22699VIC
Diploma of Engineering Technology

22700VIC
Advanced Diploma of Engineering Technology

Version #1 - 20 June 2025

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

Accredited for the period: 1 July 2025 – 30 June 2030

Version history

Version number	Details	Date approved
1.0	Initial Release: The 22669VIC Diploma of Engineering *replaces* 22478VIC Diploma of Engineering Technology The 22700VIC Advanced Diploma of Engineering *replaces* 22479VIC Advanced Diploma of Engineering Technology	20 June 2025

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Section A – Copyright and course classification information

<table>
<tr><td>1. Copyright owner of the course</td><td colspan="3">Copyright of this material is reserved to the Crown in the right of the State of Victoria on behalf of the Department of Jobs, Skills, Industry and Regions (DJSIR) Victoria; and managed by the Victorian Skills Authority.

© State of Victoria 2025 (DJSIR)</td></tr>
<tr><td>2. Address</td><td colspan="3">Executive Director
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<tr><td rowspan="2">3. Type of submission</td><td>☐</td><td colspan="2">Accreditation</td></tr>
<tr><td>☒</td><td>Reaccreditation</td><td>22478VIC – Diploma of Engineering Technology

22479VIC - Advanced Diploma of Engineering Technology</td></tr>
</table>

4. Copyright acknowledgement	The following units of competency: CPCCBC4004 Identify and produce estimated costs for building and construction projects CPCCWHS1001 Prepare to work safely in the construction industry have been imported from the CPC- Construction, Plumbing and Services Training Package administered by the Commonwealth of Australia The following units of competency: CPPBDN4110 Set up BIM-capable software and files for building design drafting projects CPPBDN6106 Produce building information modelling for building design projects have been imported from the CPP- Property Services Training Package administered by the Commonwealth of Australia The following unit of competency: MSMENV272 Participate in environmentally sustainable work practices has been imported from the MSM – Manufacturing Training Package administered by the Commonwealth of Australia The following units of competency: MEM09002 Interpret technical drawing MEM09009 Create 2D drawings using computer aided design system MEM09010 Create 3D models using computer aided design system MEM09011 Apply basic engineering design concepts MEM09022 Create 2D code files using computer aided manufacturing system MEM09023 Create 3D code files using computer-aided manufacturing system MEM09155 Prepare mechanical models for computer-aided engineering (CAE) MEM09157 Perform mechanical engineering design drafting MEM09158 Perform mechatronics engineering design drafting MEM09204 Produce basic engineering detail drawings

	MEM09213	Produce schematic drawings for hydraulic and pneumatic fluid power systems
	MEM09229	Read and interpret technical engineering drawings
	MEM10004	Enter and change programmable controller operational parameters
	MEM10005	Commission programmable controller programs
	MEM11011	Undertake manual handling
	MEM12023	Perform engineering measurements
	MEM12024	Perform computations
	MEM13015	Work safety and effectively in manufacturing and engineering
	MEM16006	Organise and communicate information
	MEM16008	Interact with computing technology
	MEM18001	Use hand tools
	MEM18002	Use power tools/hand held operations
	MEM18055	Dismantle, replace and assemble engineering components
	MEM22001	Perform engineering activities
	MEM22002	Manage self in the engineering environment
	MEM22013	Coordinate engineering projects
	MEM23003	Operate and program computers and/or controllers in engineering situations
	MEM23004	Apply technical mathematics
	MEM23006	Apply fluid and thermodynamics principles in engineering
	MEM23007	Apply calculus to engineering tasks
	MEM23063	Select and organise mechanical engineering material tests
	MEM23109	Apply engineering mechanics principles
	MEM23111	Select electrical equipment and components for engineering applications
	MEM23114	Evaluate thermodynamic systems and components
	MEM23115	Evaluate fluid power systems

MEM23120	Select mechanical machine and equipment components
MEM23121	Analyse loads on frames and mechanisms
MEM234010	Design microcontroller applications
MEM234011	Design programmable logic controller applications
MEM234014	Design a robotic system
MEM24012	Apply metallurgical principles
MEM27017	Maintain, fault find and rectify hydraulic systems for mobile plant
MEM29007	Apply networking technology principles for manufacturing and engineering applications
MEM30005	Calculate force systems within simple beam structures
MEM30006	Calculate stresses in simple structures
MEM30007	Select common engineering materials
MEM30010	Set up basic hydraulic circuits
MEM30011	Setup basic pneumatic circuits
MEM30012	Apply mathematical techniques in a manufacturing engineering or related environment
MEM30027	Prepare basic programs for programmable logic controllers
MEM30029	Use workshop equipment and processes to complete an engineering project
MEM30031	Operate computer-aided design (CAD) system to produce basic drawing elements
MEM30033	Use computer-aided design (CAD) to create and display 3D models

have been imported from the MEM - Manufacturing and Engineering Training Package administered by the Commonwealth of Australia.

The following unit of competency:

VU23477	Interpret and prepare basic two and three dimensional engineering drawings

has been imported from: 22632VIC Certificate II in Engineering Studies

		
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6. Course accrediting body	Victorian Registration and Qualifications Authority	
7. AVETMISS information	ANZSCO code Diploma ANZSCO code Advanced Diploma	312512 Mechanical Engineering Technician 312211 Civil Engineering Draftsperson
	ASCED code	0301 Manufacturing Engineering and Technology
	National course code	22669VIC Diploma of Engineering Technology 22700VIC Advanced Diploma of Engineering Technology
8. Period of accreditation	1 July 2025 – 30 June 2030	

Section B – Course information

1. Nomenclature	Standard 4.1 and 5.8 AQTF 2021 Standards for Accredited Courses
1.1 Name of the qualification	Diploma of Engineering Technology Advanced Diploma of Engineering Technology
1.2 Nominal duration of the course	Diploma of Engineering Technology = 850 - 950 hours Advanced Diploma of Engineering Technology = 1700 - 1800 hours
2. Vocational or educational outcomes	**Standard 5.1 AQTF 2021 Standards for Accredited Courses**
2.1 Outcome(s) of the course	The Diploma of Engineering Technology and Advanced Diploma of Engineering Technology are designed to qualify graduates for employment opportunities at paraprofessional level in a range of engineering, manufacturing and related industries roles. The courses allow for direct entry of school leavers as well as catering for tradespersons and technicians who wish to upskill for entry into paraprofessional positions. Specifically: • The Diploma of Engineering Technology is intended to provide participants with the following education outcomes: ○ implement and utilise engineering solutions in mechanical, civil and manufacturing engineering applications requiring substantial theoretical concepts ○ analyse, diagnose and plan with respect to mechanical, civil construction and manufacturing engineering solutions that have a basis in engineering technology ○ use technical information and concepts to plan and implement solutions for a range of engineering environments and contexts ○ troubleshoot interfacing problems between disparate technical or engineering systems ○ provide substantial support in managing projects within given time and budgetary constraints ○ oversee prescribed technical objectives within organisations that have outputs based on engineering application. • The Advanced Diploma of Engineering Technology is intended to provide participants with the following education outcomes: ○ recall and apply engineering and scientific principles in designing mechanical, civil and manufacturing engineering applications based on a well-founded specialist knowledge domain ○ analyse, diagnose, design and execute judgments with respect to mechanical, civil construction and manufacturing solutions that have a basis in engineering technology ○ prepare a brief on technical solutions and concepts with options for various engineering environments and contexts

	○ integrate and solve interfacing problems between disparate technical or engineering systems ○ provide substantial support in managing complex projects within given time and budgetary constraints
2.2 Course description	The Diploma of Engineering Technology equips students with technical knowledge and practical skills to support engineering, manufacturing, and related industries. Graduates will be equipped to improve products, optimize processes, and develop innovative solutions through theoretical and hands-on training. This qualification prepares them for roles in technical support, manufacturing operations, and process improvement. Students can specialise in Mechanical Engineering Design, Civil Engineering, or Mechatronics. The Advanced Diploma of Engineering Technology builds on foundational knowledge, enhancing students' leadership, innovation, and technical expertise in engineering and manufacturing. It equips graduates with advanced problem-solving, project management, and analytical skills to drive complex projects, optimize processes, and develop innovative solutions. This qualification prepares individuals for senior technical roles and further studies in engineering. Students can specialise in Mechanical Engineering Design, Civil Engineering, or Mechatronics.
3. Development of the course	**Standards 4.1, 5.1, 5.2, 5.3 and 5.4 AQTF 2021 Standards for Accredited Courses**
3.1 Industry, education, legislative, enterprise or community needs	The engineering, manufacturing and related industries are extremely diverse. They encompass a broad range of industries such as: transport, electro-technology components, machinery, aerospace, defence, chemicals and plastics, medical, pharmaceuticals, renewable energy technology, fabricated metals, non-metallic products, textiles and food processing. A Victorian State Government media release entitled: Accelerating growth in local manufacturing dated 31 October 2023 states: 'Victoria's $33 billion manufacturing industry is a driving force of the state's economy, made up of over 24,000 businesses, supporting more than 260,000 jobs and exporting goods worth $23.9 billion'. Manufacturing is also a changing industry which is continuing to embrace new and emerging technologies. It is now more complex with inter-dependence between services, design, and digital technologies and growing connections across value chains. Many of the jobs in the manufacturing industry are now non-production roles and relate to research and development, design, supply chain and logistics, customised goods, post-sales support and services. Victoria's engineering and manufacturing industry also leads the nation in research and development (R&D), which not only includes new product development, but also new and innovative manufacturing technologies and production processes. A number of global companies have based their R&D design and engineering operations in Victoria to take advantage of local capabilities. Several defence related R&D facilities are based in Victoria

	including BAE Systems, Thales, Siemens, BMT Design and Technology and Lockheed Martin. It's necessary therefore, for the State's current and future economy that there continues to be a ready supply of well-trained engineering graduates to meet the industry's need to continue to develop world class products and innovative manufacturing practices to remain competitive in global markets. The Diploma of Engineering Technology and the Advanced Diploma of Engineering Technology have a sound track record of meeting the engineering and manufacturing industries requirements for well-trained technician and paraprofessional engineers. The courses have provided a post-secondary school/non-trade study pathway into the engineering and manufacturing industry since the year 2000. Enrolments numbers have remained consistent for the past four years (see Item 3.2 for actual figures) and it's anticipated annual enrolments for the revised qualifications will be similar. Although the current MEM Manufacturing and Engineering Training Package Diploma and Advanced Diploma qualifications: • MEM50119 Diploma of Engineering - Advanced Trades • MEM50222 Diploma of Engineering - Technical • MEM60122 Advanced Diploma of Engineering have been updated they continue to have a post trade focus. Therefore, they lack the competencies a paraprofessional technician/engineer will require in an advanced manufacturing environment where integration of a range of technologies is becoming the norm rather than the exception. It should be noted however, a significant number of MEM units have been evaluated and considered suitable for inclusion in each qualification. For the reaccreditation of the Diploma of Engineering Technology and the Advanced Diploma of Engineering Technology there has been an extensive review of the existing courses and as consequence, several changes have been made to ensure the qualifications retain their relevance for the Victorian engineering, manufacturing and related industries. The Committee approved the removal of three streams—Manufacturing Systems, Engineering Management, and Engineering Maintenance Management—from the Diploma of Engineering Technology, and the Integrated Manufacturing Systems stream from the Advanced Diploma of Engineering Technology. As a result, a total of 53 units with no enrolments in the past five years were deleted. The re-accredited Diploma of Engineering Technology and the Advanced Diploma of Engineering Technology are designed to: • generate a training pathway for both new entrants and mature age learners to gain higher-level skills in manufacturing, engineering and related industries • provide skills and knowledge at paraprofessional level that will assist industry to stay competitive in the global marketplace • provide the knowledge and skills to enable industry to add value to its' products and services to maintain an ongoing role in the economic wellbeing of Victoria.

A Course Steering Committee was established to advise on the review and redevelopment of the courses and to confirm alignment to industry current and future needs.

The membership of the committee is comprised of:

Antoaneta Barbulescu (Chairperson)	Engineers Australia – Accreditation Consultant
Arvind Sharma	Victoria University
Amita Iyer	RMIT
Damien Sinclair	Festo
Vincent Nguyen	Dept Transport Planning
Tharakan Babu	Swinburne University

This course:

- does not duplicate, by title or coverage, the outcomes of an endorsed training package qualification
- is not a subset of a single training package qualification that could be recognised through one or more statements of attainment or a skill set
- does not include units of competency additional to those in a training package qualification that could be recognised through statements of attainment in addition to the qualification
- does not comprise units that duplicate units of competency of a training package qualification

3.2 Review for re-accreditation

An examination of the enrolment history for both qualifications for the past five years shows a steady increase in the number of enrolments for the course which illustrates the need for both of these courses (see table below)

Qualification		**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
22478VIC Diploma of Engineering Technology	Gvt Funding	451	657	532	688	1035	1340
	Fee for Service	42	52	33	59	49	38
Sub- Total		**493**	**709**	**565**	**735**	**1084**	**1378**
22479VIC Advanced Diploma of Engineering Technology	Gvt Funding	336	375	345	306	319	354
	Fee for Service	171	244	279	194	144	87
Sub-Total		507	619	624	500	463	441
Grand Total		**1000**	**1328**	**1189**	**1235**	**1547**	**1819**

(Enrolment data supplied by DJSIR, September 2024)

	An extensive review of the current courses has been undertaken by the CMM Engineering Industries under the guidance of the Course Steering Committee which included: • examination of the delivery history of all units in both qualifications over the past four years • assessment of the feedback gathered from RTOs • review of the currency of existing units, VU22452 *Use communication network concepts and practices in manufacturing and engineering applications* was removed from the core as it was deemed not fit for purpose. It was added to the elective bank and replaced by MEM29007 *Apply networking technology principles for manufacturing and engineering applications*. Additionally, MEM13015 *Work safely and effectively in manufacturing and engineering*, a newly imported unit, now replaces VU22452 as a core unit. Fifty-three (53) units were deleted from the course has they have had no enrolments in the last five years • examination of all imported units to ensure the inclusion of the latest version of each • research of the industry changes/needs especially the impact of advanced manufacturing requirements. In addition, the Course Steering Committee requested that the structure of the reaccredited courses should continue to provide: • maximum flexibility to learners when choosing units of competency • maximum flexibility for industry in selecting the required skill profiles and • the option within each course's rules to import additional units of competency from endorsed training packages or other accredited courses, if they are relevant to industry, workplaces and/or learners. To meet these requirements, a core and electives' model for both courses has been maintained, and the course rules continue to provide as much flexibility as possible when selecting elective units yet at the same time ensuring the integrity of each qualification. In particular: • core units of both qualifications have been reviewed and reduced to ensure there are only units contained in each qualification that have relevance to all industry streams • industry streams for each qualification were extensively reviewed resulting in some rationalisation e.g. Engineering Management, Engineering Maintenance Management and Fluid Power streams have been removed due to low enrolments over the current accreditation period. Relevant units belonging to the deleted streams have been relocated to the remaining streams for both qualifications. • elective stream units were reviewed to ensure their relevance and if imported, they are the current version. • to meet VRQA current requirements the packaging rules have been changed from quantity of hours to quantity of units for each qualification. The new 22669VIC Diploma of Engineering Technology supersedes and is deemed equivalent to 22478VIC Diploma of Engineering Technology and the new 22700VIC Advanced Diploma of Engineering Technology supersedes and

	is deemed equivalent to 22478VIC Diploma of Engineering Technology. Transition of current learners and enrolment of new learners must be managed in accordance with the relevant VET Regulator's requirements. Transition table below indicates the unit-by-unit relationship between the existing and new course units for both qualifications.

Transition Table

Existing course structure (units of competency)	**New course structure (units of competency)**	**Relationship E/NE/N/R**
VU21174 Program control systems	VU23918 Program and test control systems	Equivalent
VU21176 Utilise digital electronics for control applications	VU23921 Utilise digital electronics for control applications	Equivalent
VU21232 Program, operate and select a robotics system	VU23909 Program, operate and select a robotics system	Equivalent
VU21270 Implement control processes using PLCs	VU23910 Implement control processes using programmable logic controllers	Equivalent
VU22451 Investigate advanced technology applications in the manufacturing industry and related industries	VU23908 Investigate advanced technology applications in the manufacturing industry and related industries	Equivalent
VU22472 Apply electrotechnology principles in an engineering work environment	VU23914 Apply electrotechnology principles in an engineering work environment	Equivalent
VU22473 Prepare and document a work plan to fabricate an engineering product or component	VU23928 Prepare and document a work plan to fabricate an engineering product or component	Equivalent
VU22474 Apply principles of strength of materials to engineering problems	VU23919 Apply principles of strength of materials to engineering problems	Equivalent

VU22475 Apply scientific principles to engineering problems	VU23916 Apply scientific principles to engineering problems	Equivalent
VU22476 Plan for the implementation of mechanical drive systems	VU23924 Plan for the implementation of mechanical drive systems	Equivalent
VU22478 Design and prototype components and/or small structures using engineering design principles	VU23925 Design and prototype components or small structures using engineering design principles	Equivalent
VU22479 Apply fluid mechanic principles in mechanical engineering	VU23922 Apply fluid mechanic principles in mechanical engineering	Equivalent
VU22480 Implement basic materials science principles to engineering applications	VU23913 Implement basic materials science principles to engineering applications	Equivalent
VU22482 Use advanced mathematics for engineering	VU23923 Solve engineering problems using algebra	Equivalent
VU22484 Implement site investigation procedures	VU23929 Implement site investigation procedures	Equivalent
VU22485 Apply construction principles to civil engineering works	VU23930 Apply fundamentals of civil engineering to a construction project	Equivalent
VU22486 Apply principles of materials testing to civil engineering applications	VU23931 Apply principles of materials testing to civil engineering applications	Equivalent
VU22487 Apply surveying for civil engineering projects	VU23932 Apply surveying for civil engineering projects	Equivalent
VU22488 Perform measurements and layout tasks on construction site	VU23933 Perform measurements and layout tasks on construction site	Equivalent

VU22489 Produce reinforced concrete drawings	VU23934 Produce reinforced concrete drawings	Equivalent
VU22490 Produce structural steel drawings	VU23935 Produce structural steel drawings	Equivalent
VU22493 Produce drawings to enable urban road construction	VU23936 Produce drawings to enable road construction	Equivalent
VU22497 Annotate and create assemblies using solid models	VU23915 Annotate and create assemblies using solid models	Equivalent
VU22499 Apply hydraulic principles to achieve an engineering task	VU23911 Apply hydraulic principles to achieve an engineering task	Equivalent
VU22500 Apply pneumatic principles to achieve an engineering task	VU23926 Apply pneumatic principles to achieve an engineering task	Equivalent
VU22501 Set up manufacturing processes for engineering applications	VU23917 Set up manufacturing processes for engineering applications	Equivalent
VU22505 Write and modify basic CNC programs	VU23912 Write and modify basic CNC programs	Equivalent
VU22512 Conduct and analyse precision engineering measurements	VU23927 Conduct and analyse precision engineering measurements	Equivalent
VU22535 Apply advanced statics principles to engineering problems	VU23948 Apply advanced statics principles to engineering problems	Equivalent
VU22537 Apply finite element analysis	VU23942 Apply finite element analysis	Equivalent

