmable logic controllers (PLCs). This includes working safely, applying knowledge of control systems, program control functions, develop and test control programs using a range of programming language approaches developed for PLCs.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication, although the application of the unit necessitates adherence to relevant State or Territory electrical safety and regulatory requirements.

Employability Skills

This unit contains employability skills,

Application of the Unit

The unit applies to engineering environments where programmable logic controllers are used for automating processes in manufacturing, process control, building services, laboratories etc.

This unit of competency is intended for courses at Certificate IV levels or higher.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

- 1 Prepare to develop a PLC program.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 ***OH&S requirements*** and ***environmental requirements*** for a given work area are obtained and understood.
- 1.2 Established OH&S requirements and risk control measures and procedures in preparation for the work area are followed.
- 1.3 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with ***appropriate personnel***.
- 1.4 Control program and input/output interfacing requirements are determined from job specifications of the process/plant/machine to be controlled, and through consultation with appropriate personnel.
- 1.5 ***Equipment***, software and testing devices needed to carry out the work are obtained and checked for correct operation and safety.
- 1.6 Installation of programmable controller is checked for compliance safety requirements and job specification.



2	- Develop, write and test control program	2.1 OH&S requirements for carrying out the work are followed. 2.2 Circuits/machines/plant are checked as being isolated where necessary in accordance OH&S requirements and procedures. 2.3 Control solutions are developed and documented based on the specified control mode and using acceptable methods for designing control systems. 2.4 Developed control system is converted to an appropriate form, such as flow, state and ladder diagrams, using a person computer and software applicable to the programmable controller into which the program is to be entered. 2.5 Program is entered into the programmable control using a personal computer and appropriate software. 2.6 Entered instructions and settings are tested as meeting those specified in by the control system scenario. 2.7 Appropriate methods and tools are used to test control systems and operating faults and anomalies are identified and rectified. 2.8 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.
3	Finalize control program	3.1 OH&S requirements for completing the work are followed. 3.2 Program is transferred from a programmable controller to an external medium for storage. 3.3 - Control system specification and program are documented in accordance with enterprise procedures. 3.4 Work completion is reported and appropriate personnel notified in accordance with enterprise procedures.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- reading specification statements, diagrams and information
- interpreting project briefs to develop programs for control applications
- writing, testing, monitoring and debugging PLC programs
- saving and retrieving program code/data using external storage
- using a development environment efficiently
- setting up and checking hardware operations
- producing appropriate documentation for control programs
- communicating technical requirement to others;
- working with others;
- adapting to changes in work.



Required knowledge:

- PLC programming methods
 - ladder diagram
 - sequential function chart
 - structure language programming
- program control structures
- program structures
- I/O programming
- diagnostic indicators
- documentation

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts

OH&S requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Environmental requirements for example:

- liquid waste
- solid waste
- gas, fume, vapour, smoke emissions, including fugitive emissions, dust
- excessive energy and water use
- excessive noise

Appropriate personnel such as:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member

Equipment including:

- personal computer station, preferably networked
- PLCs
- PLC programming and auxiliary software
- interfacing hardware



- transducers and actuators
- hand tools
- consumables

Enterprise procedures such as:

- the use of tools and equipment
- instructions, including job sheets plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment section in Section B of the accreditation submission.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge.
- Candidates must be capable of applying the competency in new and different situations and contexts within the timeframes typically expected of the discipline, work function and industrial environment.
- Assessment should also reinforce the integration of the Employability Skills.

In particular this will incorporate evidence that shows a candidate is able to demonstrate writing programs for PLCs on more than one occasion and in different contexts. The demonstration of competence must show:

- writing programs using a wide range of programming features for a given PLC;
- I/O programming;
- use of internal flags, counters and timers;
- complex program structures using nested subroutines;
- a program design that has a high degree of maintainability.

Context of and specific resources for assessment

- Evidence should show competency working in a realistic environment and a variety of conditions.
- The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered



by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

- Evidence can be gathered through a variety of ways including:
 - observation of processes and procedures;
 - oral and/or written questioning on required knowledge and skills;
 - testimony from supervisors, colleagues, clients and/or other appropriate persons;
 - inspection of the final product or outcome;
 - a portfolio of documentary evidence.
- Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.
- Assessment should reinforce the integration of the Key Competencies.

VU22324**Build a simple network and establish end to end connectivity****Unit Descriptor**

This unit of competency describes the knowledge and skills required to apply an understanding of the architecture, structure, functions, protocols and components of a computer network in order to build a simple network and establish end to end connectivity.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication

Employability Skills

This unit contains Employability Skills

Application of the Unit

The unit applies to IT practitioners who are required to build and maintain small to medium networks using a range of client server applications and services

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Identify the elements of an interconnected computer network

- 1.1 Use and methods of connecting multiple computer networks are explained
- 1.2 Devices and topologies used in a small to medium sized network are investigated
- 1.3 Characteristics of a computer network that facilitates data communication are recognised
- 1.4 Trends and developments in computer networking are explored

2. Configure a internetwork operating system enabling connectivity of a simple network

- 2.1 ***Network devices*** for a small computer network are identified
- 2.2 ***Computer operating system*** commands or utilities required to program the Network Interface Card (NIC) are obtained from manufacturer's manuals, data books or online resources
- 2.3 Internet Protocol (IP) addresses for the network interface card (NIC) are configured
- 2.4 Function and structure of the ***Internetwork Operating System (IOS)*** is defined
- 2.5 Relevant commands of an Internetwork Operating System that facilitate connection to a LAN are selected and configured
- 2.6 Physical network devices and components are identified from a network topological drawing
- 2.7 A ***simple network topology*** is cabled
- 2.8 IOS testing commands are identified and utilised to verify end to end connectivity



	2.9 Base level troubleshooting skills and procedures are utilised to establish or re-establish network connectivity
3. Explain the operation of network protocols and layered communication models	3.1 Rules to facilitate data communication across the computer network are defined 3.2 Role of protocols and standards in facilitating communication between networks is defined 3.3 Methods of how devices access resources in a small to medium network are explained 3.4 Open Source Interconnection (OSI) and Transport Control Protocol/Internet Protocol (TCP/IP) layered models of communication are compared
4. Recognise protocols that facilitate access to the computer network	4.1 Relationship between physical layer protocols and services that facilitate and support communication across a data network is defined 4.2 Function and operation of the data link layer to support communication across a data network is recognised 4.3 Media access control techniques are defined 4.4 Role and operation of the ethernet protocol is defined 4.5 Fundamental operation of a switch is explained 4.6 Function and operation of the Address Resolution Protocol (ARP) to enable communication on a network is recognised
5. Outline the function and operation of the network layer	5.1 Operation of network layer protocols and services to support data communication across a network is explained 5.2 Operation of routers to support end to end connectivity is explained 5.3 Methods used by network devices to route data traffic are defined 5.4 Basic configurations for a router are configured
6. Implement IPv4 and IPv6 addressing	6.1 Network addressing scheme is developed utilising IPv4 addresses 6.2 Network addressing scheme is developed utilising IPv6 addresses 6.3 Testing commands for end to end connectivity are identified and utilised 6.4 Subnetting IPv4 network is demonstrated and implemented 6.5 Subnetting IPv4 network utilising Variable Length Subnet Mask (VLSM) is demonstrated and implemented 6.6 Design considerations for implementing IPv6 addresses are defined

7. Identify the function of and the protocols utilised for transport and application layers	7.1 Function and operation of transport layer protocols and services that support data communication across a network are developed 7.2 Operation of the Transport Control Protocol (TCP) and User Datagram Protocol (UDP) transport layer protocols are explained 7.3 Well known transport layer port numbers are described 7.4 Function and operation of application layer protocols that facilitate end to end data communication across a network are defined 7.5 Function and operation of well-known TCP/IP application layer protocols are defined
8. Build and verify a simple network	8.1 Addressing scheme for a small to medium network is designed 8.2 Network routers and switches are selected and configured to establish end to end connectivity 8.3 Base level troubleshooting skills and procedures are utilised to establish or repair network connectivity 8.4 Network router and switch base level security functionality is configured 8.5 Network resources are set up, configured and shared between network devices 8.6 IOS commands to establish baseline performance are utilised