VU22538 Design mechanical engineering systems	VU23941 Design basic mechanical engineering systems	Equivalent
VU22539 Design mechanical machines	VU23938 Design rotating mechanical machines	Equivalent
VU22540 Generate design solutions	VU23945 Generate design solutions	Equivalent
VU22541 Implement advanced materials science principles to engineering applications	VU23947 Implement advanced materials science principles to engineering applications	Equivalent
VU22542 Use advanced 2D & 3D computer aided drafting (CAD) techniques	VU23940 Use advanced 2D & 3D computer aided drafting (CAD) techniques	Equivalent
VU22543 Produce an advanced engineering design for a reinforced concrete structure	VU23953 Produce an advanced engineering design for a reinforced concrete structure	Equivalent
VU22545 Apply environmental solutions to civil engineering projects	VU23960 Apply environmental and heritage solutions to civil engineering projects	Equivalent
VU22546 Apply principles of mechanics to engineering structures	VU23955 Apply principles of mechanics to engineering structures	Equivalent
VU22547 Produce an engineering design for drainage pipes and culverts	VU23952 Produce an engineering design for drainage pipes and culverts	Equivalent
VU22548 Produce an engineering design for a stormwater reticulation scheme	VU23963 Produce an engineering design for a stormwater reticulation scheme	Equivalent

VU22549 Produce an engineering design for a sewerage reticulation scheme	VU23954 Produce an engineering design for a sewerage reticulation scheme	Equivalent
VU22550 Produce an engineering design for a reinforced concrete structure	VU23957 Produce an engineering design for a reinforced concrete structure	Equivalent
VU22551 Produce an engineering design for a steel structure	VU23959 Produce an engineering design for a steel structure	Equivalent
VU22552 Produce advanced engineering drawings for a reinforced concrete structure	VU23964 Produce advanced engineering drawings for a reinforced concrete structure	Equivalent
VU22553 Produce advanced engineering drawings for a steel structure	VU23965 Produce advanced engineering drawings for a steel structure	Equivalent
VU22554 Apply surveying computations to civil engineering projects	VU23950 Apply surveying computations to civil engineering projects	Equivalent
VU22558 Analyse and design foundations and footings	VU23958 Analyse and design foundations and footings	Equivalent
VU22559 Design timber structures	VU23962 Design timber structures	Equivalent
VU22560 Produce geometric designs for roads	VU23951 Produce geometric designs for roads	Equivalent
VU22561 Analyse the strength of civil structural elements	VU23961 Analyse the strength of civil structural elements	Equivalent

VU22562 Apply principles of soil mechanics to civil engineering	VU23956 Apply principles of soil mechanics to civil engineering	Equivalent
VU22563 Set up mechatronics engineering systems	VU23943 Set up and implement mechatronics engineering systems	Equivalent
VU22564 Plan and manage a robotics system	VU23944 Plan and manage a robotics system	Equivalent
VU22565 Set up fluid power controlled engineering systems	VU23937 Set up and monitor fluid power-controlled engineering systems	Equivalent
VU22567 Use extended features of computer aided drafting (CAD)	VU23946 Use extended features of computer aided drafting (CAD)	Equivalent
VU22572 Apply principles of advanced metrology in manufacturing	VU23939 Apply processes of advanced metrology in manufacturing	Equivalent
VU22573 Program and set up co-ordinate measuring machines (CMM)	VU23949 Program and set up co-ordinate measuring machines (CMM)	Equivalent
VU22452 Use communication network concepts and practices in manufacturing and engineering applications		Deleted from course
VU21170 Implement and maintain control systems for industrial processes		Deleted from course
VU21172 Apply instrumentation principles to industrial control systems		Deleted from course

VU21173 Interface control systems to industrial processes and analyse data from SCADA systems		Deleted from course
VU21545 Evaluate proportional and servo controlled fluid power systems		Deleted from course
VU21546 Monitor and adjust an integrated fluid power control system		Deleted from course
VU21547 Select components for an integrated fluid power design project		Deleted from course
VU21548 Install and commission an integrated fluid power system		Deleted from course
VU21549 Conduct a feasibility study for an integrated fluid power system		Deleted from course
VU21551 Test and monitor fluid power circuits		Deleted from course
VU21609 Install and maintain hydraulic/pneumatic systems		Deleted from course
VU22453 Handle engineering materials		Deleted from course
VU22471 Utilise Augmented Reality (AR) technology for manufacturing		Deleted from course

VU22477 Select rotating electrical machines		Deleted from course
VU22481 Apply network concepts and practices for engineering systems		Deleted from course
VU22491 Produce structural steel shop drawings		Deleted from course
VU22492 Produce engineering drawings for a rural road		Deleted from course
VU22494 Produce engineering drawings for a stormwater reticulation scheme		Deleted from course
VU22495 Analyse the performance of AC motors		Deleted from course
VU22496 Utilise analog electronics for control applications		Deleted from course
VU22498 Interface and program mechatronics engineering systems		Deleted from course
VU22502 Design jigs and fixtures for manufacturing		Deleted from course
VU22503 Create and modify surfaces for simple consumer products		Deleted from course
VU22504 Program a 3D milling machine centre		Deleted from course

VU22506 Write advanced CNC programs and operate a vertical machining centre		Deleted from course
VU22507 Write advanced CNC programs and operate a multi axis turning centre		Deleted from course
VU22508 Produce engineering components by programming and operating a CNC manufacturing cell		Deleted from course
VU22509 Apply computer aided manufacturing (CAM) processes		Deleted from course
VU22510 Apply computer aided manufacturing (CAM) 2D programming		Deleted from course
VU22511 Apply computer aided manufacturing (CAM) lathe programming		Deleted from course
VU22513 Apply principles of metrology in manufacturing		Deleted from course
VU22514 Manage inventory and operational controls within the supply chain		Deleted from course
VU22515 Manage supply chain forecasting and materials planning		Deleted from course
VU22516 Manage supply chain quality		Deleted from course
VU22517 Manage and maintain supply chain		Deleted from course

network communication and relationships		
VU22518 Manage global sourcing and supply of domestic supply chains		Deleted from course
VU22519 Manage warehouse packaging, materials handling and operational performance		Deleted from course
VU22528 Manage and review supply chain continuous improvement and benchmarked performance		Deleted from course
VU22529 Perform competitive bidding, contract preparation and contract management tasks		Deleted from course
VU22530 Plan, implement and apply preventative maintenance procedures		Deleted from course
VU22531 Establish and manage maintenance systems		Deleted from course
VU22532 Select and apply lubrication principles		Deleted from course
VU22533 Maintain bearing and rotary shaft assemblies		Deleted from course
VU22534 Perform vibration measurement and control		Deleted from course

VU22536 Apply advanced dynamics principles to engineering problems		Deleted from course
VU22544 Produce an advanced engineering design for a steel structure		Deleted from course
VU22555 Analyse piping designs		Deleted from course
VU22556 Design process plant layout		Deleted from course
VU22557 Design piping systems		Deleted from course
VU22566 Design fluid power controlled engineering systems		Deleted from course
VU22568 Manage computer aided drafting (CAD) systems		Deleted from course
VU22569 Manage computer aided drafting (CAD) in a business		Deleted from course
VU22570 Program 4th axis applications		Deleted from course
VU22571 Create advanced programs for CNC machine centres		Deleted from course
BSBINM601 Manage knowledge and information		Deleted from course
BSBMGT502 Manage people performance		Deleted from course

BSBMGT517 Manage operational plan		Deleted from course
BSBMGT605 Provide leadership across the organisation		Deleted from course
BSBMGT608 Manage innovation and continuous improvement		Deleted from course
BSBPMG411 Apply project quality management techniques		Deleted from course
BSBPMG414 Apply project information and communications techniques		Deleted from course
BSBPMG513 Manage project quality		Deleted from course
BSBPMG516 Manage project information and communication		Deleted from course
BSBPMG521 Manage project integration		Deleted from course
BSBPMG522 Undertake project work		Deleted from course
BSBREL402 Build client relationships and business networks		Deleted from course
BSBRSK501 Manage risk		Deleted from course
BSBSUS501 Develop workplace policy and procedures for sustainability		Deleted from course

BSBWHS501 Ensure a safe workplace		Deleted from course
BSBWHS507 Contribute to managing WHS information systems		Deleted from course
BSBPMG605 Direct quality management of a project program		Deleted from course
BSBPMG609 Direct procurement and contract for a project program		Deleted from course
CPCCBC4004A Identify and produce estimated costs for building and construction projects	CPCCBC4004 Identify and produce estimated costs for building and construction projects	Equivalent
CPCCWHS1001 Prepare to work safely in the construction industry	CPCWHS1001 Prepare to work safely in the construction industry	Equivalent
CPPBDN5013A Develop and collaborate on building information models for small-scale building design projects	CPPBDN6106 Produce building information modelling for building design projects	Equivalent
CPPBDN4004 Set up BIM-capable software and files for building design drafting projects	CPPBDN4110 Set up BIM capable software and files for building design drafting projects	Equivalent
MSS015002 Develop strategies for more sustainable use of resources		Deleted from course
MSS404052 Apply statistics to operational processes		Deleted from course

MSS405001 Develop competitive systems and practices for an organisation		Deleted from course
MSS405030 Optimise cost of a product or service		Deleted from course
MSS015007 Develop a business case for sustainability improvements		Deleted from course
MSS015008 Develop strategic sustainability plans		Deleted from course
MSS405075 Facilitate the development of a new product		Deleted from course
MSMENV272 Participate in environmentally sustainable work practices	MSMENV272 Participate in environmentally sustainable work practices	No Change
MSMSUP400 Develop and monitor quality systems		Deleted from course
MEM09002B Interpret technical drawing	MEM09002 Interpret technical drawing	Equivalent
MEM09009C Create 2D drawings using computer aided design system	MEM09009 Create 2-D drawings using computer-aided design system	Equivalent
MEM09010C Create 3D models using computer aided design system	MEM09010 Create 3-D models using computer-aided design system	Equivalent
MEM09011B Apply basic engineering design concepts	MEM09011 Apply basic engineering design concepts	Equivalent

MEM09022A Create 2D code files using computer aided manufacturing system	MEM09022 Create 2-D code files using computer-aided manufacturing system	Equivalent
MEM09023A Create 3D code files using computer aided manufacturing system	MEM09023 Create 3-D code files using computer-aided manufacturing system	Equivalent
MEM09155A Prepare mechanical models for computer-aided engineering (CAE)	MEM09155 Prepare mechanical models for computer-aided engineering (CAE)	Equivalent
MEM09157A Perform mechanical engineering design drafting	MEM09157 Perform mechanical engineering design drafting	Equivalent
MEM09158A Perform mechatronics engineering design drafting	MEM09158 Perform mechatronics engineering design drafting	Equivalent
	MEM09204 Produce basic engineering detail drawings	Newly Imported Unit
MEM09213A Produce schematic drawings for hydraulic and pneumatic fluid power systems	MEM09213 Produce schematic drawings for hydraulic and pneumatic fluid power systems	Equivalent
	MEM09229 Read and interpret technical engineering drawings	Newly Imported Unit
MEM10004B Enter and change programmable controller operational parameters	MEM10004 Enter and change programmable controller operational parameters	Equivalent
MEM10005B Commission programmable controller programs	MEM10005 Commission programmable controller programs	Equivalent

	MEM11011 Undertake manual handling	Newly Imported Unit
MEM12023A Perform engineering measurements	MEM12023 Perform engineering measurements	Equivalent
	MEM12024 Perform computations	Newly Imported Unit
	MEM13015 Work safely and effectively in manufacturing and engineering	Newly Imported Unit
MEM14005A Plan a complete activity	MEM14006 Plan work activities	Equivalent
MEM14091A Integrate manufacturing fundamentals into an engineering task	MEM14091 Integrate manufacturing fundamentals into an engineering task	Equivalent
MEM16006A Organise and communicate information	MEM16006 Organise and communicate information	Equivalent
MEM16008A Interact with computing technology	MEM16008 Interact with computing technology	Equivalent
MEM16010A Write reports	MEM16010 Write reports	Equivalent
MEM18001C Use hand tools	MEM18001 Use hand tools	Equivalent
MEM18002B Use power tools/hand held operations	MEM18002 Use power tools/hand held operations	Equivalent
MEM18055B Dismantle, replace and assemble engineering components	MEM18055 Dismantle, replace and assemble engineering components	Equivalent
MEM22001A Perform engineering activities	MEM22001 Perform engineering activities	Equivalent

MEM22002A Manage self in an engineering environment	MEM22002 Manage self in the engineering environment	Equivalent
MEM22013A Coordinate engineering projects	MEM22013 Coordinate engineering projects	Equivalent
MEM23003A Operate and program computers and/or controllers in engineering situations	MEM23003 Operate and program computers and/or controllers in engineering situations	Equivalent
MEM23004A Apply technical mathematics	MEM23004 Apply technical mathematics	Equivalent
MEM23006A Apply fluid and thermodynamics principles in engineering	MEM23006 Apply fluid and thermodynamics principles in engineering	Equivalent
MEM23007A Apply calculus to engineering tasks	MEM23007 Apply calculus to engineering tasks	Equivalent
MEM23063A Select and test mechanical engineering materials	MEM23063 Select and organise mechanical engineering material tests	Equivalent
MEM23109A Apply engineering mechanics principles	MEM23109 Apply engineering mechanics principles	Equivalent
MEM23111A Select electrical equipment and components for engineering applications	MEM23111 Select electrical equipment and components for engineering applications	Equivalent
MEM23114A Evaluate thermodynamic systems and components	MEM23114 Evaluate thermodynamic systems and components	Equivalent
MEM23115A Evaluate fluid power systems	MEM23115 Evaluate fluid power systems	Equivalent

MEM23120A Select mechanical machine and equipment components	MEM23120 Select mechanical machine and equipment components	Equivalent
MEM23121A Analyse loads on frames and mechanisms	MEM23121 Analyse loads on frames and mechanisms	Equivalent
MEM234010A Design microcontroller applications	MEM234010 Design microcontroller applications	Equivalent
MEM234011A Design programmable logic controller applications	MEM234011 Design programmable logic controller applications	Equivalent
MEM234014A Design a robotic system	MEM234014 Design a robotic system	Equivalent
MEM24012C Apply metallurgy principles	MEM24012 Apply metallurgical principles	Equivalent
MEM18052B Maintain Fluid Power Systems for Mobile Plant	MEM27017 Maintain, fault find and rectify hydraulic systems for mobile plant	Equivalent
	MEM30005 Calculate force systems within simple beam structures	Newly Imported Unit
	MEM29007 Apply networking technology principles for manufacturing and engineering applications	Newly Imported Unit
	MEM30006 Calculate stresses in simple structures	Newly Imported Unit
MEM30007A Select common engineering materials	MEM30007 Select common engineering materials	Equivalent
MEM30010A Set up basic hydraulic circuits	MEM30010 Set up basic hydraulic circuits	Equivalent

MEM30011A Setup basic pneumatic circuits	MEM30011 Set up basic pneumatic circuits	Equivalent
MEM30012A Apply mathematical techniques in a manufacturing engineering or related environment	MEM30012 Apply mathematical techniques in a manufacturing engineering or related environment	Equivalent
MEM30016A Assist in the analysis of a supply chain	MEM30016 Assist in the analysis of a supply chain	Equivalent
MEM30017A Use basic preventative maintenance techniques and tools	MEM30017 Use basic preventative maintenance techniques and tools	Equivalent
MEM30027A Prepare basic programs for programmable logic controllers	MEM30027 Prepare basic programs for programmable logic controllers	Equivalent
MEM30029A Use workshop equipment and processes to complete an engineering project	MEM30029 Use workshop equipment and processes to complete an engineering project	Equivalent
MEM30031A Operate computer-aided design (CAD) system to produce basic drawing elements	MEM30031 Operate computer-aided design (CAD) system to produce basic drawing elements	Equivalent
MEM30033A Use computer-aided design (CAD) to create and display 3D models	MEM30033 Use computer-aided design (CAD) to create and display 3D models	Equivalent
MEM09156A Prepare mechatronic models for computer-aided engineering (CAE)		Deleted from course
MEM13014A Apply principles of occupational		Deleted from training package

health and safety in work environment		
MEM14088A Apply maintenance engineering techniques to equipment and component repairs and modifications		Deleted from course
MEM14092A Integrate maintenance fundamentals into an engineering task		Deleted from course
MEM22012A Coordinate resources for an engineering project or operation		Deleted from course
MEM22014A Coordinate engineering-related manufacturing operations		Deleted from course
MEM23005A Apply statistics and probability techniques to engineering tasks		Deleted from course
MEM23008A Apply advanced algebra and numerical methods to engineering tasks		Deleted from course
MEM23064A Select and test mechatronic engineering materials		Deleted from course
MEM23112A Investigate electrical and electronic controllers in engineering applications		Deleted from course
MEM23116A Evaluate programmable logic		Deleted from course

controller and related control system component applications		
MEM23117A Evaluate microcontroller applications		Deleted from course
MEM23122A Evaluate computer integrated manufacturing systems		Deleted from course
MEM23123A Evaluate manufacturing processes		Deleted from course
MEM23134A Evaluate jigs and fixtures		Deleted from course
MEM23125A Evaluate maintenance systems		Deleted from course
MEM23126A Evaluate industrial robotic applications		Deleted from course
MEM23131A Evaluate rapid prototyping applications		Deleted from course
MEM23132A Evaluate rapid manufacturing processes		Deleted from course
MEM23133A Evaluate rapid tooling applications		Deleted from course
MEM23138A Evaluate suitability of materials for engineering-related applications		Deleted from course
MEM234003A Design machines and ancillary equipment		Deleted from course

MEM234004A Design for engineering-related noise and vibration mitigation		Deleted from course
MEM234032A Manage fluid power related technologies in an enterprise workplace		Deleted from course
MEM30014A Apply basic just in time systems to the reduction of waste		Deleted from course
TLIR5006 Develop, implement and review purchasing strategies		Deleted from course
TLIR5014 Manage suppliers		Deleted from course
TLIL5055 Manage a supply chain		Deleted (from training package)

4. Course outcomes	Standards 5.5, 5.6 and 5.7 AQTF 2021 Standards for Accredited Courses
4.1 Qualification level	The 22669VIC Diploma of Engineering Technology aligns to the Diploma level of the Australian Qualifications Framework (AQF) in that graduates will have: **Knowledge:** • technical and theoretical knowledge and concepts, with depth in specific areas within the field of engineering technology **Skills:** • cognitive and communication skills to identify, analyse, synthesise and act on information from a range of engineering/manufacturing sources • cognitive, technical and communication skills to analyse, plan, design and evaluate approaches to unpredictable problems and/or management requirements in the field of engineering/manufacturing • specialist technical and creative skills to express ideas and perspectives in their chosen engineering/manufacturing specialisation • communication skills to transfer knowledge and specialist skills to others and demonstrate understanding of engineering/manufacturing technology **Application of knowledge and skills:** Graduates of the Diploma will demonstrate the application of knowledge and skills: • with depth in areas of specialisation, in known and changing contexts • to transfer and apply theoretical concepts and/or technical and/or creative skills in a range of engineering/manufacturing situations • with personal responsibility and autonomy in performing complex technical operations with responsibility for own outputs in relation to broad parameters for quantity and quality • with initiative and judgment to organise the work of self and others and plan, coordinate and evaluate the work of teams within generally well defined parameters. The Volume of Learning for the Diploma of Engineering Technology is typically 1 - 2 years. This is made up of structured tuition and assessments, plus unstructured learning such as locating and gathering information for assignments and project work, investigating pathway options for further study and/or future employment in the engineering, manufacturing or related industry. The 22700VIC Advanced Diploma of Engineering Technology aligns to the Advanced Diploma level of the Australian Qualifications Framework (AQF) in that graduates will have:

	Knowledge: • specialised and integrated technical and theoretical knowledge within one or more fields of engineering/manufacturing technology **Skills:** • cognitive, communication skills to identify, analyse, synthesise and act on information from a range of sources for various engineering/manufacturing activities • cognitive and communication skills to transfer knowledge and skills to others and to demonstrate understanding of specialised knowledge with depth in some areas of engineering and/or manufacturing • cognitive and communication skills to formulate responses to complex engineering/manufacturing problems • wide-ranging specialised technical, creative or conceptual skills to express ideas and perspectives within an engineering or manufacturing context **Application of knowledge and skills:** Graduates of the Advanced Diploma will demonstrate the application of knowledge and skills: • with depth in areas of engineering/manufacturing specialisation, in contexts subject to change • with initiative and judgment in planning, design, technical or management functions in engineering/manufacturing, with some direction • to adapt a range of fundamental principles and complex techniques to known and unknown situations within their area of engineering/manufacturing specialisation • across a broad range of technical or management engineering/manufacturing functions, with accountability for personal outputs and personal and team outcomes within broad parameters. The Volume of Learning for the Advanced Diploma of Engineering Technology is typically 1.5 - 2 years. This is made up of structured tuition and assessments, plus unstructured learning such as research for assignment and project work, investigating pathway options for further study and/or future employment in the engineering, manufacturing or related industry.
4.2 Foundation skills	**Foundations skills summary – 22669VIC Diploma of Engineering** Reading Skills to: • interpret complex information from reference texts, manufacturer's catalogues and industrial magazines and websites Writing skills to: • write technical or non-technical reports that include some level of analysis and/or research

	Oral communication skills to:	• communicate effectively across a range of communication networks in the workplace • use engineering terminology and language appropriate to the situation and target audience • relay information to team members using appropriate language for the audience
	Numeracy skills to:	• perform calculations in binary and hexadecimal number systems • analyse financial and numerical information embedded in a range of texts and tasks
	Learning skills to:	• maintain knowledge of relevant legislative requirements, codes and standards • use information from a range of sources to research technical information and data suitable and appropriate for engineering/manufacturing applications • identify and consult appropriate personnel and technical experts or other reference sources to obtain/verify information
	Problem solving skills to:	• analyse information and data from operations, processes, and test results including determining trends from graphical data • develop solutions and make recommendations for engineering/manufacturing related problems based on analysis of data • apply mathematical techniques and scientific principles to engineering situations
	Initiative and enterprise skills to:	• apply statistical processes to make recommendations and find solutions for equipment and process improvements • make modifications to work plans and schedules to overcome unforeseen difficulties or developments • initiate significant modifications to plant and equipment that lead to desired changes in performance
	Teamwork skills to:	• work as part of a team that may include apprentices, other tradespersons, technicians, engineers and production personnel • provide clear and precise information to team members • delegate and supervise work where appropriate

	Planning and organising skills to:	• organise, sort, categorise and sequence information • select and use planning techniques and tools to plan, sequence and prioritise work operations • prepare, monitor and review work plans, schedules, programs and budgets
	Self-management skills to:	• carry out work within given timeframe, process and quality constraints • carry out work safely and in accordance with company policy and procedures and legislative requirements • monitor work to ensure compliance with legislation, codes and national standards
	Technology skills to:	• use computing technology to access, input and store information • apply engineering knowledge and principles • search computer databases and the internet for technical information and data suitable for engineering/manufacturing applications • inspect engineering/manufacturing plant, equipment and systems for optimum operation and undertake modifications as required
	Digital literacy skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts to present findings to stakeholders
	Foundation skills summary – 22700VIC Advanced Diploma of Engineering Technology	
	Reading Skills to:	• interpret and follow information on legislative and regulatory requirements, codes of practice, specifications, design briefs, charts, lists, drawings and other applicable reference documentation
	Writing skills to:	• communicate complex ideas through reports, presentations, meetings and one on one communication • use standard engineering drawing symbols, references, terminology and scientific notation
	Oral communication skills to:	• consult and advise internal and external clients to ensure clarification of requirements for projects or operations • mentor others

	Numeracy skills to:	• perform calculations in binary and hexadecimal number systems • analyse financial and numerical information embedded in a range of texts and tasks
	Learning skills to:	• research, evaluate and report information on systems, techniques, requirements, options and solutions. • undertake research by consulting appropriate personnel and accessing information from a range of sources • review and maintain academic development, work experience, ethical practice, indemnity, negotiation, consultation and human relations with respect to the practice of engineering • identify options for professional development opportunities
	Problem solving skills to:	• analyse and evaluate information to determine requirements, strategies and solutions (including benefit/cost analysis) • apply and manipulate mathematical techniques and scientific principles to engineering situations • evaluate environmental and sustainability performance of equipment and processes and make recommendations for improvements • identify and select common engineering materials by their principal properties • diagnose performance and process problems
	Initiative and enterprise skills to:	• apply skills and knowledge in new and different situations and contexts • use judgement and discretion • facilitate and capitalise on change and innovation • generate innovative and creative ideas, approaches and solutions
	Teamwork skills to:	• work as part of single and multi-disciplinary teams that include other paraprofessionals, professionals, trades and production personnel • provide clear and precise information to team members • negotiate and communicate with stakeholders • delegate and supervise work where appropriate

	Planning and organising skills to:	• design and plan documentation for particular applications • manage work priorities and resources • prepare, monitor and review work plans, programs and budgets • identify requirements and manage processes to ensure adequate resourcing, programming, maintenance and training for operations
	Self-management skills to:	• manage own time and own processes • complete tasks in a competent and timely manner • set personal goals and plans • gain and use feedback to improve personal performance • address all legislation, codes and standards related to safety, environmental impact and sustainability issues
	Technology skills to:	• apply engineering knowledge and principles • select and apply engineering techniques and associated technologies, software and hardware • use technology appropriately to manage work priorities and commitments • use a CAD program, computer and peripherals
	Digital literacy skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts to present findings to stakeholders
4.3 Recognition given to the course (if applicable)	Not Applicable	
4.4 Licensing/regulatory requirements (if applicable)	No licensing, legislative, regulatory or certification requirements apply to these courses at the time of publication.	
5. Course rules	**Standards 5.8 and 5.9 AQTF 2021 Standards for Accredited Courses**	
5.1 Course structure	**22669VIC Diploma of Engineering Technology**	

	To achieve this qualification learners must successfully complete at least **eighteen (18)** units comprising of: • **nine (9) core units** from **Table 1** *plus* • **nine (9) elective units** *of which:* ○ **at least seven (7) units** from **Table 2** which can be selected from one stream or across streams ○ **No more than two (2) elective units** can be drawn from **Table 4** or from other endorsed training packages and/or accredited courses provided the units are consistent with the qualification AQF level and outcomes of the course. **22700VIC Diploma of Engineering Technology** Designated streams are: - Mechanical Engineering - Civil Engineering - Mechatronic Engineering To achieve this qualification with a designated stream included learners must successfully complete at least **eighteen (18**) units comprising of: • **nine (9) core units** from **Table 1** *plus* • **nine (9) elective units** *of which:* ○ **at least seven (7) units** from the **designated stream** from **Table 2** ○ **No more than two (2) elective units** can be drawn from **Table 4** or from other endorsed training packages and/or accredited courses provided the units are consistent with the qualification AQF level and outcomes of the course. **Note:** Units completed for the Diploma chosen from **Tables 2 and 4** cannot be credited towards the required number of units to complete the Advanced Diploma. Learners exiting the course prior to completion will be issued with a Statement of Attainment listing the units they have successfully completed. Selection of elective units must be based on industry vocational outcomes and volume of learning that falls within the overall nominal hours range determined for this qualification.

Table 1 – Diploma of Engineering Technology (Core units)

Unit of competency code	Unit of competency title	Field of Education code (6-digit)	Pre-requisite	Nominal hours
Core units				
MEM13015	Work safely and effectively in manufacturing and engineering	120505	Nil	40
MEM16006	Organise and communicate information	120505	MEM13015	20
MEM16008	Interact with computing technology	080905	MEM13015 MEM16006	20
MEM22001	Perform engineering activities	120505	MEM16006	60
MEM22002	Manage self in an engineering environment	080305	MEM16006	40
MEM23004	Apply technical mathematics	010101	Nil	80
MEM30007	Select common engineering materials	030305	Nil	40
MEM30031	Operate computer-aided design (CAD) system to produce basic drawing elements	039999	Nil	40
VU23908	Investigate advanced	030799	Nil	60

	technology applications in the manufacturing industry and related industries			
			Total nominal hours for Core units =	**400**

Table 2 – Designated stream elective units				
Mechanical Engineering				
VU23477	Interpret and prepare basic two and three dimensional engineering drawings	030199	Nil	20
VU23909	Program, operate and select a robotics system	030701	Nil	60
VU23910	Implement control processes using programmable logic controllers	031301	Nil	80
VU23911	Apply hydraulic principles to achieve an engineering task	030703	Nil	60
VU23912	Write and modify basic CNC programs	030101	Nil	40
VU23913	Implement basic materials science principles to engineering applications	030701	Nil	40
VU23914	Apply electrotechnology	030799	Nil	40

	principles in an engineering work environment			
VU23915	Annotate and create assemblies using solid models	030199	Nil	40
VU23916	Apply scientific principles to engineering problems	030701	Nil	60
VU23917	Set up manufacturing processes for engineering applications	030101	Nil	40
VU23918	Program and test control systems	031301	Nil	60
VU23919	Apply principles of strength of materials to engineering problems	030701	Nil	60
VU23921	Utilise digital electronics for control applications	031301	Nil	60
VU23922	Apply fluid mechanic principles in mechanical engineering	030703	Nil	80
VU23923	Solve engineering problems using algebra	030701	Nil	60
VU23924	Plan for the implementation of	031301	Nil	60

	mechanical drive systems			
VU23925	Design and prototype components or small structures using engineering design principles	031301	Nil	60
VU23926	Apply pneumatic principles to achieve an engineering task	030703	Nil	60
VU23927	Conduct and analyse precision engineering measurements	030101	Nil	40
VU23928	Prepare and document a work plan to fabricate an engineering product or component	030709	Nil	20
MEM09002	Interpret technical drawing	030701	MEM12023 MEM12024 MEM13015 MEM16006	40
MEM09009	Create 2-D drawings using computer-aided design system	020115	MEM09002 MEM12023 MEM12024 MEM13015 MEM16006 MEM16008	80
MEM09010	Create 3-D models using computer-aided design system	020115	MEM09002 MEM09009 MEM12023	40

			MEM12024 MEM13015 MEM16006 MEM16008	
MEM09011	Apply basic engineering design concepts	030701	MEM09002 MEM12023 MEM12024 MEM13015 MEM16006	60
MEM09022	Create 2-D code files using computer-aided manufacturing system	020115	MEM09002 MEM12023 MEM12024 MEM13015 MEM16006 MEM16008	40
MEM09023	Create 3-D code files using computer-aided manufacturing system	020115	MEM09002 MEM09022 MEM12023 MEM12024 MEM13015 MEM16006 MEM16008	60
MEM09155	Prepare mechanical models for computer-aided engineering (CAE)	039999	MEM23004 MEM23109	60
MEM09157	Perform mechanical engineering design drafting	030101	Nil	80
MEM09158	Perform mechatronics	030101	Nil	80

	engineering design drafting			
MEM09213	Produce schematic drawings for hydraulic and pneumatic fluid power systems	039999	MEM09204 MEM09229	60
MEM09204	Produce basic engineering detail drawings	039999	MEM09229	80
MEM09229	Read and interpret technical engineering drawings	039999	Nil	40
MEM10004	Enter and change programmable controller operational parameters	031305	MEM09002 MEM13015 MEM16006 MEM16008	20
MEM10005	Commission programmable controller programs	031305	MEM09002 MEM10004 MEM13015 MEM16006 MEM16008	40
MEM11011	Undertake manual handling	030717	MEM13015 MEM16006	20
MEM12023	Perform engineering measurements	120103	MEM13015 MEM16006	30
MEM12024	Perform computations	010101	MEM13015 MEM16006	30
MEM18001	Use hand tools	030717	MEM11011 MEM13015 MEM16006	20

MEM18002	Use power tools/hand held operations	030717	MEM11011 MEM13015 MEM16006	20
MEM18055	Dismantle, replace and assemble engineering components	030701	MEM09002 MEM11011 MEM12023 MEM13015 MEM16006 MEM18001 MEM18002	30
MEM23003	Operate and program computers and/or controllers in engineering situations	030101	MEM16006 MEM16008	80
MEM23006	Apply fluid and thermodynamics principles in engineering	030701	MEM23004	80
MEM23007	Apply calculus to engineering tasks	010101	MEM23004	80
MEM23063	Select and organise mechanical engineering material tests	030701	MEM23004 MEM23109	60
MEM23109	Apply engineering mechanics principles	030701	MEM23004	60
MEM23111	Select electrical equipment and components for engineering applications	031313	MEM23004	60
MEM23114	Evaluate thermodynamic	030703	MEM23004 MEM23006	60

	systems and components			
MEM24012	Apply metallurgy principles	030305	MEM13015 MEM16006	40
MEM27017	Maintain, fault find and rectify hydraulic systems for mobile plant	030717	MEM09002 MEM11011 MEM12023 MEM13015 MEM16006 MEM18001 MEM18002 MEM18055	60
MEM29007	Apply networking technology principles for manufacturing and engineering applications	031305	Nil	90
MEM30010	Set up basic hydraulic circuits	030999	Nil	40
MEM30011	Set up basic pneumatic circuits	030999	Nil	40
MEM30012	Apply mathematical techniques in a manufacturing engineering or related environment	010101	Nil	40
MEM30027	Prepare basic programs for programmable logic controllers	030101	Nil	20
MEM30029	Use workshop equipment and processes to	030717	MEM13015	60

	complete an engineering project			
MSMENV272	Participate in environmentally sustainable work practices	059999	Nil	30
Civil Engineering				
VU23477	Interpret and prepare basic two- and three-dimensional engineering drawings	030199	Nil	20
VU23925	Design and prototype components or small structures using engineering design principles	031301	Nil	60
VU23923	Solve engineering problems using algebra	030701	Nil	60
VU23929	Implement site investigation procedures	030901	Nil	60
VU23930	Apply fundamentals of civil engineering to a construction project	030901	Nil	60
VU23931	Apply principles of materials testing to civil engineering applications	030911	Nil	60

VU23932	Apply surveying for civil engineering projects	030901	Nil	80
VU23933	Perform measurements and layout tasks on construction site	030901	Nil	60
VU23934	Produce reinforced concrete drawings	030903	Nil	40
VU23935	Produce structural steel drawings	030903	Nil	40
VU23936	Produce drawings to enable road construction	030901	Nil	60
CPCWHS1001	Work safely in the construction industry	061301	Nil	6
CPPBDN4110	Set up BIM-capable software and files for building design drafting projects	080905	Nil	40
CPCCBC4004	Identify and produce estimated costs for building and construction projects	040307	Nil	60
MEM09002	Interpret technical drawing	030701	MEM12023 MEM12024 MEM13015 MEM16006	40
MEM12023	Perform engineering measurements	120103	MEM13015 MEM16006	30

MEM12024	Perform computations	010101	MEM13015 MEM16006	30
Mechatronics Engineering				
VU23477	Interpret and prepare basic two and three dimensional engineering drawings	030199	Nil	20
VU23909	Program, operate and select a robotics system	031301	Nil	60
VU23910	Implement control processes using programmable logic controllers	031301	Nil	80
VU23911	Apply hydraulic principles to achieve an engineering task	030703	Nil	60
VU23912	Write and modify basic CNC programs	030101	Nil	40
VU23914	Apply electrotechnology principles in an engineering work environment	030799	Nil	20
VU23915	Annotate and create assemblies using solid models	030199	Nil	40
VU23917	Set up manufacturing processes for engineering applications	030101	Nil	40

VU23918	Program and test control systems	031301	Nil	60
VU23921	Utilise digital electronics for control applications	031301	Nil	60
VU23922	Apply fluid mechanic principles in mechanical engineering	030703	Nil	80
VU23923	Solve engineering problems using algebra	030701	Nil	60
VU23926	Apply pneumatic principles to achieve an engineering task	030703	Nil	60
VU23927	Conduct and analyse precision engineering measurements	030101	Nil	40
MEM09002	Interpret technical drawing	030701	MEM12023 MEM12024 MEM13015 MEM16006	40
MEM09009	Create 2-D drawings using computer-aided design system	020115	MEM13015 MEM16006	80
MEM09010	Create 3-D models using computer-aided design system	020115	MEM09002 MEM12023 MEM12024 MEM13015 MEM16006 MEM16008	60

MEM09011	Apply basic engineering design concepts	030701	MEM09002 MEM12023 MEM12024 MEM13015 MEM16006	60
MEM09022	Create 2-D code files using computer-aided manufacturing system	020115	MEM09002 MEM12023 MEM12024 MEM13015 MEM16006 MEM16008	40
MEM09023	Create 3-D code files using computer-aided manufacturing system	020115	MEM09002 MEM09022 MEM12023 MEM12024 MEM13015 MEM16006 MEM16008	60
MEM09155	Prepare mechanical models for computer-aided engineering (CAE)	039999	MEM23004 MEM23109	60
MEM09157	Perform mechanical engineering design drafting	030101	Nil	80
MEM09158	Perform mechatronics engineering design drafting	030101	Nil	80
MEM09213	Produce schematic drawings for hydraulic and	039999	MEM09204 MEM09229	60

	pneumatic fluid power systems			
MEM09204	Produce basic engineering detail drawings	039999	MEM09229	80
MEM09229	Read and interpret technical engineering drawings	039999	Nil	40
MEM10004	Enter and change programmable controller operational parameters	031305	MEM09002 MEM13015 MEM16006 MEM16008	20
MEM10005	Commission programmable controller programs	031305	MEM09002 MEM10004 MEM13015 MEM16006 MEM16008	40
MEM11011	Undertake manual handling	030717	MEM13015 MEM16006	20
MEM12023	Perform engineering measurements	120103	MEM13015 MEM16006	30
MEM12024	Perform computations	010101	MEM13015 MEM16006	30
MEM18001	Use hand tools	030717	MEM11011 MEM13015 MEM16006	20
MEM18002	Use power tools/hand held operations	030717	MEM11011 MEM13015 MEM16006	20

MEM18055	Dismantle, replace and assemble engineering components	030701	MEM09002 MEM11011 MEM12023 MEM13015 MEM16006 MEM18001 MEM18002	30
MEM23003	Operate and program computers and/or controllers in engineering situations	030101	MEM16006 MEM16008	80
MEM23006	Apply fluid and thermodynamics principles in engineering	030701	MEM23004	80
MEM23007	Apply calculus to engineering tasks	010101	MEM23004	80
MEM23109	Apply engineering mechanics principles	030701	MEM23004	60
MEM23111	Select electrical equipment and components for engineering applications	031313	MEM23004	60
MEM27017	Maintain, fault find and rectify hydraulic systems for mobile plant	030717	MEM09002 MEM11011 MEM12023 MEM13015 MEM16006 MEM18001 MEM18002 MEM18055	60

MEM29007	Apply networking technology principles for manufacturing and engineering applications	031305	Nil	90
MEM30010	Set up basic hydraulic circuits	030999	Nil	40
MEM30011	Set up basic pneumatic circuits	030999	Nil	40
MEM30027	Prepare basic programs for programmable logic controllers	030101	Nil	20
MEM30029	Use workshop equipment and processes to complete an engineering project	030717	MEM13015	60
			Elective units range of hours =	**450 - 550**
			Core units total hours =	**400**
			Total course range of hours	**850 - 950**

Course rules	Standards 5.8 and 5.9 AQTF 2021 Standards for Accredited Courses
5.1 Course structure – Advanced Diploma	**22669VIC Advanced Diploma of Engineering Technology** To achieve the qualification learners must successfully complete at least **thirty three (33)** units comprising of: • **eleven (11) core units** from **Table 3** *plus* • **twenty (22) elective units**, *of which:* o **at least twelve (12) elective units** from **Table 4** which can be selected from one stream or across streams (and have not been completed as part of the Diploma)

	○ **remaining ten (10) elective units** to be selected from **Table 2** and/or **Table 4** (which have not been completed as part of the Diploma) ○ **no more than three (3) units** can be drawn from other endorsed training packages and/or accredited courses provided the units are consistent with the qualification AQF level and outcomes of the course (and have not been completed as part of the Diploma). **22700VIC Advanced Diploma of Engineering Technology** Designated streams are: - Mechanical Engineering Design - Civil Engineering Design - Mechatronic Engineering Design To achieve the qualification with a designated stream included learners must successfully complete at least **thirty-three (33)** units comprising of: • **eleven (11) core units** from **Table 3** *plus* • **twenty (22) elective units**, *of which:* ○ **at least twelve (12) elective units** must be from a **designated stream in Table 4** and have not been completed as part of the Diploma ○ **remaining ten (10) elective units** to be selected from **Table 2** and/or **Table 4** and have not been completed as part of the Diploma **no more than three (3) units** can be drawn from other endorsed training packages and/or accredited courses provided the units are consistent with the qualification AQF level and outcomes of the course and have not been completed as part of the Diploma. **Note:** Units completed for the Diploma chosen from **Tables 2 and 4** cannot be credited towards the required number of units to complete the Advanced Diploma. Learners exiting the course prior to completion will be issued with a Statement of Attainment listing those units they have successfully completed. Selection of elective units must be based on industry vocational outcomes and volume of learning that falls within the overall nominal hours range determined for this qualification.