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- using appropriate tools to develop and test network addressing
- translating paper network designs into a sketch of physical devices and connections
- using internetworking operating systems commands
- reading and interpret documents such as manufacturer's manuals, data books, online resources
- implementing basic network connectivity between devices
- configuring monitoring tools available for small to medium sized business networks
- configuring initial settings on a network device configuring router interfaces and testing and verifying correct functionality
- configuring applications and to verify their connection to provide network services

Required knowledge:

- switch interface configuring and tests to verify correct functionality
- setting IP addresses on end points and network devices
- network devices
 - routers
 - switches
- network access
 - physical layer protocols
 - network media



- data link protocols
- media access control
- ethernet
- network layer
 - network layer protocols
 - routing protocols
 - Routers
 - configuring routers and switches
- Transport Layer Protocols (TCP)
- User Datagram Protocol (UDP)
- Application Layer Protocols (ALP)
- computer operating system commands
- network operating system commands
- computer network architecture
- internet and computer network communication
- OSI layered communication model
- TCP/IP layered communication model
- comparing similarities and differences between the OSI and TCP/IP models
- encapsulation and de-encapsulation concepts as they relate to data flow in a network
- network addressing schemes
 - Classful & VLSM
 - IPv4 and IPv6 addressing
 - Network Address Translation (NAT) concepts
- subnetting IPV4 networks
- subnetting IPv6 networks
- cabling LANs
- base level troubleshooting procedures
- use testing commands eg (ping, Tracert, etc)

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Network devices includes but not limited to:

- hubs
- switches
- routers
- workstations
- IPads
- android tablets

Computer operating system includes but not limited to:

- Windows versions
- Linux
- MacOS

Internetwork Operating System (IOS) includes but not limited to:

- Cisco IOS
- Huawei IOS
- Palo Alto IOS
- HP IOS
- VMWare IOS



Simple network topology includes but not limited to:

- routers
- switches
- end points

Base level troubleshooting includes but not limited to:

- ping
- traceroute
- examination of router routing table
- examination of ARP table
- inspection of interface configuration:
 - IPconfig
 - show CDP Neighbors
 - show IP interface brief
 - show interface

Basic configurations for a router includes but not limited to:

- configuring an IP address to an ethernet interface
- enabling the interface
- checking the interface address
- configuring an IP address to an ethernet interface
- enabling the interface
- checking the interface address

Network addressing includes but not limited to:

- static addresses
- dynamic addressing
- subnets

Network resources includes but not limited to:

- files
- software
- TFTP Server
- Wireshark

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

To be considered competent in this unit assessors must be satisfied the candidate can demonstrate the achievement of all of the elements of the competency to the level defined by the associated performance criteria

Specifically they must be able to:

- identify the elements of an interconnected computer network
- explain the operation of the OSI and TCP/IP layered communication models
- identify the operation of and utilise relevant protocols at the Data link, Network, Transport and Application layers
- construct IP addresses and subnets for a small to medium sized network
- configure routers and switches and assign IP addresses to end points for a small to medium sized network
- utilise test and troubleshooting commands and procedures for a small to medium sized computer network.

Context of and specific resources for assessment

Evidence should show competency working in a realistic environment and a variety of conditions. The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

This unit may be assessed on the job, off the job or a combination of both. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures
- oral and/or written questioning
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- portfolio of documented evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons

VU22325**Configure and troubleshoot network switches and routers****Unit Descriptor**

This unit of competency describes the knowledge and skills required to recognise and describe the architecture, components and operations of routers and switches in a small network.