Table 3 – Advanced Diploma of Engineering Technology (Core units)

Unit of competency code	Unit of competency title	Field of Education code (6-digit)	Pre-requisite	Nominal hours
Core units				
MEM13015	Work safely and effectively in manufacturing and engineering	120505	Nil	40
MEM16006	Organise and communicate information	120505	MEM13015	20
MEM16008	Interact with computing technology	080905	MEM13015 MEM16006	20
MEM22001	Perform engineering activities	120505	MEM16006	60
MEM22002	Manage self in an engineering environment	080305	MEM16006	40
MEM23004	Apply technical mathematics	010101	Nil	80
MEM30007	Select common engineering materials	030305	Nil	40
MEM30031	Operate computer-aided design (CAD) system to produce basic drawing elements	039999	Nil	40

VU23908	Investigate advanced technology applications in the manufacturing industry and related industries	030799	Nil	60
MEM22013	Coordinate engineering projects	080315	MEM16006	60
MEM30033	Use computer-operated design (CAD) to create and display 3-D models	039999	MEM30031	40
			Total nominal hours of core units =	**500**

Table 4 – Designated Stream Elective units

Unit of competency code	Unit of competency title	Field of Education code (six-digit)	Pre-requisite	Nominal hours
Mechanical Engineering Design				
VU23937	Set up and monitor fluid power-controlled engineering systems	030703	Nil	80
VU23938	Design rotating mechanical machines	030701	Nil	80
VU23939	Apply processes of advanced metrology in manufacturing	030701	Nil	60
VU23940	Use advanced 2D & 3D computer aided drafting (CAD) techniques	039999	Nil	80
VU23941	Design basic mechanical engineering systems	030701	Nil	60
VU23942	Apply finite element analysis	030701	Nil	60
VU23943	Set up and implement mechatronics engineering systems	030703	Nil	60
VU23944	Plan and manage a robotics system	030701	Nil	60

VU23945	Generate design solutions	030701	Nil	60
VU23946	Use extended features of computer aided drafting (CAD)	030199	Nil	40
VU23947	Implement advanced materials science principles to engineering applications	030701	Nil	60
VU23948	Apply advanced statics principles to engineering problems	030701	MEM23007 MEM23109	60
VU23949	Program and set up co-ordinate measuring machines (CMM)	030301	Nil	60
MEM23006	Apply fluid and thermodynamics principles in engineering	030701	MEM23004	80
MEM23007	Apply calculus to engineering tasks	010101	MEM23004	80
MEM23109	Apply engineering mechanics principles	030701	MEM23004	60
MEM23115	Evaluate fluid power systems	030703	MEM23004 MEM23006	60
MEM23120	Select mechanical machine and equipment components	030101	MEM23004 MEM23109 MEM30005 MEM30006	80
MEM23121	Analyse loads on frames and mechanisms	030101	MEM23004 MEM23007 MEM23109	80
MEM234010	Design microcontroller applications	031303	Nil	40
MEM234011	Design programmable logic controller applications	031303	Nil	60
MEM234014	Design a robotic system	031303	Nil	40
MEM29007	Apply networking technology principles for manufacturing and engineering applications	031305	Nil	90
MEM30005	Calculate force systems within simple beam structures	010101	MEM30012	40
MEM30006	Calculate stresses in simple structures	010101	MEM30012	40
MEM30012	Apply mathematical techniques in a manufacturing engineering or related	010101	Nil	40

	environment			
Civil Engineering Design				
VU23950	Apply surveying computations to civil engineering projects	030901	Nil	40
VU23916	Apply scientific principles to engineering problems	030701	Nil	60
VU23919	Apply principles of strength of materials to engineering problems	030701	Nil	60
VU23940	Use advanced 2D & 3D computer aided drafting (CAD) techniques	030199	Nil	80
VU23951	Produce geometric designs for roads	030901	Nil	60
VU23952	Produce an engineering design for drainage pipes and culverts	030907	Nil	80
VU23953	Produce an advanced engineering design for a reinforced concrete structure	030903	Nil	40
VU23954	Produce an engineering design for a sewerage reticulation scheme	030907	Nil	40
VU23955	Apply principles of mechanics to engineering structures	030903	Nil	60
VU23956	Apply principles of soil mechanics to civil engineering	030911	MEM23004	60
VU23957	Produce an engineering design for a reinforced concrete structure	030903	Nil	40
VU23958	Analyse and design foundations and footings	030901	MEM23004	40
VU23959	Produce an engineering design for a steel structure	030903	Nil	60
VU23960	Apply environmental and heritage solutions to civil engineering projects	030901	Nil	40
VU23961	Analyse the strength of civil structural elements	030903	MEM23109	60
VU23962	Design timber structures	030901	Nil	60
VU23963	Produce an engineering design for a stormwater reticulation scheme	030907	Nil	40

VU23948	Apply advanced statics principles to engineering problems	030701	MEM23007 MEM23109	60
VU23964	Produce advanced engineering drawings for a reinforced concrete structure	030903	Nil	40
VU23965	Produce advanced engineering drawings for a steel structure	030903	Nil	40
CPPBDN6106	Produce building information modelling for building design projects	040303	Nil	100
MEM23006	Apply fluid and thermodynamics principles in engineering	030701	MEM23004	80
MEM23007	Apply calculus to engineering tasks	010101	MEM23004	80
MEM23109	Apply engineering mechanics principles	030701	MEM23004	60
Mechatronic Engineering Design				
VU23916	Apply scientific principles to engineering problems	030701	Nil	60
VU23919	Apply principles of strength of materials to engineering problems	030701	Nil	60
VU23937	Set up and monitor fluid power-controlled engineering systems	030703	Nil	80
VU23938	Design rotating mechanical machines	030701	Nil	80
VU23939	Apply processes of advanced metrology in manufacturing	030701	Nil	60
VU23940	Use advanced 2D & 3D computer aided drafting (CAD) techniques	030199	Nil	80
VU23941	Design basic mechanical engineering systems	030701	Nil	60
VU23943	Set up and implement mechatronics engineering systems	030703	Nil	60
VU23944	Plan and manage a robotics system	030701	Nil	60
VU23946	Use extended features of computer aided drafting (CAD)	030199	Nil	40
VU23948	Apply advanced statics principles to engineering problems	030701	MEM23007 MEM23109	60

VU23949	Program and set up co-ordinate measuring machines (CMM)	030301	Nil	60
MEM23006	Apply fluid and thermodynamics principles in engineering	030701	MEM23004	80
MEM23007	Apply calculus to engineering tasks	010101	MEM23004	80
MEM23109	Apply engineering mechanics principles	030701	MEM23004	60
MEM23115	Evaluate fluid power systems	030703	MEM23004 MEM23006	60
MEM23120	Select mechanical machine and equipment components	030101	MEM23004 MEM23109 MEM30005 MEM30006	80
MEM234010	Design microcontroller applications	031303	Nil	40
MEM234011	Design programmable logic controller applications	031303	Nil	60
MEM234014	Design a robotic system	031303	Nil	40
MEM29007	Apply networking technology principles for manufacturing and engineering applications	031305	Nil	90
MEM30005	Calculate force systems within simple beam structures	010101	MEM30012	40
MEM30006	Calculate stresses in simple structures	010101	MEM30012	40
MEM30012	Apply mathematical techniques in a manufacturing engineering or related environment	010101	Nil	40
			Elective units range of hours =	**1200 - 1300**
			Core units total hours =	**500**
			Total course range of hours	**1700 - 1800**

5. Course rules	Standard 5.11 AQTF 2021 Standards for Accredited Courses
5.2 Entry requirements	**Diploma of Engineering Technology:** There are no essential entry requirements for the Diploma of Engineering Technology. However, learners are best equipped to achieve the outcomes of this course if they have minimum language, literacy and numeracy skills that are equivalent to level 3 of the Australian Core Skills Framework (ACSF). Details can be found on the website here. **Advanced Diploma of Engineering Technology:** There are no essential entry requirements for the Advanced Diploma of Engineering Technology. However, learners are best equipped to achieve the outcomes of this course if they have completed the Diploma of Engineering Technology and minimum language, literacy and numeracy skills that are equivalent to level 4 of the Australian Core Skills Framework (ACSF). Details can be found on the website here.
6. Assessment	**Standard 5.12 and 5.14 AQTF 2021 Standards for Accredited Courses**
6.1 Assessment strategy	All assessment, including Recognition of Prior Learning (RPL) must be compliant with the requirements of: • Standard 1 of the Australian Quality Training Framework (AQTF): Essential Conditions and Standards for Initial/Continuing Registration and Guidelines 4.1 and 4.2 of the VRQA Guidelines for VET Providers or • the Standards for Registered Training Organisations 2015 (SRTOs) or • the relevant standards and guidelines for Registered Training Organisations in effect at the time of assessment Assessment strategies must ensure that: • all assessments are valid, reliable, flexible and fair • learners are informed of the context and purpose of the assessment and the assessment process • feedback is provided to learners about the outcomes of the assessment process and guidance given for future options

	• time allowance to complete a task is reasonable and reflects the industry expectations of an operator Assessment strategies should be designed to: • cover a range of skills and knowledge required to demonstrate achievement of the course aim • collect evidence on a number of occasions to suit a variety of contexts and situations • be appropriate to the knowledge, skills, methods of delivery and needs and characteristics of learners • assist assessors to interpret evidence consistently • be equitable to all groups of learners Assessment methods may include: • oral and/or written questioning • inspection of final process/product outcomes • portfolio of documented evidence • demonstration of required physical tasks A holistic approach to assessment is encouraged. This may be achieved by combining the assessment of more than one unit where it better replicates working practice. Assessment of the imported units must reflect the requirements of the Assessment Guidelines in the relevant training package or accredited course.
6.2 Assessor competencies	Assessment must be undertaken by a person or persons in accordance with: • Standard 1.4 of the AQTF: Essential Conditions and Standards for Initial/Continuing Registration and Guidelines 3 of the VRQA Guidelines for VET Providers, or • the Standards for Registered Training Organisations 2015 (SRTOs), or • the relevant standards and Guidelines for RTOs at the time of assessment. Units of competency imported from training packages or accredited courses must reflect the requirements for assessors specified in that training package or accredited course.

7. Delivery	Standards 5.12, 5.13 and 5.14 AQTF 2021 Standards for Accredited Courses
7.1 Delivery modes	Delivery strategies should be selected to reflect the nature of the industry specific competencies, incorporating foundation skills, and the need of the learner. Due to the potential for a dispersed distribution of learners, course 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. It is recommended that the courses be conducted using project based delivery and assessment methods involving the clustering of units, to maximise opportunities for learners to have learning experiences which are as close as possible to a real-work environment. Delivery methods may include, but are not limited to: • classroom presentation • work-based projects • case study analyses • practical work • project-based learning encompassing the clustering of units Delivery of the imported endorsed and accredited units of competency must be consistent with the guidelines in the relevant training package or accredited course.
7.2 Resources	Successful delivery of these courses requires access to current engineering systems and equipment. For this to occur, providers and engineering workplaces may form partnerships to deliver realistic and authentic training and assessment. The resources that must be available for these courses relate to normal work practice using procedures, information and resources typical of a workplace. This should include: • WHS/OHS policy and work procedures and instructions; • access to an engineering/manufacturing workplace environment • operational access to relevant machines, tools, materials, and consumables • access to relevant plans, drawing facilities, CAD system and relevant software and instructions • manufactures' specifications/manuals Training must be undertaken by a person or persons in accordance with:

	• Standard 1.4 of the AQTF: Essential Conditions and Standards for Initial/Continuing Registration and Guideline 3 of the VRQA Guidelines for VET Providers, or • the Standards for Registered Training Organisations 2015 (SRTOs), or • the relevant standards and Guidelines for RTOs at the time of assessment. Units of competency imported from training packages or accredited courses must reflect the requirements for trainers specified in that training package or accredited course.

8. Pathways and articulation	Standard 5.10 AQTF 2021 Standards for Accredited Courses
	Applicants who have already successfully completed any endorsed or accredited unit of competency from previous study will receive direct credit transfer for the same unit/s in these courses. Likewise, graduates of these courses will also gain direct credit transfer of units successfully completed in any future courses containing the same units. The revised Diploma of Engineering Technology fully articulates into the revised Advanced Diploma of Engineering Technology. However, the transition table in Item 3.2 will need to be consulted for articulation/credit transfer arrangements for graduates who have completed an earlier version of the Diploma and wish to entry the new Advanced Diploma of Engineering Technology. There are no formal articulations arrangements between the Advanced Diploma and higher education courses. Providers intending to arrange articulation with other VET or higher education course should refer to the: AQF Second Edition 2013 Pathways Policy

9. Ongoing monitoring and evaluation	Standard 5.15 AQTF 2021 Standards for Accredited Courses
9.1 Monitoring and evaluation	The Curriculum Maintenance Manager - Engineering Industries is responsible for the ongoing monitoring and maintenance of the courses during their accreditation period. The Curriculum Maintenance Manager - Engineering Industries will undertake a formal review of the courses at the mid-point of the accreditation period. The review will involve consultation with: • course participants and graduates • manufacturing and engineering industry representatives • teaching/assessing staff Any significant changes to the courses resulting from the review will be reported to the VRQA through a formal amendment process. The review of the courses may also indicate that the course or courses in total should be expired if a suitable qualification becomes available through the continuous improvement of a MEM Metals and Engineering Training Package.

Section C – Units of competency

Units of competency contained in the course	
Units developed for these accredited courses	
Code	**Title**
VU23908	Investigate advanced technology applications in the manufacturing industry and related industries
VU23909	Program, operate and select a robotics system
VU23910	Implement control processes using programmable logic controllers
VU23911	Apply hydraulic principles to achieve an engineering task
VU23932	Apply surveying for civil engineering projects
VU23930	Apply fundamentals of civil engineering to a construction project
VU23912	Write and modify basic CNC programs
VU23929	Implement site investigation procedures
VU23913	Implement basic materials science principles to engineering applications
VU23931	Apply principles of materials testing to civil engineering applications
VU23933	Perform measurements and layout tasks on construction site
VU23950	Apply surveying computations to civil engineering projects
VU23914	Apply electrotechnology principles in an engineering work environment
VU23915	Annotate and create assemblies using solid models
VU23916	Apply scientific principles to engineering problems

VU23917	Set up manufacturing processes for engineering applications
VU23918	Program and test control systems
VU23919	Apply principles of strength of materials to engineering problems
VU23921	Utilise digital electronics for control applications
VU23937	Set up and monitor fluid power-controlled engineering systems
VU23938	Design rotating mechanical machines
VU23939	Apply processes of advanced metrology in manufacturing
VU23940	Use advanced 2D and 3D computer aided (CAD) drafting techniques
VU23951	Produce geometric designs for roads
VU23936	Produce drawings to enable road construction
VU23935	Produce structural steel drawings
VU23922	Apply fluid mechanic principles in mechanical engineering
VU23952	Produce an engineering design for drainage pipes and culverts
VU23953	Produce an advanced engineering design for a reinforced concrete structure
VU23954	Produce an engineering design for a sewerage reticulation scheme
VU23955	Apply principles of mechanics to engineering structures
VU23956	Apply principles of soil mechanics to civil engineering
VU23957	Produce an engineering design for a reinforced concrete structure
VU23958	Analyse and design foundations and footings

VU23934	Produce reinforced concrete drawings
VU23959	Produce an engineering design for a steel structure
VU23960	Apply environmental and heritage solutions to civil engineering projects
VU23961	Analyse the strength of civil structural elements
VU23923	Solve engineering problems using algebra
VU23941	Design basic mechanical engineering systems
VU23942	Apply finite element analysis
VU23943	Set up and implement mechatronics engineering systems
VU23944	Plan and manage a robotics system
VU23962	Design timber structures
VU23963	Produce an engineering design for a stormwater reticulation scheme
VU23945	Generate design solutions
VU23924	Plan for the implementation of mechanical drive systems
VU23946	Use extended features of computer aided drafting (CAD)
VU23947	Implement advanced materials science principles to engineering applications
VU23925	Design and prototype components or small structures using engineering design principles
VU23926	Apply pneumatic principles to achieve an engineering task
VU23948	Apply advanced statics principles to engineering problems
VU23964	Produce advanced engineering drawings for a reinforced concrete structure

VU23965	Produce advanced engineering drawings for a steel structure
VU23927	Conduct and analyse precision engineering measurements
VU23928	Prepare and document a work plan to fabricate an engineering product or component
VU23949	Program and set up co-ordinate measuring machines (CMM)

Units of competency imported from other accredited courses

These units are not included in this course document. Refer Part A (Item 4) for details of the courses from which each unit is drawn. The course documents can be accessed from: https://www.vic.gov.au/department-accredited-vet-courses

Code	Title
VU23477	Interpret and prepare basic two and three dimensional engineering drawings

Units of competency imported from training packages

These units are not included in this course document and are available from: www.training.gov.au

Code	Title
CPCCBC4004	Identify and produce estimated costs for building and construction projects
CPCWHS1001	Prepare to work safely in the construction industry
CPPBDN4110	Set up BIM-capable software and files for building design drafting projects
MEM09002	Interpret technical drawing
MEM09009	Create 2-D drawings using computer-aided design system
MEM09010	Create 3-D models using computer-aided design system
MEM09011	Apply basic engineering design concepts
MEM09022	Create 2-D code files using computer-aided manufacturing system
MEM09023	Create 3-D code files using computer-aided manufacturing system
MEM09155	Prepare mechanical models for computer-aided engineering (CAE)

MEM09157	Perform mechanical engineering design drafting
MEM09158	Perform mechatronics engineering design drafting
MEM09213	Produce schematic drawings for hydraulic and pneumatic fluid power systems
MEM09204	Produce basic engineering detail drawings
MEM09229	Read and interpret technical engineering drawings
MEM10004	Enter and change programmable controller operational parameters
MEM10005	Commission programmable controller programs
MEM11011	Undertake manual handling
MEM12023	Perform engineering measurements
MEM12024	Perform computations
MEM13015	Work safely and effectively in manufacturing and engineering
MEM16006	Organise and communicate information
MEM16008	Interact with computing technology
MEM18001	Use hand tools
MEM18002	Use power tools/hand held operations
MEM18055	Dismantle, replace and assemble engineering components
MEM22001	Perform engineering activities
MEM22002	Manage self in an engineering environment
MEM23003	Operate and program computers and/or controllers in engineering situations
MEM23004	Apply technical mathematics
MEM23006	Apply fluid and thermodynamics principles in engineering

MEM23007	Apply calculus to engineering tasks
MEM23063	Select and organise mechanical engineering material tests
MEM23109	Apply engineering mechanics principles
MEM23111	Select electrical equipment and components for engineering applications
MEM23114	Evaluate thermodynamic systems and components
MEM24012	Apply metallurgy principles
MEM27017	Maintain, fault find and rectify hydraulic systems for mobile plant
MEM30007	Select common engineering materials
MEM30010	Set up basic hydraulic circuits
MEM30011	Set up basic pneumatic circuits
MEM30012	Apply mathematical techniques in a manufacturing engineering or related environment
MEM30027	Prepare basic programs for programmable logic controllers
MEM30029	Use workshop equipment and processes to complete an engineering project
MEM30031	Operate computer-aided design (CAD) system to produce basic drawing elements
MSMENV272	Participate in environmentally sustainable work practices

Unit code	**VU23908**
Unit title	**Investigate advanced technology applications in the manufacturing and related industries**
Application	This unit describes the performance outcomes, knowledge and skills required to investigate the applications of advanced manufacturing technologies in manufacturing and related industries. It requires the ability to investigate applications of advanced technologies, how the technology impacts the process, product or service and benefits/improvements to the industries where it is used. This unit applies to a person who is preparing for a career in the engineering, manufacturing or related industries. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s) Optional field	Nil
Competency Field Optional field	N/A
Unit Sector Optional field	N/A

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. Assessment of performance is to be consistent with the assessment requirements.	
1	Examine the applications of advanced technologies in manufacturing and related industries	1.1	Sources of information on advanced manufacturing technologies in the engineering and manufacturing industries are identified
		1.2	Real world examples of advanced manufacturing and engineering achievements are located
		1.3	Impact of advanced manufacturing technologies on processes, products and/or services are determined
2	Investigate an advanced technology and its' impact on a process, product and/or service	2.1	Application and parameters of the technology being investigated are defined and its' integration with existing production methods are clarified
		2.2	Design principles of technology are explored and documented

		2.3	Value adding dimension of the technology is determined and documented
		2.4	Impact on workforce capabilities and/or customer demands and market competitiveness are determined
		2.5	Future developments in technology and its application are examined
3	Present research on advanced technology	3.1	Research material is compiled, and the format of the presentation is planned
		3.2	Presentation of the investigation is prepared, trialled and amended as required
		3.3	Research is presented to relevant audience/stakeholder

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare technical documentation using appropriate terminology
Oral communication skills to:	• communicate with technical personnel
Learning skills to:	• assess the nature and scope of new advanced technologies and their applications
Problem-solving skills to:	• identify and address the impact of new technology introduced on the workforce and customers
Digital literacy skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts to present findings to stakeholders

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23908 Investigate advanced technology applications in the manufacturing and related industries	VU22451 Investigate advanced technology applications in the manufacturing and related industries	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23908- Investigate advanced technology applications in the manufacturing and related industries

Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit including the ability to:
	• research and define at least two (2) examples of advanced manufacturing technology, analyse the principles of each technology including the value-add component and provide examples of the application of each:
	  ○ one example is to be process orientated and
	  ○ the other is to be product or service orientated
	• prepare and provide a presentation of the findings to a relevant audience/stakeholder within a given timeframe.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of: • current advanced manufacturing technologies which impact on both process, products and services • advanced manufacturing technologies nomenclature such as Industry • sources of information on the manufacturing, engineering and related industries • diversity of the manufacturing, engineering and related industries including key sectors and structure • presentation techniques and resources.
Assessment Conditions	Assessment should be conducted in a real workplace or simulated environment that replicates real workplace conditions with access to: • computer equipment • the internet and a library • workplace documentation **Assessor requirements:** Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit Code	**VU23909**
Unit title	**Select, program and operate a robotics system**
Application	This unit describes the performance outcomes, knowledge and skills required to select, program, operate and trial a robotics system. It requires the ability to write a program in a suitable language, to simulate industrial applications, install and trial the program to meet operational specifications. This unit of applies to a person working at paraprofessional level in a manufacturing enterprise where industrial robots are used as part of the production process. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Determine robot requirements	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements for a given work area are clarified
	1.2 Robot selection criteria are established with appropriate personnel
	1.3 Robot features, specifications and system requirements are determined in accordance with selection criteria
	1.4 Safety features and risk control measures for robot and operating environment are established, in consultation with appropriate personnel

		1.5	Manufacturer operating procedures and engineering drawings are interpreted to define robot function and tool path geometry
2	Install robot	2.1	OHS/WHS requirements for carrying out the work are followed
		2.2	Schedule for robot installation and commissioning is prepared
		2.3	Robot installation is coordinated with appropriate personnel
		2.4	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
		2.5	Unexpected situations are resolved with appropriate personnel, and in accordance with workplace procedures
		2.6	Sensors are interfaced to robot, in accordance with established procedures
		2.7	Robot is programmed to interact with peripherals
3	Program robot	3.1	OHS/WHS requirements for carrying out the work are followed
		3.2	Programming requirements are identified
		3.3	Program plan is developed, in accordance with established procedures
		3.4	Programming method is selected, as required
		3.5	Coordinates are calculated for tool path or robot function
		3.6	Program is written in required language and in accordance with standard operating procedures
		3.7	Safety features are incorporated in robot program
		3.8	Operation sheet is prepared, in accordance with established procedures
4	Trial robot	4.1	OHS/WHS requirements for carrying out and completing the work are followed
		4.2	Work site is made safe in accordance with established safety procedures
		4.3	Robot and computer equipment are prepared for program trial

4.4 Program is trialled by operating robot in manual mode in conjunction with operator as appropriate

4.5 Program performance is verified against required specifications and with appropriate technical experts or other technical reference sources

4.6 Program is edited if necessary to adjust operation as required

4.7 Results are documented and work completion notified according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Oral communication skills to:	• relay information to team members using appropriate language for the audience
Numeracy skills to:	• analyse financial and numerical information embedded in a range of texts and tasks
Learning skills to:	• assess the nature and scope of new concepts and identify priorities and procedures within timeframes
Problem-solving skills to:	• carry out program trials and address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23909 Program, operate and select a robotics system	VU21232 Program, operate and select a robotics system	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23909 – Program, operate and select a robotics system
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must be able to: • demonstrate the ability to set up, program and trial a robotics system to simulate at least two (2) different industrial applications.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• robot selection criteria and procedures:
	  ○ classification and application of industrial robots
	  ○ features and components/mechanisms of robots
	  ○ end effectors and applications
	  ○ robot movements
	  ○ drive systems
	  ○ robot specifications, incl. capabilities, operating conditions, limitations
	  ○ pre-selection planning
	  ○ criteria in selecting a robot
	• robot Installation:
	  ○ pre-installation planning
	  ○ installation
	  ○ layout
	  ○ system documentation
	  ○ safety factors esp. to AS2939 -1987
	• interfacing:
	  ○ interfacing with the robot controller
	  ○ external memory
	  ○ sensor
	  ○ other peripherals
	  ○ program control of interfacing
	• robot sensors:
	  ○ type of sensors

- sensor interfacing and compatibility
- sensor programming

- troubleshooting and diagnostic:
  - control system
  - diagnostic function
  - troubleshooting and fault isolation
  - procedures
- maintenance:
  - preventative maintenance
  - maintenance scheduling
  - maintenance procedures
- programming robots:
  - methods and procedures, incl. manual, walkthrough, lead through, offline, optical/vision or sensor systems
  - industrial and special applications e.g. palletising, machine interfacing
  - input/output signals
  - synchronisation
  - sub-routines
  - robots in industrial Flexible Manufacturing System (FMS).

Assessment Conditions

Assessment must be conducted in a real workplace or simulated environment that replicates real workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant robotic equipment, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit Code	**VU23910**
Unit title	**Implement control processes using programmable logic controllers**
Application	This unit describes the performance outcomes, knowledge and skills required to program programmable logic controllers (PLCs) within an industrial setting. It requires the ability to plan the PLC application, program to the PLC for a given application, test, debug and verify the PLC function The unit applies to a technician working in an industrial environment which applies the use of PLCs to control manufacturing processes. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Plan PLC application	1.1 Established occupational health and safety/work health and safety (OHS/WHS) requirements and environmental requirements for a given work area are followed
	1.2 PLC application is determined from documentation, job sheets or discussions with appropriate personnel
	1.3 Measurements and data required are identified and appropriate control system components selected

		1.4	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
		1.5	Implementation of the control system is analysed, and optimum approach is selected, planned for 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
2	Design PLC program outline	2.1	OHS/WHS 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	OHS/WHS requirements for carrying out the work are followed
		3.2	PLC is programmed according to manufacturer specifications and job requirements
		3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
4	Test and document PLC program	4.1	OHS/WHS requirements for completing the work are followed
		4.2	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 workplace procedures
		4.6	Work completion is notified to appropriate personnel according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• document programs and produce logic flow diagrams
Oral communication skills to:	• consult and communicate with others in the workplace
Problem-solving skills to:	• locate hardware and software faults
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• ensure programming is carried out in a timely manner
Technology skills to:	• use main features and functions of digital tools and program applications

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23910 Implement control processes using programmable logic controllers	VU21270 Implement control processes using PLCs	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23910 - Implement control processes using programmable logic controllers

Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit including the ability to:
	• program PLCs for an application within an industrial setting on two (2) occasions and in two (2) different contexts. In doing so the learner must:
	  ○ test, debug and document PLCs program
	  ○ apply OHS/WHS procedures and practices including the use of risk control measures.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• types of programmable controller and their applications
	• control logic such as:
	  ○ programmable logic
	  ○ relay to logic programmable logic
	  ○ control relay logic conversion
	  ○ application of logic flow diagrams
	• types of program editors and their application
	• types of memory devices and their application
	• operation of advanced logic concepts:
	• application of counters & timers
	• advanced control instructions
	• hardware fault location and rectification
	• software fault location and rectification

Assessment Conditions	Assessment must be conducted in a real workplace or simulated environment that replicates real workplace conditions with access to: • OHS/WHS policy and safe work procedures • relevant machines, equipment, tools, materials and consumables • relevant plans, drawings and work instructions and manufacturer specifications/manuals • personal protective equipment (PPE).

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23911**
Unit title	**Apply hydraulic principles to achieve an engineering task**
Application	This unit describes the performance outcomes, knowledge and skills required to apply hydraulic principles to achieve an engineering task. It requires the ability to select components, construct a hydraulic system and machine control circuitry, test and fault find the system and carry out routine maintenance. This unit applies to a person working at paraprofessional level in an industrial engineering or manufacturing enterprise where the application of hydraulics forms part the production of goods or services. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Apply hydraulic principles to plan, conduct, and complete an engineering task	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are determined 1.2 Applications of hydraulics to engineering activities are provided 1.3 Hydraulic units, terms and symbols are recognised and applied 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 to meet the given engineering task
		1.6	Potential hydraulic hazards are identified and reported according to workplace procedures
		1.7	Safety and risk control measures are applied when working with hydraulics
2	Determine hydraulic requirements when planning engineering task	2.1	OHS/WHS 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 manufacturer 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	Required resources and equipment are obtained in accordance with workplace procedures and checked for correct operation
		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 workplace procedures
3	Install, operate and test hydraulic equipment and devices	3.1	OHS/WHS requirements, codes of practice, manufacturer specifications, environmental requirements and workplace procedures are identified and applied
		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 is installed and set up to operate for the purpose intended according to manufacturer operating instructions
		3.4	Testing and fault tracing on hydraulic and electro-hydraulic components and systems is safely performed

3.5	Preventative maintenance requirements are identified, and a routine maintenance plan is prepared
3.6	Work completion notified in according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation and interpret circuit diagrams
Oral communication skills to:	• consult and communicate with other team members involved in the task
Numeracy skills to:	• perform hydraulic pressure and flow measurements and related calculations
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• follow relevant OHS/WHS procedures in planning and organizing
Technology skills to:	• construct and operate hydraulic circuits and transmission systems

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23911 Apply hydraulic principles to achieve an engineering task	VU22499 Apply hydraulic principles to achieve an engineering task	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23911 - Apply hydraulic principles to achieve an engineering task

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit including the ability to:

- apply hydraulic principles by planning, constructing and testing a hydraulic system and machine control circuitry to achieve an engineering task on two (2) occasions and each in a different context.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- 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.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates real workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant hydraulic equipment, tools, materials and consumables

- relevant plans, drawings and instructions and
- manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23932**
Unit title	**Apply surveying for civil engineering projects**
Application	This unit describes the performance outcomes, knowledge and skills required to design and establish survey control for engineering and construction purposes. It requires the ability to take measurements for calculation of survey data, draw sketches/plans, collect and process topographical data for detailed mapping. The unit applies to a person working at paraprofessional level in an engineering/civil engineering environment where measurement and set out of engineering works is undertaken. Work safe permit/s e.g. white card railway access are obtained in accordance with regulatory requirements where applicable.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify survey to be undertaken	1.1 Occupational health and safety/work health and safety (OHS/WHS) and environmental requirements for a given work area are determined
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel

		1.3	Survey and analysis task is identified from documentation, work requests or discussions with appropriate personnel
		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site
		1.5	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan survey	2.1	OHS/WHS requirements such as site-specific Safe Work Method Statement (SWMS) /toolbox meeting for carrying out the work are followed
		2.2	Documentation relating to existing survey control and features is accessed and analysed
		2.3	Surveying equipment is checked for calibration and conforming to Australian standard
		2.4	Reconnaissance of construction/engineering sites and site induction is performed to local standards or regulations in accordance with workplace procedures
		2.5	Survey risk management procedures are established and discussed with appropriate personnel
3	Conduct survey and analyse results	3.1	OHS/WHS and SWMS requirements for carrying out the work are followed
		3.2	Survey control and collection of topographical data for detailed mapping is conducted to job requirements in accordance with workplace procedures
		3.3	Survey equipment including levels, total station, global positioning system (GPS) and relevant data recorder devices are operated according to manufacturer directions
		3.4	Results are processed in relevant software packages, analysed and computations are applied according to workplace procedures
		3.5	Decisions for dealing with unexpected situations are made from discussions with appropriate

			personnel, job specifications and workplace procedures
4	Document, report and store results	4.1	Processed results are documented and reported to appropriate personnel according to workplace procedures
		4.2	Results are stored and archived according to workplace procedures
		4.3	Equipment and tools used in survey are maintained and stored in accordance with workplace procedures

Range of conditions

This competency includes both desk and fieldwork.

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret task related documentation, job instructions, drawings and OHS/WHS procedures
Oral communication skills to:	• relay information to team members using appropriate language for the audience
Numeracy skills to:	• make computations and record the results
Learning skills to:	• assess the nature and scope of new concepts and identify priorities and procedures within timeframes
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23932 Apply surveying for civil engineering projects	VU22487 Apply surveying for civil engineering projects	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23932 - Apply surveying for civil engineering projects

Performance Evidence	There must be evidence the learner has completed the tasks outlined in the elements, performance criteria and foundation skills in this unit evidence of the ability to:
	• design and establish survey control for engineering and construction purposes. In doing so the learner must on at least two (2) occasions in two different contexts:
	  ○ measure and calculate survey data, draw sketch/plans, collect and process topographical data for detailed mapping and related computational requirements
	  ○ identify and follow OHS/WHS procedures and site-specific Safe Work Method Statement (SWMS) for carrying out the work.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of: • level - basic operation, testing and maintenance • total station – basic operation, testing and maintenance • GPS - basic operation, testing and maintenance three-dimensional survey control using total stations or theodolite electronic and electronic distance measurement (EDM) • radiations in three dimensions using total stations and/or theodolite and data recorder • mapping of an engineering/construction sites using level, total station, GPS and data recorders • computing co-ordinates and bearings and distances as related to grids and general set out works for construction works and building site set out • setting out for a construction works using level, total station tapes and GPS • OHS/WHS, SWMS, tool box meetings and environmental considerations on a civil engineering construction site including personal protective equipment (PPE) • management of hazards when working on a civil construction
Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy SWMS and work procedures and instructions • two survey sites

- relevant survey equipment, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.
- personal protective equipment (PPE)

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23930**
Unit title	**Apply fundamentals of civil engineering to a construction project**
Application	This unit describes the performance outcomes, skills and knowledge required to apply fundamentals of civil engineering to a construction project. It requires the ability to recognise and apply the fundamentals of infrastructure engineering, urban planning, hydrology and natural built environment requirements to a civil engineering construction project. The unit applies to a person working at paraprofessional level in a civil engineering environment where civil engineering design and construction project work is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Establish the required civil engineering fundamentals for a construction project	1.1 Occupational health and safety/work health and Safety (OHS/WHS) and environmental requirements for a given work area are determined
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel
	1.3 Fundamentals of infrastructure engineering, urban planning, hydrology and natural built environmental for the civil engineering

			construction project are identified and discussed with appropriate personnel.
		1.4	Appropriate personnel are consulted to ensure the work is coordinated effectively with others
		1.5	Resources and equipment needed for the project are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Employ relevant civil engineering fundamentals to the construction project	2.1	OHS/WHS requirements for carrying out the work are followed
		2.2	Construction project material is collected and identified from documents, work requests or discussions with appropriate personnel
		2.3	Infrastructure engineering, urban planning, hydrology and natural built environmental fundamentals are applied to meet the project requirements
		2.4	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
3	Complete and compile construction project outcomes	3.1	Construction project work is finalised to conform with civil engineering fundamentals, design references, relevant Australian standards and workplace procedures
		3.2	Project work is presented and discussed with appropriate personnel in accordance with workplace procedures
		3.3	Results are stored and archived according to workplace procedures

Range of conditions

This competency includes both desk and fieldwork.