The unit also includes the knowledge and skills to configure and troubleshoot routers and switches and to resolve common issues with virtual Local Area Networks (VLANs) and inter-VLAN routing in both Internet Protocol (IP)v4 and (IP)v6 networks.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

The unit applies to an IT practitioner required to analysis, configure and troubleshoot routers and switches in small to medium sized business network.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Configure a router for basic operation	1.1 The process of how a router uses information in data packets to make forwarding decisions in the network is described 1.2 Methods used by a router to learn about remote networks is explained 1.3 Router to facilitate communication between multiple directly connected networks is configured
2. Configure and troubleshoot static and default routes	2.1 Configuration of static and default routing protocols are described and followed 2.2 Static and default routes are configured and implemented 2.3 Static and default route configurations are tested for correct operation
3. Apply dynamic routing protocols and Routing Information Protocols (RIPv2)	3.1 Function and operation of dynamic routing protocols are explained 3.2 Operation of the RIPv2 routing protocol is implemented 3.3 Route source, administrative distance and metric for a given route is determined from the routing table
4. Configure network switches	4.1 Function and operation of switched networks are explained 4.2 Method used by layer 2 switches to forward data in a small to medium size LAN is described



	4.3	Layer 2 (switch) is configured to meet network specifications.
	4.4	Standard troubleshooting techniques are utilised to establish end to end connectivity.
	4.5	Best practise switch security for the network is configured
5. Configure Virtual Local Area Networks (VLANs)	5.1	Method in which VLAN segment broadcast domains is demonstrated
	5.2	VLAN segmentation is implemented
	5.3	Multiple VLANs are configured and established
	5.4	Inter VLAN routing is configured and tested
6. Secure a network using standard Access Control Lists (ACL's)	6.1	Security threats are recognised and control measures initiated according to enterprise procedures.
	6.2	Purpose and operation of standard ACL's are defined
	6.3	Layer 3 security utilising Standard Access Control Lists are implemented
	6.4	Standard Access Lists troubleshooting techniques are followed and applied
7. Implement Dynamic Host Control Protocol (DHCP)	7.1	DHCP for IPv4 (DHCPv4) across multiple LANs is implemented
	7.2	DHCP for IPv6 (DHCPv6) across multiple LANs is implemented
8. Implement Network Address Translation (NAT) for IPv4	8.1	Function and operation of NAT used to provide IPv4 addresses is explained
	8.2	NAT is configured and verified
	8.3	Troubleshooting methods for NAT are deployed
9. Implement device discovery, management and maintenance	9.1	Discovery protocols used to map network topology are implemented
	9.2	Network Time Protocol (NTP) and System Logging (SYS-LOG) protocols are implemented
	9.3	Methods to maintain Router and Switch configuration files are followed

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- implementing DHCP on a router
- implementing network address translation (NAT)
- implementing access control lists (ACLs) to filter traffic
- determining how a router will forward traffic based on the contents of a routing table
- implementing static routing
- demonstrating how switching operates in a small to medium-sized business network
- configuring Ethernet switch ports
- implementing VLANs
- using monitoring tools and network management protocols to troubleshoot data networks



- configuring monitoring tools used for small to medium size business networks
- configuring initial settings on a network device
- utilising and configuring Network Address Translation (NAT)
- utilising network discovery protocols eg CDP Neighbours
- configuring and interpreting Network Time Protocol (NTP)
- configuring and interpreting System Logging (SYSLOG) files

Required knowledge:

- base level network security with switches
- inter-VLAN routing
- network segmentation with VLANs
- routing tables and packet forwarding decisions
- static routes
- default routes
- dynamic routing
- distance vector routing protocols eg. RIP v2
- routing tables.
- Access Control Lists (ACL's)
- Dynamic Host Control Protocol (DHCP)
- Network Address Translation (NAT)
- Network Time Protocol (NTP)
- System Logging (SYSLOG) files
- Cisco Discovery Protocols eg Neighbours

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Standard troubleshooting techniques include but not limited to:

- ping
- traceroute
- examine router routing table
- examine Address resolution Protocol (ARP) table
- inspection of interface configuration:
 - IPconfig
 - show Cisco Discovery Protocol eg Neighbours
 - show IP interface brief
 - show interface

Best practise switch security include but not limited to:

- setting passwords
- unused port deactivation
- blocking ports
- secure Media Access Control (MAC) addresses

Standard Access Lists troubleshooting techniques Include but not limited to:

- access list placement
- access list structure
- access list configuration

Function and operation of NAT used to provide IPv4 addresses Include but not limited to:

- static NAT
- dynamic NAT
- Port Address Translation (PAT)



Troubleshooting methods for NAT

Include but not limited to:

- NAT configuration
- using test commands:
 - clear ip nat statistics
 - show ip nat translations
 - debug ip nat
 - ping
 - show ip route

Methods to maintain Router and Switch configuration files Include but not limited to:

- copy and paste the configuration file to a text file
- copy to a Trivial File Transfer Protocol (TFTP) server

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

To be considered competent in this unit assessors must be satisfied the candidate can demonstrate the achievement of all of the elements of the competency to the level defined by the associated performance criteria

Specifically they must be able to:

- configure a router for basic operation including static and dynamic routing
- configure a switch for basic operation, including VLANs
- create and deploy standard access lists (ACL's) to control common security threats
- deploy Dynamic Host Control Protocol (DHCP)
- implement Network Address Translation (NAT) for IPv4
- implement device discovery, management and maintenance
- utilise test and troubleshooting commands and procedures.

Context of and specific resources for assessment

Evidence should show competency working in a realistic environment and a variety of conditions. The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

This unit may be assessed on the job, off the job or a combination of both. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate



Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures
- oral and/or written questioning
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- portfolio of documented evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate person

VU22326**Apply network scaling tools and techniques****Unit Descriptor**

The unit of competency describes the knowledge and skills required to use tools and techniques to scale an existing network design to improve reliability and accommodate predicted growth.

The unit covers network architecture, configuring and troubleshooting routers and switches for advanced functionality, Spanning Tree Protocol (STP) concepts and configurations and implementation of etherchannel and Hot Standby Routing Protocol (HSRP). The unit also covers the implementation of dynamic routing such as Enhanced Interior Gateway Routing Protocol (EIGRP) and single and multi-area Open Shortest Path First (OSPF).

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication

Employability Skills

This unit contains Employability Skills

Application of the Unit

The unit applies to an IT practitioner required to scale (expand) an existing small to medium size business network to remove bottlenecks and accommodate predicted growth.

ELEMENT**PERFORMANCE CRITERIA**

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1. Plan the expansion of an existing network	1.1 Identify Local Area Network (LAN) design concepts for a small to medium sized network 1.2 <i>Using the existing network design, data bottlenecks</i> are identified 1.3 Concepts of <i>hierarchical scalable design</i> for a network are explored 1.4 Network devices based on feature compatibility are identified and selected
2. Implement scaling Virtual Local Area Network (VLAN) methods	2.1 Inter-switch connectivity for a switched LAN environment is identified and configured 2.2 <i>Inter VLAN routing troubleshooting tools and methodologies</i> are utilised 2.3 Inter VLAN routing using Layer 3 switching to forward data is implemented
3. Define and implement the Spanning Tree Protocol (STP) for a small to medium sized network	3.1 Simple switched network containing redundant links is configured and implemented 3.2 Differences between <i>different implementations of STP</i> are defined