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret design references, environmental controls information and relevant building codes and legislation
Writing skills to:	• prepare technical documentation relating to the project
Oral communication skills to:	• ask questions and relay information to team members using appropriate language for the audience
Numeracy skills to:	• undertake structural analysis
Learning skills to:	• assess the nature and scope of new concepts and identify priorities and procedures within timeframes
Problem-solving skills to:	• resolve unexpected situations related to the project
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• plan and organise tasks while ensuring compliance with OHS/WHS procedures
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title Current version	Code and Title Previous version	Comments
VU23930 Apply fundamentals of civil engineering to a construction project	VU22485 Apply construction principles to civil engineering works	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23930 - Apply fundamentals of civil engineering to a construction project

Performance Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements, performance criteria and foundation skills of this unit, and provide evidence of the ability to:
	• develop and complete two (2) civil engineering construction projects each in a different context. In doing so the learner must:
	  ○ implement OHS/WHS procedures and practices including the application of risk control measures
	  ○ demonstrate the ability to apply relevant civil engineering fundaments to each facet of the construction projects.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• fundamentals of infrastructure engineering and civil construction including:
	  ○ earth works
	  ▪ types of excavation
	  ▪ wet v/s dry conditions
	  ▪ trench excavations
	  ▪ equipment selection
	  ○ materials of construction
	  ▪ concrete (including prestressed concrete, fiber reinforced concrete)
	  ▪ steel (including jointing methods of structural steel)
	  ○ types of dams
	  ○ tunnelling
	  ▪ methods of tunnelling
	  ▪ tunnelling lining
	  ▪ equipment selection
	  ○ parapet wall height
	  ○ concrete reinforcement cover requirement
	  ○ slope stability

- pavement design
- hydrology including:
  - hydrological cycle
  - water management
  - pipe works
- sustainable design including:
  - environment engineering
  - renewable energy integration
  - green building concepts
- Project planning including:
  - resource allocation
  - timelines
  - quality control
  - risk assessment

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy SWMS and work procedures instructions
- two project briefs
- CAD hardware and software
- relevant design reference, Australian standards
- personal protective equipment (PPE)

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23912**
Unit title	**Write and modify basic CNC programs**
Application	This unit describes the performance outcomes, knowledge and skills required to create and modify basic computer numerical control (CNC) programs for linear and circular turning and milling operations limited to two dimensional and two and half dimensional (2D and 2.5D). (The unit does not include programming machines with multiple spindles and using complex programming structures). The unit applies to people working at a paraprofessional level in a manufacturing environment where metallic and non-metallic components or parts are produced by CNC controlled machine centers. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Determine programming requirements	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements for a given work area are determined
	1.2 Programming requirements are determined from documentation, work requests or discussions with appropriate personnel
	1.3 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace

		1.4	Resources and equipment needed for the task are obtained in accordance with enterprise workplace procedures and checked for correct operation and safety
2	Write/modify CNC machine program and operation sheet	2.1	Machine function and tool path is defined by referencing engineering drawings
		2.2	Coordinates for tool path and machine function are calculated
		2.3	CNC program is written and/or modified using EIA-274-D coding standard and according to enterprise workplace procedures
		2.4	Operations sheets are produced in accordance with enterprise workplace procedures
		2.5	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes
3	Verify CNC program	3.1	Program is tested and verified by operating machine in manual mode
		3.2	Corrective action is taken to eliminate any errors in the program and the program is manually revalidated
		3.3	Program is documented and stored according to enterprise workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• Interpret documentation, specifications and drawings

Planning and organising skills to:

- plan and schedule required operations

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23912 Write and modify basic CNC programs	VU22505 Write and modify basic CNC programs	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23912 - Write and modify basic CNC programs
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit including the ability to: • write and modify two (2) CNC programs using EIA-274-D coding standard • verify CNC programs for single spindle machines for straight and circular tool motion on each occasion.
Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of: • motions of various machines centres • programmable functions • CNC process flow • point of reference • program structures • program codes and languages • program formatting • programming mistakes • linear and circular tool motion control • offsets and compensation techniques • tool length compensation.
Assessment Conditions	Assessment must be conducted in a real workplace or simulated environment that replicates real workplace conditions with access to: • OHS/WHS policy and work procedures and instructions • relevant machines, tools, materials and consumables • relevant plans, drawings and instructions and manufacturer specifications/manuals. **Assessor requirements:** Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23929**
Unit title	**Implement site investigation procedures**
Application	This unit describes the performance outcomes, knowledge and skills required to apply site investigation procedures and geological studies in accordance with the relevant Australian standards. It requires the ability to carry out site investigations and tests, which includes testing and analysis of soils, identifications of major rock and mineral types, setting up, calibrating and operating test equipment and completing reporting requirements. The unit applies to a person working at paraprofessional level in a civil engineering environment where testing and analysis of materials is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify site location and materials to be tested and analysed	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) and environmental requirements for the field work area are determined and followed
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel
	1.3 Desktop study is undertaken to determine site location, site history and proposed investigation method, testing and analysis tasks

		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site
		1.5	Resources and equipment needed for the task are obtained in accordance with enterprise procedure and checked for correct operation and safety
2	Plan test analysis	2.1	OHS/WHS requirements for carrying out the work are followed
		2.2	Requirements to determine site investigation and to provide adequate testing samples is confirmed
		2.3	Test equipment is checked for calibration and conformance with relevant Australian standard
		2.4	Materials to be tested are prepared in accordance with workplace procedures
3	Conduct test and analysis of results	3.1	OHS/WHS requirements for carrying out the work are followed
		3.2	Test equipment is set-up and tests are conducted to job requirements and in accordance with Australian standard
		3.3	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes
		3.4	Results of the tests are analysed and verified with the appropriate person
4	Document and report test results	4.1	Test results are recorded according to workplace procedure
		4.2	Results are stored and archived according to workplace procedure
		4.3	Resources and equipment are checked and stored according to workplace procedure

Range of conditions

This unit may include office, laboratory and fieldwork contexts or work environments.

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret task related documentation, job instructions and drawings
Writing skills to:	• prepare technical documentation and reports
Oral communication skills to:	• relay information to team members using appropriate language for the audience
Numeracy skills to:	• analyse financial and numerical information embedded in a range of texts and tasks
Learning skills to:	• assess the nature and scope of new concepts and identify priorities and procedures within timeframes
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• carry out site sampling including setting up and calibrating sampling testing equipment
Technology skills to:	• use main features and functions of digital tools required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23929 Implement site investigation procedures	VU22484 Implement site investigation procedures	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23929 - Implement site investigation procedures

Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit and in doing so the learner must:
	• conduct testing and engineering analysis of soils on a least two (2) occasions and in two (2) different contexts and in doing so:
	  ○ follow relevant OHS/WHS procedures and practices including the use of risk control measures
	  ○ access soil samples and conduct testing and analysis in accordance with the appropriate Australian standard.
	  ○ prepare and complete required documentation

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• purpose of a desktop study prior to planning and undertaking site work
	• hazard and risk issues when conducting site investigation
	• geological classifications including unified soil classification system
	• minerals, exploration and engineering
	• rocks, mechanics and engineering
	• structural geology and mapping
	• mining of rocks and minerals
	• quarry products and uses
	• sampling and testing of rock products
	• impact of groundwater on sampling and testing
	• characteristics of soils including:
	  ○ compression and expansion of soils:
	  ○ modes of failure of soils and structures
	  ○ unified soil classification system
	  ○ field and laboratory tests
	  ○ methods of describing soils
	  ○ permeability of soils
	• Australian Standards for geological sampling and testing
	• OHS/WHS regulations and safe work practices for on-site and laboratory work activities

Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates real life workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions.
- testing facilities including soil samples and testing equipment materials and consumables
- relevant geological plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23913**
Unit title	**Implement basic materials science principles to engineering applications**
Application	This unit describes the performance outcomes, knowledge and skills required to apply basic principles of materials science to engineering problems. It requires the ability to recognise and classify the most common materials used in engineering, know the properties of materials and the factors that influence those properties and carry out testing of materials to evaluate the engineering properties. The unit applies to a person working at paraprofessional level in an engineering/manufacturing environment where material testing and evaluations are undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Prepare for materials testing and evaluation task	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) and environmental requirements for a given work area are determined
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel
	1.3 Materials testing and evaluation task requirements are determined through

			documentation, job sheets and discussion with appropriate personnel
		1.4	Where necessary expert advice is sought with respect to the materials science task and in accordance with workplace procedures
		1.5	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site
		1.6	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation
2	Perform materials testing and evaluation task	2.1	OHS/WHS requirements for carrying out the work are followed
		2.2	Appropriate materials testing and evaluation methodology is chosen for given task
		2.3	Materials testing and evaluation is undertaken according to workplace procedures
		2.4	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
3	Complete and document materials testing and evaluation task	3.1	Resources and equipment used for the task are checked, cleaned and stored in accordance with workplace procedures
		3.2	Documentation associated with materials testing and evaluation task is prepared according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation and job instructions
Writing skills to:	• prepare technical documentation
Oral communication skills to:	• relay information to team members using appropriate language for the audience
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• ability to plan and organise tasks while ensuring compliance with OHS/WHS procedures
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23913 Implement basic materials science principles to engineering applications	VU22480 Implement basic materials science principles to engineering applications	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23913 - Implement basic materials science principles to engineering applications
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit and in so doing the learner must demonstrate the ability to: • apply basic testing procedures on at least four (4) common engineering materials to determine their suitability for a given engineering application. • apply safe work practices in an engineering testing environment
Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of: • classification of common engineering materials • structure and properties of common engineering materials • stress and strain behaviour of materials: • tensile testing of materials • hardness and impact testing • chemical properties of common engineering materials • ferrous and non-ferrous metals • classification of polymers, their applications and manufacturing processes • applications of ceramic materials and their manufacturing processes • applications of composite materials: • effects of mechanical and thermal processes on the properties of materials • non-destructive testing of common engineering materials
Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy and work procedures and instructions. • materials testing facilities and testing equipment and consumables • common engineering material samples • personal protective equipment (PPE) **Assessor requirements:** • Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23931**
Unit title	**Apply principles of material testing to civil engineering applications**
Application	This unit describes the performance outcomes, knowledge and skills required to undertake practical activities and tests of common construction materials, such as aluminum, brick, timber and concrete and analyse the results. The unit applies to a person working at paraprofessional level in a civil engineering environment where testing and analysis of materials is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify materials to be tested	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) and environmental requirements for a given work area are determined
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel
	1.3 Testing and analysis task is identified from documentation, work requests or discussions with appropriate personnel
	1.4 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site

		1.5	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan test and set up testing equipment	2.1	OHS/WHS requirements for carrying out the work are followed.
		2.2	Materials to be tested are prepared to Australian and/or local standards or regulations in accordance with workplace procedures.
		2.3	Test equipment is checked for calibration and conforming to Australian standard
		2.4	Origin of the materials to be tested is identified and recorded
3	Conduct test and analyse results	3.1	OHS/WHS requirements for carrying out the work are followed.
		3.2	Tests are conducted to job requirements in accordance with relevant Australian standards
		3.3	Test equipment is operated/used in accordance with Australian standard.
		3.4	Results are analysed and reported to the appropriate person
		3.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
4	Document and report results	4.1	Results are recorded according to workplace procedures
		4.2	Results are stored and archived according to workplace procedures

Range of conditions

The unit may include office, laboratory and fieldwork contexts or work environments.

Foundation Skills

This section describes language, literacy, numeracy and employment skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare technical documentation using appropriate terminology
Oral communication skills to:	• relay information to team members using appropriate language in a civil engineering environment
Numeracy skills to:	• analyse financial and numerical information embedded in a range of texts and tasks
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Technology skills to:	• use main features and functions of digital tools required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23931 Apply principles of material testing to civil engineering applications	VU22486 Apply principles of material testing to civil engineering applications	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23931 - Apply principles of material testing to civil engineering applications
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit, including evidence of the ability to: • undertake practical activities and tests in accordance with the relevant Australian Standard for four (4) common construction materials • analyse and document the results for each of the four (4) tests in accordance with workplace procedures.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• common materials including: aluminium, steels, bricks, timber, adhesives, plastics, aggregates, concrete in the construction industry
	• application/use of the various materials including:
	  ○ properties of each material
	  ○ methods of processing/manufacture of each material
	  ○ surface finishing for building materials
	  ○ impact of time and weather on construction building materials
	• test procedures to determine materials the physical properties
	  ○ Australian Standards for materials tests
	  ○ setting up, calibrating and operating test equipment
	  ○ analysis and documenting of test results
	  ○ OHS/WHS issues relevant to material testing activities

Assessment Conditions	Assessment must be conducted in the workplace or simulated workplace environment that replicates workplace conditions with access to: • samples of construction materials • OHS/WHS policy and workplace procedures and instructions • testing equipment and operating manuals • tools and consumables for setting up and calibrating testing equipment • Australian standards for testing of construction materials **Assessor requirements:** Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23933**
Unit title	**Perform measurements and layout tasks on construction sites**
Application	This unit describes the performance outcomes, knowledge, and skills required to perform basic measurement and layout tasks on construction sites, including the use of levels and distance measuring techniques. It requires the ability to apply safe practices and procedures, plan survey activities, conduct site reconnaissance, set up and calibrate survey equipment, perform surveying measurements and document and report results. The unit applies to a person working as a paraprofessional in a structural/civil engineering environment where measurement and set out of engineering works is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify survey to be undertaken	1.1 Occupational health and safety/work health and safety (OHS/WHS) and environmental requirements for a given work area are determined
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel
	1.3 Survey and analysis task is identified from documentation, work requests or discussions with appropriate personnel

		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site
2	Plan survey	2.1	OHS/WHS requirements for carrying out the work are followed
		2.2	Documentation relating to existing survey features is accessed and analysed
		2.3	Resources and equipment required for the survey are obtained in accordance with enterprise procedures and checked for correct operation
		2.4	Reconnaissance of the construction/engineering site is performed in accordance with workplace procedures
		2.5	Survey risk management procedures are established and discussed with appropriate personnel
3	Conduct survey and analyse results	3.1	OHS/WHS requirements for carrying out the work are followed
		3.2	Surveying measurements are performed in accordance with job requirements and workplace procedures
		3.3	Survey equipment is operated/used according to manufacturer's manual and workplace procedures.
		3.4	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
4	Document, and report results	4.1	Scaled and orientated sketch of the engineering site with form lines and features is prepared
		4.2	Results are recorded, analysed and reported to appropriate personnel according to workplace procedures
		4.3	Equipment and tools used in survey are maintained and stored in accordance with workplace procedures

4.4	Results are stored and archived according to workplace procedures
4.5	Work completion is notified to appropriate personnel according to workplace procedures

Range of conditions

This competency includes both desk and fieldwork.

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare technical documentation
Oral communication skills to:	• relay information to team members using appropriate language for the audience
Numeracy skills to:	• perform survey measurements
Learning skills to:	• assess the nature and scope of new concepts and identify priorities and procedures within timeframes
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• plan survey activities including organising site reconnaissance and visits
Technology skills to:	• use main features and functions of digital tools and applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23933 Perform measurements and layout tasks on construction sites	VU22488 Perform measurements and layout tasks on construction sites	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23933 - Perform measurements and layout tasks on construction sites
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit and provide evidence of the ability to on least two (2) occasions each in a different context: • carry out construction/engineering site reconnaissance, and perform surveying measures in accordance with job instructions • prepare and document a scaled and orientated sketch of engineering site annotated with form lines and features.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• surveying fundamentals including:
	  ○ measurement reference system and measurable quantities
	  ○ co-ordinate and orientation reference systems
	  ○ surveying applications to engineering projects
	  ○ graphical and mathematical relationship between measurements and coordinate systems
	  ○ requirements for survey control and topographic mapping for engineering projects including location, density & longevity of control monuments
	• reconnaissance of construction/engineering sites including:
	  ○ locate important features
	  ○ field sketch terrain and cultural features
	  ○ approximately locate proposed works on a site
	  ○ place survey control monuments
	  ○ reconnaissance surveys by:
	  ▪ compass, clinometer & pace traverse
	  ▪ single frequency GPS
	• detail measurement on a construction/engineering site including:
	  ○ measured horizontal distances by tape and plumb bob to an accuracy of +/- 5mm in 20 metres
	  ○ determined horizontal distance from slope distances and vertical angle
	  ○ magnetic directions
	  ○ the relative position of points and features by offset and radiation
	  ○ producing sketches with measured dimensions of buildings and other cultural and natural features

- annotating sketches to identify features and their attributes using standard surveying symbols

- Third Order Levelling - two Peg Test:
  - test and adjust automatic levels if maladjustment exceeds 5mm in 30metres
- 'Rise and Fall' method including:
  - differential levelling in closed traverses, calculate reduced levels using Rise and Fall method of level reduction to an accuracy of +/- 12mm √k where k = total traverse length
  - determination of reduced levels of features and survey control monuments
  - calculation of clearances under overhangs/bridges using an inverted staff
  - use of automatic and electronic levels, laser planes and hydrostatic methods to obtain reduced levels of features on engineering sites
- Height of Collimation - Grid Contouring and Volumes including:
  - how to set out a grid and level it, using H.O.C. method
  - preparation of a contour plan from grid spot levels to a specified accuracy and stated contour interval
  - production of a cross section through a contour plan showing cut and fills
  - determination of the volume of a solid, the surface of which has been levelled and contoured.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- two (2) construction/engineering sites
- surveying equipment and consumables
- OHS/WHS policy and work procedures and personal protective equipment (PPE)
- relevant plans, drawings and instructions and manufacturer's specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23950**
Unit title	**Apply surveying computations to civil engineering projects**
Application	This unit describes the performance outcomes, knowledge and skills required to apply computational concepts and methods that are common to civil engineering and surveying projects. It requires the ability to convert survey measurements and data into surveying and mapping coordinates and apply computational set out data to facilitate the construction of an engineering project. This does not include the use of calculus. The unit applies to a person working at paraprofessional level in a civil engineering environment where surveying data mapping and computations are undertaken for the completion of engineering project work. This may include both office and fieldwork for the gathering of relevant data. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify surveying computational requirements	1.1 Occupational health and safety, workplace health and safety (OHS/WHS), and environmental requirements for a given work area are determined
	1.2 Surveying computational task is determined through work requests, design briefs, documentation or equivalent and clarified with the appropriate personnel
	1.3 Expert advice is sought with respect to the surveying computational task and according to workplace procedures, where appropriate

		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others
		1.5	Resources and equipment needed for the task are obtained in accordance with workplace procedures
2	Conduct surveying computational tasks	2.1	OHS/WHS requirements for carrying out the work are followed
		2.2	Industry codes, regulations and technical documentation relevant to the surveying computational task are interpreted
		2.3	Tables and graphs, surveying plans or equivalent where appropriate are used to obtain surveying computational data
		2.4	Appropriate assumptions underlying the surveying computational task are made and recorded
		2.5	Resources required are identified, obtained and checked as fit for purpose
		2.6	Most appropriate computational method is selected and justified
3	Perform surveying calculations	3.1	Arithmetic operations are performed, including decimals and fractions for a given application or circumstance
		3.2	Calculator functions can be used in computational sequences
		3.3	Features of a scientific calculator are utilised to efficiently perform computations
4	Attend to surveying computation contingencies	4.1	OHS/WHS requirements for carrying out the work are followed
		4.2	Computations are performed and results recorded according to workplace procedures
		4.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
		4.4	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcome

5	Complete surveying computation procedures	5.1	Results are validated and discussed with appropriate personnel
		5.2	Results are graphed, tabled or sketched charted in accordance with workplace procedures, where appropriate
		5.3	Work completion notification is conveyed to appropriate personnel in accordance with workplace procedures
		5.1	Results are validated and discussed with appropriate personnel

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret job instructions and other related documentation
Oral communication skills to:	• consult and communicate with other project personnel
Numeracy skills to:	• perform manual surveying computations using tables, graphs and surveying plans
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• identify and follow relevant OHS/WHS procedures
Technology skills to:	• use main features and functions of digital tools and software applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23950 Apply surveying computations to civil engineering projects	VU22554 Apply surveying computations to civil engineering projects	Equivalent