	3.3	Per VLAN Spanning Tree (PVST), Rapid PVST and STP in a switched LAN environment is implemented
4. Implement etherchannel and Hot Standby Routing Protocol (HSRP)	4.1	Operation of link aggregation in a switched LAN environment is defined
	4.2	Link aggregation in a switched LAN environment is implemented and tested
	4.3	HSRP is implemented and tested
	4.4	Base level troubleshooting skills are utilised to verify network connectivity
5. Configure Dynamic Routing Protocols	5.1	Features and characteristics of dynamic routing protocols are defined and implemented
	5.2	Function and operation of distance vector protocols are defined and implemented
	5.3	Function and operation of link state protocols are defined and implemented
6. Configure Enhanced Interior Gateway Routing Protocol (EIGRP)	6.1	Function and operation of the EIGRP dynamic routing protocol is evaluated and implemented for a IPv4 network
	6.2	Function and operation of the EIGRP dynamic routing protocol is evaluated and implemented for a IPv6 network
	6.3	EIGRP is configured to improve network performance
	6.4	Trouble shooting methodologies and tools for EIGRP implementation are deployed
7. Configure Open Shortest Path First (OSPF) protocol	7.1	Function and operation of single area OSPF dynamic routing protocol is defined
	7.2	Single area OSPFv2 dynamic routing protocol is implemented
	7.3	Single area OSPFv3 dynamic routing protocol is implemented
	7.4	Function and operation of multi-area OSPF dynamic routing protocol is defined
	7.5	Multi-area OSPFv2 dynamic routing protocol is implemented
	7.6	Multi-area OSPFv3 dynamic routing protocol is implemented
	7.7	Features of OSPF to improve network performance are configured
	7.8	Trouble shooting methodologies and tools for OSPF implementation are deployed

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- configuring network interfaces
- configuring network routing
- verifying routing is functional
- troubleshooting advanced routing for client networks
- identifying network bottlenecks
- scaling VLANs

Required knowledge:

- principles of scaling a network
- scalable network architectures
 - core layer
 - distribution layer
 - access layer
- principles of router redundancy
- likely causes of network bottlenecks
- etherchannel configuration for increased data throughput
- STP concepts
- STP implementation methodologies:
 - Rapid Spanning Tree Protocol (RSTP)
 - Per VLAN Spanning Tree Plus Protocol (PVST+)
- routing and packet forwarding
- static routing
- dynamic routing
- scalable routing strategies
 - e.g. VSLM and CIDR
- routing tables
- link-state routing protocols.
 - e.g. OSPF single and multi-area
- hybrid routing protocols
 - e.g. EIGRP
- tuning mechanisms for EIGRP and OSPF
- network trouble shooting methodology

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Using the existing network design, data bottlenecks includes but not limited to:

- switch trunk links
- highly subscribed LAN ports

Hierarchical scalable design includes but not limited to:

- core layer
- distribution layer
- access layer

Inter VLAN routing troubleshooting tools and methodologies includes but not limited to:

- bottom up testing
- ping
- traceroute
- examination of routing table
- inspection of interface configuration:
 - IPconfig
 - show IP interface brief
 - show interface

Different implementations of STP: includes but not limited to:

- STP
- PVST+
- RSTP
- Rapid PVST+

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

To be considered competent in this unit assessors must be satisfied the candidate can demonstrate the achievement of all of the elements of the competency to the level defined by the associated performance criteria

Specifically they must be able to:

- identify LAN design concepts and requirements
- implement STP and HSRP for a small to medium sized network
- implement etherchannel to improve data throughput
- configure, implement and troubleshoot the EIGRP dynamic routing protocol for IPv4 and IPv6
- configure, implement and troubleshoot the OSPF dynamic routing protocol for IPv4 and IPv6 in a single or multi area small to medium sized network
- utilise test and troubleshooting commands and procedures



Context of and specific resources for assessment

Evidence should show competency working in a realistic environment and a variety of conditions. The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

This unit may be assessed on the job, off the job or a combination of both. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working as part of a team. The assessment environment should not disadvantage the candidate.

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures
- oral and/or written questioning
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- portfolio of documented evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons

VU22327**Establish connectivity to a wide area network (WAN)****Unit Descriptor**

The unit of competency describes the knowledge and skills to connect a small to medium enterprise to a wide area network (WAN) and to plan appropriate network services. The unit includes serial WAN access technologies and protocols such as High Level Data Link (HDLC), Point to Point (PPP) and Point to point over Ethernet (PPoE). The unit also introduces General Routing Encapsulation (GRE) tunnelling and single homed and routing protocol and external Border Gateway Protocol (eBGP).

Local Area Network (LAN) topics include configuring Simple Network Management Protocol (SNMP), Cisco Switched Port Analyser (SPAN) and examining Quality of Service (QoS) requirements.

The unit also explores trends and directions in the evolution of computer networks

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication

Employability Skills

This unit contains Employability Skills

Application of the Unit

The unit applies to an IT practitioner required to establish connectivity of a small to medium sized network to a WAN network

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

2. Plan the network connectivity to a Wide Area Network (WAN)

- 1.1 Range of **WAN access technologies** available to a small to medium sized network is evaluated
- 1.2 Nature and scope of the network, **WAN connection and performance expectations** are established in consultation with **relevant personnel**
- 1.3 Network hardware, software, **WAN communication protocol** requirements are selected and sourced in accordance with **established procedures**
- 1.4 WAN access technology suitable for the small to medium sized network is selected

2. Configure point to point WAN connections

- 2.1 Operation of a High Level Data Link Control (HDLC) encapsulation for a serial point to point WAN connection is configured
- 2.2 Operation of Point to Point Protocol (PPP) encapsulation for a serial point to point WAN connection is configured



	2.3	Established troubleshooting procedure and tools are utilised to identify and rectify PPP WAN implementation issues
3. Select and implement various branch connections available	3.1	Broadband remote access technologies to support business requirements are identified and selected
	3.2	Point to Point Protocol over Ethernet (PPPoE) for a router is configured and implemented
	3.3	Function and operation of Virtual Private Networks (VPN's) to secure a remote site to site connection is determined
	3.4	Generic Routing Encapsulation (GRE) tunnel for a remote site to site connection is implemented
	3.5	External Border Gateway Protocol (eBGP) for a single homed access network is implemented
4. Review and implement Access Control Lists (ACL's)	4.1	Standard access lists for IPv4 are configured and implemented
	4.2	Extended Access lists for IPv4, are configured and implemented
	4.3	Access lists for IPv6 are configured and implemented
	4.4	Troubleshooting procedures are established and utilised to identify and rectify any ACL configuration and operational issues
5. Monitor network security	5.1	Procedures to mitigate common security attacks for a small to medium sized LAN are defined
	5.2	Simple Network Management Protocol (SNMP) to monitor network operation is configured
	5.3	Cisco Switch Port Analyser (SPAN) to troubleshoot network problem are configured
6. Explore Quality of Service (QoS) requirements	6.1	Purpose and operation of Quality of Service (QoS) are explained
	6.2	Methods that networking devices use to implement QoS for a network is explained
8. Implement network troubleshooting methods	7.1	Network troubleshooting procedures are established and appropriate tools are selected
	7.2	End to end connectivity troubleshooting methodologies are performed
7. Research trends and directions in the evolution of computer networks	8.1	Function, directions and operation of Internet of Things (IOT) devices are examined
	8.2	Directions in cloud computing and virtualisation in network computing are explored
	8.3	Requirements of network programming in emerging networks and devices are investigated

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- assessing customer requirements and performance expectation regarding WAN connectivity
- determining and selecting appropriate WAN configurations and access technologies
- facilitating network connectivity by installing and configuring a WAN communication protocol such as PPP, HDLC and PPPoE
- implementing and troubleshooting IPv4 and IPv6 Access control Lists (ACL's)
- identifying QoS mechanisms to support WAN connectivity
- establishing procedures and selecting appropriate tools to troubleshoot client networks
- evaluating current trends and directions in networking. eg IOT, cloud computing, virtualised systems and network programming

Required knowledge:

- OSI layered communication model
- WAN link protocols such as PPP, HDLC and PPPoE
- VPN Technologies
- ADSL Technologies
- network security monitoring
- QoS mechanisms
- methods to secure Site to Site Connectivity
 - VPN's
 - GRE
 - IPsec
 - Tunnels
 - eBGP
- tools to monitor a network
 - System Message Logging (SYSLOG)
 - Simple Network Monitoring Protocol (SNMP)
 - Netflow
 - Wireshark
 - Cisco Port Analyser (SPAN)
- WAN troubleshooting methodologies and diagnostic tools
- Internet of Things (IoT)
- cloud computing

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 in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

WAN access technologies includes but not limited to:

- dedicated lines
 - leased lines
 - Integrated Services Digital Network (ISDN)
 - frame relay
 - Asynchronous Transfer Mode (ATM)
 - dial up
 - Ethernet Wan
 - Multiprotocol Label Switching (MPLS)
 - Very-small-aperture terminal (VSAT)
- public infrastructure
 - digital subscriber line (DSL)
 - cable
 - wireless
 - 3G/4G/5G Cellular

WAN connection and performance expectations includes but not limited to:

- connection bandwidth
- connection services
- Internet service provider (ISP) connections
- Internet Protocol Telephony (ITP) future requirements

Relevant personnel includes but not limited to:

- IT supervisor
- IT manager
- IT site engineer
- client

WAN communication protocols includes but not limited to:

- High-Level Data Link Control (HDLC)
- Point to Point Protocol (PPP)
- Point to Point Protocol over Ethernet (PPPoE)
- Frame Relay
- MPLS

Established procedures includes, but are not limited to:

- use of tools and equipment
- instructions, including job sheets, plans, drawings and designs
- reporting and communication
- manufacturers' specifications
- operational procedures

Established troubleshooting procedures and tools includes but not limited to:

- network documentation
- troubleshooting process
- layered approach to troubleshooting
- software troubleshooting tools
- hardware troubleshooting tools
- protocol analysers



- wireshark
- Syslog
- Simple Network Management Protocol (SNMP)
- ping
- Traceroute
- examine router routing table
- examine Address Resolution Protocols (ARP) table
- inspection of interface configuration:
 - IPconfig
 - show IP interface brief
 - show interface

Mitigating common security attacks includes but not limited to:

- CDP Reconnaissance Attack
- Telnet attacks
- MAC address table flooding attack
- Virtual Local Area Network (VLAN) attacks
- Dynamic Host Configuration Protocol (DHCP) attacks

Quality of Service (QoS) mechanisms includes but not limited to:

- voice
- video
- data
- queuing algorithms
 - First In First Out (FIFO)
 - Weighted Fair Queuing (WFQ)
 - Cross Based Weighted Fair Queuing (CBWFQ)
 - Low Latency Queuing (LLQ)

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

To be considered competent in this unit assessors must be satisfied the candidate can demonstrate the achievement of all of the elements of the competency to the level defined by the associated performance criteria

Specifically they must be able to:

- plan, configure and connect a wide area network connection for a small to medium organisation
- identify QoS requirements for a small to medium sized network
- utilise, test and troubleshoot commands to determine end to end connectivity for a small to medium sized computer network
- demonstrate a knowledge of trends and directions in the evolution of computer networks eg IOT devices, virtualisation trends and network programming

Context of and specific resources for assessment

Evidence should show competency working in a realistic environment and a variety of conditions. The candidate will have access to all tools, equipment, materials and documentation required. The candidate will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

This unit may be assessed on the job, off the job or a combination of both. Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working as part of a team. The assessment environment should not disadvantage the candidate

Method of assessment

Evidence can be gathered through a variety of ways including:

- observation of processes and procedures
- oral and/or written questioning
- testimony from supervisors, colleagues, clients and/or other appropriate persons
- inspection of the final product or outcome
- portfolio of documented evidence.

Where performance is not directly observed and/or is required to be demonstrated over a period of time and/or in a number of locations, any evidence should be authenticated by colleagues, supervisors, clients or other appropriate persons