Assessment Requirements

Title	Assessment Requirements for: VU23950 Apply surveying computations to civil engineering projects
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit including the ability to: • apply surveying computations to three (3) different engineering projects and verify results for each.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• surveying computation (manual techniques):
	  ○ horizontal angles from observed directions
	  ○ horizontal angular misclosures and compute bearings
	  ○ vertical angles from vertical circle reading
	  ○ distances for meteorological effects
	  ○ slope distance and vertical angle to horizontal distance and vertical component
	  ○ height difference from vertical component, height of instrument and height of target
	  ○ horizontal distances and bearings to Eastings and Northings, closed traverse computations, isolation of most likely source of gross errors and adjustment of traverses
	• coordinating geometry operations using software tools:
	  ○ known or given coordinated points
	  ○ data from previous surveys e.g., cadastral plans /architectural plans
	  ○ coordinated transformations on data sets with common points
	  ○ coordinate file merging
	  ○ coordinate geometry operations which generate new points by:
	  ▪ traverses and radiations
	  ▪ intersections of direction and/or distance combinations
	  ▪ fitting circles using various criteria
	  ▪ creating parallel entities
	  ○ traverse data and adjustment
	  ○ out data tabulation:
	  ▪ coordinated points
	  ▪ points regularly spaced along lines
	  ▪ points regularly spaced along circular curves

- area operations on personal computers:
    - areas of polygons
    - areas of figures with circular curves
    - polygons to achieve a specified area by:
        - rotation of a line
        - parallel movement of a line.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- computer equipment and software, scientific calculator, relevant charts and graphs
- relevant plans, drawings, and instructions and manufacturer specifications
- survey computations and data for three civil engineering projects.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23914**
Unit title	**Apply electrotechnology principles in an engineering work environment**
Application	The unit describes the performance outcomes knowledge and skills required to apply electrotechnology principles in an engineering work environment. It requires the ability to select, set-up and use a range of test equipment to measure voltage, current and resistance as well as identifying commonly used electrical/electronic devices for the supply of power and for the control of machines and plant. The unit applies to a person working at paraprofessional level and required to apply electrotechnology principles in an engineering work environment. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify electrical principles to plan, conduct or complete engineering tasks	1.1 Basic electrical units, terms and symbols are recognised and applied 1.2 Basic electrical diagrams are interpreted, and the operation of the circuit explained to appropriate personnel in the workplace

		1.3	Potential electrical hazards are identified and reported according to workplace procedures
2	Determine electrical requirements when planning engineering tasks	2.1	Electrical measurement devices are used to measure basic electrical quantities in simple DC and AC circuits
		2.2	Electrical measurements are interpreted 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 and safety/workplace health and safety (OHS/WHS) requirements, relevant Australian standards, codes of practice, manufacturer specifications, environmental requirements and enterprise procedures are identified and followed
		3.2	Electrical equipment and devices are operated safely and only for the purpose intended according to manufacturer operating instructions, specifications and specific safety requirements
		3.3	Electrical equipment and devices that have been safety tested and appropriately tagged are operated
4	Locate protection device in an electrical circuit and isolate the circuit	4.1	Location of protection devices for electrical circuits and equipment are identified
		4.2	Purpose and types of protection devices is explained
		4.3	Subsections of the electrical distribution are isolated and made safe

Range of conditions

Unit relates to simple DC and AC circuits

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Oral communication skills to:	• relay information to team members using appropriate language for the audience
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23914 Apply electrotechnology principles in an engineering work environment	VU22472 Apply electrotechnology principles in an engineering work environment	Equivalent

Assessment Requirements Template

Title	Assessment Requirements for VU23914 - Apply electrotechnology principles in an engineering work environment

Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit including the ability to:
	• Interpret basic electrical diagrams and use electrical devices/equipment to measure voltage, current and resistance and test for continuity and insulation on three (3) occasions each in a different context. In doing so the learner must:
	  ○ implement and apply OHS/WHS workplace procedures and practices including the use of risk control measures
	  ○ locate and recognise electrical protection devices and isolate an electrical circuit.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• basic electricity:
	  ○ concepts of electromotive force (emf)
	  ○ 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.

Assessment Conditions

Assessment must be conducted in a real workplace or simulated environment that replicates real workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant machines, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23915**
Unit title	**Annotate and create assemblies using solid models**
Application	This unit describes performance outcomes, knowledge and skills required to annotate and create assemblies using solid models with Computer Aided Drafting (CAD) software to create three dimensional (3D) solid models for presentation purposes. It requires the ability to apply CAD to illustrate 3D images of assembled engineering components, using rendering techniques such as the use of light and shade and also adding annotations. The unit applies to a person working at paraprofessional level in an engineering enterprise involved in the design and analysis of a wide range of engineering components and systems. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Prepare for solid assembly modelling task	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements for a given work area are determined
	1.2 Solid modelling assembly task requirements are identified from documentation, job sheets or through discussions with appropriate personnel
	1.3 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace

		1.4	Resources and computer aided drafting (CAD) equipment needed for the solid modelling assembly task are obtained in accordance with enterprise procedures and set up and checked for correct operation
2	Prepare drawing of solid assembly	2.1	Most appropriate 3D modelling and assembly software is chosen for the given assembly task.
		2.2	3D solid modelling software is applied to create the represented engineering components in accordance with the job requirements
		2.3	Key assembly features of the solid modelling package are fully exploited to optimise the presentation
		2.4	Rendering techniques are applied to 3D models to enhance presentation
		2.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures.
		2.6	Solid models of components and assemblies are checked and edited where required
3	Complete solid model assembly task	3.1	All required annotations and references are added to the presentation as required and in accordance with workplace procedure
		3.2	Hard copies of 3D solid models and assemblies are produced
		3.3	Documentation associated with the solid modelling assembly task is checked and signed off in accordance with workplace procedure
		3.4	3D models and assemblies' files are saved and stored for later retrieval

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Oral communication skills to:	• relay information to team members using appropriate language
Learning skills to:	• determine the scope of the task in consultation with other project members
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Technology skills to:	• use main features and functions of digital tools, software and electronic applications required for the task

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23915 Annotate and create assemblies using solid models	VU22497 Annotate and create assemblies using solid models	Equivalent

Assessment Requirements Template

Title	Assessment Requirements for VU23915 Annotate and create assemblies using solid models
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit including the ability to: • create rendered 3D model of at least three (3) engineering components using the features of appropriate CAD software, for presentation purposes.
Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of: • 3D modelling and assembly software • principle tools used in the creation and manipulation of solid models • creation of assemblies from library items e.g., off the shelf parts • application of rendering techniques to create the illusion of the third dimension • 'top down' and 'bottom up' modelling techniques to produce components/parts. • application of annotations and references • presentation processes
Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy and work procedures and instructions • access to relevant CAD equipment, tools, materials and consumables • access to relevant plans, drawings and instructions and manufacturer specifications/manuals. **Assessor requirements:** • Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23916**
Unit title	**Apply scientific principles to engineering problems**
Application	This unit describes the performance outcomes, knowledge and skills required to apply scientific principles to solve problems common to all engineering fields. It requires the ability to demonstrate the application of quantities and units, vector and scalar quantities, kinematics dynamics, heat and temperature, constitution of matter and error and uncertainty. This unit applies to a person working at paraprofessional level in an engineering, manufacturing and construction environments where the application of scientific principles can provide a solution to standard engineering problems. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify the scientific principles embedded in an engineering problem	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) and environmental requirements for a given work area are determined
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel

		1.3	Engineering problem is determined through requests, design briefs and clarified with appropriate personnel
		1.4	Scientific principles related to the engineering problem are identified and discussed with the appropriate person
		1.5	Expert advice is sought with respect to the engineering problem and according to workplace procedures, where appropriate
		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 workplace procedures and checked for correct operation and safety
2	Analyse an engineering problem	2.1	Relevant OHS/WHS requirements for carrying out the work are followed
		2.2	Industry codes, regulations and technical documentation relevant to the engineering problem are interpreted
		2.3	Tables and graphs are used to obtain computational data
		2.4	Appropriate assumptions underlying the engineering problem are made and recorded
		2.5	Most appropriate analytical, computational or design methodology is selected and justified
		2.6	Resources and equipment required are identified, obtained and checked as fit for the purpose
3	Verify, document and interpret outcomes	3.1	Results of the analysis are recorded and documented in accordance with requirements and workplace procedures
		3.2	Results are graphed and/or charted and interpreted, where appropriate
		3.3	A formal report to present outcomes is prepared according to workplace procedures

3.4	Outcomes of analysis are verified and discussed with appropriate personnel

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret job instructions, technical documents and OHS/WHS procedures
Writing skills to:	• prepare technical documentation relating to engineering solutions using appropriate terminology
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• address technical contingencies clarify engineering problems
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices including the use of scientific principles risk control measures
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23916 Apply scientific principles to engineering problems	VU22476 Apply scientific principles to engineering problems	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23916 - Apply scientific principles to engineering problems
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • Research and apply scientific principles to solve engineering problems on at least two (2) occasions each in a different context

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• heating devices and measuring devices electromagnetic waves:
	  ○ electromagnetic spectrum
	  ○ frequency
	  ○ periodicity
	  ○ wavelength
	• fundamentals of electricity:
	  ○ electrical charge
	  ○ electrical current
	  ○ voltage resistance
	  ○ Ohms law
	  ○ power including direct current (DC), alternating current (AC)
	  ○ electromagnetism
	  ○ capacitance
	• rotational motion:
	  ○ angular displacement
	  ○ angular velocity
	  ○ angular acceleration
	• moment of inertia
	• torque
	• SI System of Units:
	  ○ fundamental standards
	  ○ scientific notation
	  ○ significant figures
	• linear motion:
	  ○ displacement, velocity and acceleration

- equations of linear motion
- free falling bodies

- circular motion:
  - angular displacement, velocity and acceleration
  - equations of circular motion
  - relationship between linear and circular motion
- work, energy, power:
  - work and equivalence with energy, power, gravitational potential energy, kinetic energy, other types of energy, energy transformations
  - work done by a constant force
  - work done by a variable force
  - potential energy
  - kinetic energy
  - principle of energy transformations
  - work – energy equation
  - power
- simple machines:
- dynamics of linear motion:
  - mass, force and acceleration
  - inertia force
  - acceleration against a resistance
  - acceleration against gravity
  - systems of bodies in motion
  - centrifugal force
- momentum:
  - principle of conservation of momentum
- heat and temperature:
  - kinetic theory
  - phase transition
  - specific heat
  - latent heat
  - temperature scales
  - temperature measurement
- error and uncertainty:
  - sources of error
  - treatment of error and uncertainty

- importance of minimising error
- calculation of error.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant machines, tools, materials and consumables
- scienitic calculator
- relevant plans, drawings, graphs, charts and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23917**
Unit title	**Set up manufacturing processes for engineering applications**
Application	This unit describes the performance outcomes, skills and knowledge required to select and implement manufacturing processes for specific engineering applications. The principal processes include metal forming operations, fabrication, powder metallurgy, machine tools and computer numerical controlled (CNC) equipment. The unit applies to a person working at paraprofessional level in an engineering and/or manufacturing environment where a number of manufacturing processes are used. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Determine principal processes within the manufacturing industry	1.1 Principal engineering processes and their applications are identified 1.2 Key features of the selected engineering processes are identified 1.3 Advantages and disadvantages of selected engineering processes for given manufacturing applications are confirmed
2 Select process for a specified manufacturing application	2.1 Manufacturing outcomes and requirements are identified and clarified with appropriate personnel 2.2 Functional specifications and other factors affecting the selection of engineering processes are identified

		2.3	Suitable engineering process is selected based on manufacturing requirements, functional specifications/factors and discussions with appropriate personnel
		2.4	Calculations and assumptions are made to facilitate the installation of the machinery and equipment
3	Implement and commission selected process	3.1	Occupational Health and Safety/Work Health and Safety (OHS/WHS) requirements for carrying out the work are followed
		3.2	Stages and activities required for engineering process are identified and documented according to enterprise procedures
		3.3	Manufacturing requirements of Total Quality Management (TQM), Just in Time (JIT) and competitive (lean manufacturing) environments are applied
		3.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved
		3.5	Resources and equipment for the process are identified and sourced
		3.6	Resources and equipment for the process are installed, set up and trialled for functionality
		3.7	Process is commissioned in accordance with enterprise procedures

Range of conditions

Engineering processes may include but not limited to:

- forming
- casting
- forging
- extrusion
- press-working
- powder metallurgy
- automatic lathes
- grinding
- CNC machinery

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Oral communication skills to:	• relay information to relevant personnel in the setting up of the manufacturing process
Numeracy skills to:	• take measurements and perform calculations to determine process installation requirements
Learning skills to:	• assess the nature and scope of new concepts and identify priorities and procedures within timeframes
Problem-solving skills to:	• address technical contingencies and risks
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices including the use of manufacturing processes risk control measures
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23917 Set up manufacturing processes for engineering applications	VU22501 Set up manufacturing processes for engineering applications	Equivalent

Assessment Requirements Template

Title	Assessment Requirements for VU23917 - Set up manufacturing processes for engineering applications
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must be able to: • Select and set up two (2) different principal manufacturing processes for two (2) different applications. In doing so the learner must: • carry out these tasks following all relevant OHS/WHS and environmental requirements • select each engineering process based on the manufacturing and functionality requirements • correctly apply calculations and assumptions for each process • install, set up and trial for functionality the resources and equipment for each process.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	•
	• sequencing operations
	• factors influencing process selection
	• materials and process preparation
	• properties and characteristics of materials and consumables
	• process to review and revise outcomes against task objectives and requirements
	• communication:
	  ○ categorising manufacturing methods
	  ○ 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

- engineering processes:
    - principal engineering processes
    - applications, features and principles of engineering processes
    - advantages and disadvantages of engineering processes
- engineering process selection:
    - scientific principles relevant to engineering processes
    - scientific principles in the choice of methods, processes & construction techniques
    - provision for particular materials properties in the choice of methods, processes & construction techniques
    - factors affecting process selection
    - the suitability of application to particular continuous, mass, batch, jobbing shop, sequential or cellular manufacture and assembly
    - identifying and considering materials properties in the choice of methods, processes & construction techniques
    - regulations, standard procedures and material safety data sheet (MSDS) specifications
    - manufacturing requirements
- manufacturing processes:
    - selecting methods, processes and construction techniques suitable for continuous, mass, batch or jobbing shop production, work cell or sequential manufacture and assembly
    - applications suitable for a range of materials handling techniques
    - principles of TQM, JIT and Competitive (lean manufacturing)
    - calculations and assumptions for processes & construction techniques choices
    - materials handling processes and procedures
- OHS/WHS requirements:
    - protective equipment
    - material safety management systems
    - hazardous substances and dangerous goods code
    - local safe operation procedures
    - awards provisions
- environmental considerations:
    - types, disposal and environmental impact of liquid waste
    - disposal classification, management of solid waste
    - sources, control and regulations governing air emissions control

- consumption, conservation and sustainability of excessive energy and water usage
- sources, impact and mitigation of excessive noise considerations.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant machines, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23918**
Unit title	**Program and test control systems**
Application	This unit describes the performance outcomes, knowledge and skills required to program and test an industrial control system associated with manufacturing processes. The unit applies to a person working at paraprofessional level in a manufacturing environment where control systems in manufacturing processes are used. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Plan for implementing a control system	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are determined
	1.2 Established OHS/WHS requirements and risk control measures and procedures are followed in preparation of the work area
	1.3 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	Apply control system plan and handle contingencies	2.1	OHS/WHS 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	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 workplace procedures
3	Commission and document the control system	3.1	OHS/WHS requirements for completing the work are followed
		3.2	Equipment and machinery are checked as being isolated where necessary during commissioning process
		3.3	Control system is tested ‘live’ and appropriate safety precautions are taken according to workplace procedures
		3.4	Control system is documented, and documentation is stored in accordance with workplace procedures
		3.5	Work completion is notified to appropriate personnel according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation and read and understand design briefs
Writing skills to:	• prepare technical documentation relating to control systems
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• perform dimensional computations
Problem-solving skills to:	• address technical contingencies and risks including testing control system functionality against specification
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices including the use of program risk control measures
Technology skills to:	• create efficient software interfaces between programmable device(s) and peripheral devices

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23918 Program and test control systems	VU21174 Program control systems	Equivalent

Assessment Requirements Template

Title	Assessment Requirements for VU23918 - Program and test control systems
Performance Evidence	The learner must be able to demonstrate competency in all of the elements and performance criteria and foundation skills in this unit. In doing so the learner must: • implement, program, test and commission control systems on two (2) occasions each in a different context.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• input/output devices:
	  ○ types of input/output devices
	  ○ limitations of input/output devices
	  ○ linearization methods
	  ○ commercial examples
	  ○ means of connection
	• control system software:
	  ○ control language
	  ○ types of control languages
	  ○ PC to PLC interfaces
	  ○ control structure
	  ○ software debugging
	  ○ fault finding techniques
	• dimensional calculations:
	  ○ mathematical functions
	  ○ 7 SI fundamental units
	  ○ gas quantities
	  ○ order of magnitude
	  ○ dimensions
	  ○ scientific and engineering notations
	• measurement and control terminology
	• safety concerns:
	  ○ software reliability
	  ○ noise immunity.

Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy and work procedures and instructions • relevant machines, tools, materials and consumables • relevant plans, drawings and instructions and manufacturer specifications/manuals. **Assessor requirements:** Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23919**
Unit title	**Apply principles of strength of materials to engineering problems**
Application	This unit describes the performance outcomes, knowledge and skills required to assess the strength of materials used in engineering applications. It requires the ability to undertake general design work determining the strength of materials including the impact of stress, strain, deformation, properties of sections shear force and testing. The unit applies to a person working in an engineering environment as a technician or paraprofessional engineer responsible for undertaking general design work. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify the tasks for assessing strength of materials	1.1 Occupational health and safety/workplace, health and safety (OHS/WHS) and environmental requirements for a given work area are determined
	1.2 Established OHS/WHS 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	Strength of materials task is determined through request, design briefs or equivalent and clarified with appropriate personnel
		1.5	Where appropriate expert advice is sought with respect to the strength of material task and in accordance with workplace procedures
		1.6	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace
		1.7	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Select the appropriate testing regime	2.1	Relevant OHS/WHS requirements for carrying out the work are followed
		2.2	Industry codes, regulations and technical documentation relevant to the strength of materials task are interpreted and understood
		2.3	Tables and graphs are used to obtain computational data, where appropriate
		2.4	Appropriate assumptions underlying the strength of materials are made and recorded
		2.5	Most appropriate computational method is selected and justified
3	Undertake materials testing	3.1	Relevant OHS/WHS requirements for carrying out the work are followed
		3.2	Strength of materials test is performed and results recorded
		3.3	Decisions for dealing with unexpected situations are made based on discussions with appropriate personnel, job specifications and workplace procedures
4	Verify and interpret results	4.1	Equipment and tools used with this task are maintained and stored in accordance with workplace procedures
		4.2	Results are graphed or charted, where appropriate
		4.3	Results are interpreted, verified and discussed with appropriate personnel

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare technical documentation relating to material strength using appropriate terminology
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices including the use of risk control measures
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23919 Apply principles of strength of materials to engineering problems	VU22474 Apply principles of strength of materials to engineering problems	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23919 - Apply principles of strength of materials to engineering problems
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • apply strength of materials solutions to common engineering problems on five (5) occasions each in a different context.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• stress and strain of engineering materials
	• centrally loaded connections:
	  ○ thin walled pressure vessels
	  ○ properties of plane figures
	  ○ simple beams (point and distribute loads):
	  ○ torsional stress
	  ○ thermal stress
	• classification of materials
	• properties of engineering materials:
	  ○ physical properties
	  ○ mechanical properties
	  ○ chemical properties
	• materials testing methods of engineering materials:
	  ○ destructive testing and applications
	  ○ Non-Destructive Testing (NDT)
	  ○ corrosion testing
	• engineering materials:
	  ○ engineering applications of:
	  ▪ ferrous metals
	  ▪ non-ferrous metals
	  ▪ polymers
	• effects of mechanical and thermal processes on the properties of materials.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant machines, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23937**
Unit title	**Set up and monitor fluid power-controlled engineering systems**
Application	This unit describes the performance outcomes, knowledge and skills required to plan, set up and implement a fluid power-controlled system. It requires the ability to test, and fault find as well as maintain and repair single and multi-actuator fluid power circuits. This unit applies to a person working at paraprofessional level technician or paraprofessional engineer in an industrial engineering/manufacturing workplace where the application of fluid power is used to produce goods or services. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Plan implementation of a fluid power-controlled system	1.1 Established OHS/WHS requirements and risk control measures and procedures are incorporated into the implementation plan
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel
	1.3 Requirements for implementing or maintaining a fluid power system are determined from documentation, reports, or clients and from discussions with appropriate personnel

		1.4	Fluid power system implementation or maintenance task is planned and documented taking operational requirements into consideration
		1.5	Implementation or maintenance work is scheduled and operational consequences communicated to the 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 workplace procedures and checked for correct operation and safety
2	Implement and maintain a fluid power controlled system	2.1	Relevant OHS/WHS requirements for carrying out the work are followed
		2.2	Equipment/machines/plant is checked as being isolated where necessary in strict accordance with OHS/WHS requirements
		2.3	Implementation or maintenance task is carried out according to prepared work plan
		2.4	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes
3	Conduct final testing and complete documentation	3.1	Relevant OHS/WHS requirements for completing the work are followed
		3.2	Fluid power system is tested for functionality and, if required, faults are corrected in accordance with workplace procedures
		3.3	Work site is made safe in accordance with established safety procedures
		3.4	Implementation or maintenance of the fluid power system is completed, and machinery/equipment is checked for correct operation
		3.5	Fluid power system implementation and maintenance task is documented and the appropriate personnel notified

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare technical documentation
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices including the use of risk control measures
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23937 Set up and monitor fluid power-controlled engineering systems	VU22565 Set up fluid power controlled engineering systems	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23937 - Set up and monitor fluid power-controlled engineering systems
Performance Evidence	The learner must be able to demonstrate competency in all of the elements and performance criteria in this unit. In doing so the learner must: • plan, implement and set up a fluid power-controlled system consistent with job requirements as well as perform tests, correct faults and commission the system on at least two (2) occasions each in a different context.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• fluid power controlled system concepts and equipment including:
	  ○ electrical components
	  ○ system controllers e.g. Programmable Logic Controllers (PLC)
	  ○ linear actuators
	  ○ control valves (hydraulic and pneumatic)
	  ○ circuit design and analysis (single linear actuator)
	  ○ hydraulic pumps
	  ○ filters
	  ○ air compressors
	  ○ receivers and after-coolers
	  ○ rotary actuators (hydraulic and pneumatic)
	  ○ accumulators
	  ○ hydrostatic transmissions
	  ○ pneumatic circuit design
	  ○ hydraulic circuit design
	• test equipment and testing procedure
	• establishing a maintenance schedule for the system

Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- system components, testing equipment, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23938**
Unit title	**Design rotating mechanical machines**
Application	This unit describes the performance outcomes, knowledge and skills required to design rotating machines, using catalogued mechanical components and standard machine parts and assemblies The unit applies to a person working at paraprofessional level in an industrial engineering workplace where mechanical machine designs are developed to produce goods or services. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.	
1	Interpret design requirements for a rotating machine	1.1	Machine design task is determined through requests, work orders or equivalent and clarified with the appropriate personnel
		1.2	Mechanical variables which will affect the design are analysed
		1.3	Expert advice is sought with respect to the design task and according to workplace procedures, where appropriate
2	Select mechanical machine components	2.1	OHS/WHS requirements for carrying out the work are followed
		2.2	Machine components are selected from applicable reference documents to meet the

			design specification, calculations and to satisfy cost and reliability requirements
		2.3	Component sizes and tolerances are calculated using standard formulas and standard (tabulated) component data
		2.4	Mechanical measurements and calculations are performed and interpreted correctly
3	Design mechanical machine	3.1	OHS/WHS requirements for carrying out the work are followed
		3.2	Resources and equipment for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
		3.3	Principles of mechanical drive systems and standard machine design are applied to the design task
		3.4	Feasibility of proposed design is determined based on calculations and relevant diagrams/drawings
		3.5	Machine design is prepared using relevant calculations
		3.6	Machine design is optimised within design parameters, using relevant calculations
		3.7	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
4	Document machine design	4.1	OHS/WHS requirements for carrying out the work are followed
		4.2	Design documentation and reports are prepared with all relevant design information
		4.3	Final design specifications are established and agreed on with appropriate personnel
		4.4	Work completion is notified according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• perform measurements and calculations
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices including the use of risk control measures
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit Mapping Information

Code and Title Current Version	Code and Title Previous Version	Comments
VU23938 Design rotating mechanical machines	VU22539 Design mechanical machines	Equivalent

Assessment Requirements Template

Title

Assessment Requirements for VU23938 - Design rotating mechanical machines

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- interpret design requirements for a rotating machine and develop a design solution using catalogued mechanical components and standard machine parts on at least two (2) occasions each for a different requirement.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- design factors including:
  - basic principles of strength analysis
  - tensile, shear/torsional and bending strength
  - drive shaft materials for given conditions
  - fatigue, shock, stress raisers and endurance
  - types of stress
  - spline and pin sizes and formulae
  - fatigue failure theory
  - factor of safety
  - fits and tolerances
  - Australian Standards
  - material specifications
  - drawing requirements
- shaft types including:
  - circular and non-circular
  - keyed
  - flanged
  - crank webbed
  - hollow
  - pinned shafts
  - shafts with flats
  - splined shafts
  - square and rectangular
  - hollow circular and thin walled

- keyed and other stress-raised shafts
- calculations and formulae including:
  - standard formulae to determine loading of shaft systems
  - fatigue figure analysis
  - stress formulae
  - spline and pin formulae
  - formulae to determine standard and irregular shaft sizes
  - force analysis
  - formulae to analyse drive suitability
  - formulae to determine axial and bending forces
- design documentation including:
  - document types
  - components and elements of design documents
  - sequence and structure of information
  - use of tables graphs and charts
  - style and language
  - report terminology
- design skills including:
  - manual and/or CAD drawing and drafting
  - AS 1100 parts 1 -10
  - design aids
  - reference manuals and other documentation
  - mechanical formulae, calculations and measurement within the scope of this unit
  - engineering materials.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant CAD equipment, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals/catalogues.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23939**
Unit title	**Apply processes of advanced metrology in manufacturing**
Application	This unit describes the performance outcomes, knowledge and skills required to apply principles of advanced metrology for large-scale production runs of products during and after fabrication. It requires the ability to process variables such as effects and control of tolerances, precise angular measurements, measurements of complex forms such as screw threads, gears and cams, selecting measurement instruments and the application of statistics to the measurement and production process. The unit applies to a person working at paraprofessional level in an industrial manufacturing workplace where mechanical machine design is used to produce goods or services. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Set up advanced metrology process	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are determined
	1.2 Established OHS/WHS 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	Advanced metrology task is determined from documentation or reports and discussed with appropriate personnel
		1.5	Appropriate advanced metrology technique, measuring equipment and process are selected according to requirements and workplace procedures
		1.6	Appropriate personnel are consulted to ensure that the work is co-ordinated effectively with others involved at the workplace
		1.7	Resources for metrology process are obtained in accordance with workplace procedures
		1.8	Equipment is checked for correct operation, safety and calibrated, where required
2	Apply advanced metrology process	2.1	OHS/WHS requirements for carrying out the work are followed
		2.2	Environmental conditions for the advanced metrology process are checked and controlled
		2.3	Dimensional effects of non-standard tolerances are calculated and taken into consideration
		2.4	Complex measurements are conducted to the accuracy required using appropriate techniques and results recorded
		2.5	Uncertainty of complex measurements are assessed and recorded
		2.6	Statistical and uncertainty calculations are carried out, where required
		2.7	Decisions and methods of dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
3	Evaluate advanced metrology process for quality control	3.1	OHS/WHS requirements for completing the work are followed
		3.2	Complex measurement results are analysed, interpreted and assessed against specifications and/or standards

3.3	Process production viability is determined from the data obtained
3.4	Metrology journal entries are made covering equipment, method, set up in accordance with workplace procedures
3.5	Recommendations are made with respect to inspected production process
3.6	Advanced metrology process is documented and appropriate personnel are notified in accordance with workplace procedures

Range of conditions

Metrology process includes requirements to:

- assess specifications for:
  - straightness and flatness
  - squareness and angularity
  - taper and angularity
  - roundness and concentricity
  - surface texture
  - limit gauge systems

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret texts, drawings, specifications, standards and other applicable reference documents
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• calibrate and set up complex measuring equipment

	• calculate statistics and uncertainties of measurements
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices including the use of risk control measures
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23939 Apply processes of advanced metrology in manufacturing	VU22572 Apply principles of advanced metrology in manufacturing	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23939 - Apply processes of advanced metrology in manufacturing

Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:
	• demonstrate a range of advanced metrology processes in two (2) different contexts and present a final report that includes:
	  ○ details of the processes used
	  ○ assumptions made
	  ○ control and environmental measures taken
	  ○ the assessment of results obtained
	  ○ statistical and error calculations
	  ○ recommendations with respect to the inspected manufacturing process.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• standards and their traceability
	• advanced measuring equipment calibrations
	• accuracy, precision, error
	• minimising errors
	• distribution statistics
	• calculation of uncertainties
	• tolerances and specifications
	• types of advanced measurement equipment
	• precise measurement of:
	  ○ angles
	  ○ gauges
	  ○ diameter and length
	  ○ screw threads
	  ○ gears
	  ○ cams.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant advanced measuring equipment, machines, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23921**
Unit title	**Utilise digital electronics for control applications**
Application	This unit describes performance outcomes, knowledge and skills required to utilise 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 included. The unit applies to a person working at paraprofessional level in an industrial engineering/manufacturing enterprise where digital electronics is used to control a wide variety of processes. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Prepare application of digital electronic to control task	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are determined 1.2 Established OHS/WHS 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
		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	OHS/WHS requirements for carrying out the work are followed
		2.2	Equipment/machines/plant are checked as being isolated, where necessary, in strict accordance with OHS/WHS requirements
		2.3	Digital control task is carried out in accordance with requirements to specifications and according to workplace procedures
		2.4	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
3	Complete and document digital control task	3.1	Work site is made safe in accordance with established safety procedures
		3.2	Digital control work is tested for correct operation within given specifications and workplace procedures
		3.3	Digital control task is documented and completion reported to appropriate personnel

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret and evaluate documentation, specifications, manufacturers' manuals and drawings
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• address technical contingencies and risks associated with control applications including troubleshooting digital circuits
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices including the use of digital electronics risk control measures
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23921 Utilise digital electronics for control applications	VU21176 Utilise digital electronics for control applications	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23921 - Utilise digital electronics for control applications

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- utilise digital electronics on at least two (2) applications each in a different simple control of engineering and/or manufacturing process.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- 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.

Assessment Conditions

Assessment should be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- Relevant production processes, digital equipment, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23940**
Unit title	**Use advanced 2D and 3D computer aided drafting (CAD) techniques**
Application	This unit describes the performance outcomes, knowledge and skills required to use computer aided drafting (CAD) techniques to prepare complex 2D and 3D representations of products or components for engineering applications. It requires the ability to create 2D and 3D views, apply solid modelling and rendering techniques, manipulate shapes, movement through space, edit, manage files and produce hardcopy output. The unit applies to a person working at paraprofessional level in an engineering design environment using a CAD system to produce images of products and component parts. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Prepare for drawing tasks	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements for a given work area are determined
	1.2 Drawing task including purpose, scope, and presentation requirements are confirmed with appropriate personnel
	1.3 Resources and equipment needed for the drawing task are obtained in accordance with workplace procedures and checked for correct operation

2	Perform drawing tasks	2.1	Drawing tasks are carried out to industry standards and in accordance with workplace procedures
		2.2	Key features of the CAD package are fully exploited to obtain optimum outcomes
		2.3	Decisions and methods for dealing with unexpected situations are made from discussions with appropriate personnel and drawing tasks requirements
		2.4	Editing function is used to facilitate modification of geometric shapes in completion of a 3D view
3	Save files and complete drawing task	3.1	Hard copy of final drawings are printed and reviewed
		3.2	Drawing files are saved in various formats for retrieval and use in CAD system or other application software
		3.3	Equipment is shut down according to workplace procedures
		3.4	Drawing task is documented and appropriate personnel notified in accordance with workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Oral communication skills to:	• consult and coordinate drawing task with other relevant personnel

Problem-solving skills to:	• address technical contingencies and risks
Planning and organising skills to:	• incorporate OHS/WHS procedures and practices in operational activity
Technology skills to:	• set up and use a CAD system to prepare complex 2D and 3D images

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23940 Use advanced 2D and 3D computer aided drafting (CAD) techniques	VU22542 Use advanced 2D and 3D computer aided drafting (CAD) techniques	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23940 - Use advanced 2D and 3D computer aided drafting (CAD) techniques

Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:
	• use CAD to prepare complex 2D and 3D images of two (2) products or parts which demonstrate the application of the techniques:
	  ○ editing
	  ○ manipulations of shapes
	  ○ creation of views
	  ○ movement through space
	  ○ region and solid modelling techniques
	  ○ rendering
	  ○ producing hard copy output and
	  ○ saving files in other formats to enable retrieval in other software applications.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• designing applications:
	  ○ areas, perimeters, volumes, angles, starting, ending, other controlling points
	• use of commercial programs:
	  ○ editing, file manipulation, design drafting
	  ○ inbuilt design and data handling
	  ○ spreadsheets, bill of material, data base, programming languages
	• manipulation of shapes:
	  ○ complex lines and arcs, splines, special single entity multiple lines, unique involute profiles, Archimedean profiles
	• multiple 3D views:
	  ○ setting up the environment on screen, top view, front and side views, 3D views
	• movement through space:
	  ○ drawing on any created views, relocating coordinate system as necessary

- creation of views:
    - creation of 3D complex views by manipulation of drawing planes and location of geometric shapes
- editing:
    - use of function to facilitate modification of geometric shapes in completion of a 3D view
- display of 3D view:
    - wire line, solid face, isometric, perspective, orthographic
- saving:
    - use of assembly drawing file for plotting
- theory of the terminology associated with modelling:
    - region modelling, solids modelling, wire frame as opposed to solids
- region modelling techniques:
    - creating a region primitive, editing regions
    - extracting area properties from region models
- solid modelling techniques:
    - creating solid primitives
    - editing solid primitives
    - converting region models to solid models
    - creating composite regions
    - creating composite solids
    - sectioned models
    - cutting plane and cross hatching
- rendering types and preferences
- rendering techniques and surface finish options

Assessment Conditions

Assessment should be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- CAD software and hardware materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23951**
Unit title	**Produce geometric designs for roads**
Application	This unit describes the performance outcomes, knowledge and skills required to produce geometric designs of both rural and urban roads in accordance with the relevant parts of Austroads Guide to Road Design (AGRD) series. It requires the ability to apply the design features of intersections, horizontal and vertical alignment of roadway centrelines, superelevation and sight distance requirements and environmental considerations. This unit applies to a person working as part of a project team at paraprofessional level in a civil engineering environment where design of rural and urban roads are developed. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify roadway requirements to be designed	1.1 Established occupational health and safety/workplace health and safety (OHS/WHS) requirements and risk control measures and procedures are followed in preparation of the work area
	1.2 Design brief and relevant documentation is sought and examined
	1.3 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved with the project

		1.4	Resources and equipment needed for the task are obtained in accordance with workplace procedures.
2	Design and calculate the combined horizontal and vertical alignment of a roadway centreline	2.1	Tabulated data is extracted and a typical cross section plan is developed.
		2.2	Data required to detail the combined horizontal and vertical alignment of the road centreline is calculated
		2.3	Data required to detail the left/right pavement edge levels is calculated
		2.4	Data required to detail the left/right shoulder point levels is calculated
		2.5	Data is recorded in table form and applied to the design
3	Develop superelevation requirements	3.1	Position/s of the superelevation are determined
		3.2	Lengths of superelevation are determined
		3.3	Maximum, minimum and relative grade of the superelevation are calculated
		3.4	Curve and adverse cross fall requirements are calculated
		3.5	Overland water flows and underground drainage systems are incorporated into the design
4	Implement sight distance requirements	4.1	Stopping sight distances requirements are calculated
		4.2	Approach and overtaking and other related sight distances are calculated
		4.3	Data is recorded in table form and applied to the design
5	Design intersections	5.1	Traffic volumes and traffic analysis data is utilised to determine intersection type and configuration
		5.2	Turning templates are applied and functional layout is developed for the intersection
		5.3	Intersection sight distances criteria are applied
		5.4	Data required to horizontally and vertically define the intersection is calculated

		5.5	Pavements are correctly contoured
		5.6	Design and specifications are detailed on required road design drawings
6	Determine environment considerations	6.1	Nature strip and landscaping requirements are established
		6.2	High level roadside infrastructure such as fencing and signage are determined
		6.3	Environment zones and culture heritage conservation areas are identified
		6.4	Appropriate noise attenuation systems for the environment are determined
		6.5	Requirements for public transport operations and other road user needs such as cyclist lanes and pedestrian crossings, walkways and special needs are determined
		6.6	Roadside and pavement drainage requirements are determined
		6.7	Type and placement of safety barriers is determined
7	Complete and present final design drawings, specifications and design report	7.1	Design drawings and specifications are completed
		7.2	Design report is prepared highlighting the key features of the design as well as any areas where specific design criteria within the brief could not be achieved
		7.3	Design is reviewed against project brief and in conjunction with appropriate personnel and amendments completed if required
		7.4	Final design drawings, specifications and report are signed off by appropriate person/s and archive according to workplace procedure

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation, documentation specifications and drawings
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• source the appropriate resources and equipment to undertake design tasks
Technology skills to:	• operate CAD and data management software

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23951 Produce geometric designs for roads	VU22560 Produce geometric designs for roads	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23951 - Produce geometric designs for roads
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • develop at least one (1) urban road design and at least one (1) geometric rural road design to meet the requirements of a design brief, relevant parts of the Austroads Guide to Road Design (AGRD) Series and Department of Transport & Planning supplements.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• geometric design introduction including:
	  ○ objectives of geometric design
	  ○ road safety including safe system principles
	  ○ International Road Assessment Program (IRAP) and Australian Road Assessment Program (AusRAP) version of the International Road Assessment Program
	  ○ critical factors influencing design, design parameters including traffic volumes, composition and level of service
	  ○ Normal Design Domain (NDD) / Extended Design Domain (EDD) including Context Sensitive Design (CSD)
	  ○ design speed and operating speed including speed parameters and 85th percentile speed (Operating Speed)
	  ○ alignment controls
	• environmental considerations, including:
	  ○ environment zones
	  ○ culture heritage conservation areas
	  ○ landscape and urban design,
	  ○ noise considerations
	• road classifications
	  ○ traffic lane widths and road crossfalls
	  ○ access points
	  ○ cross section
	  ○ access points

    - consideration for on road public transport
    - provision for vulnerable road users such as: pedestrians, cyclists, E – scooters
    - Disability Discrimination Act (DDA) access requirement
    - medians
    - shoulders
    - verge
    - batters
    - nature strips (urban environment)
    - roadside drainage consideration, including subsurface drainage (pavement drainage)
    - Network Roadside Risk Intervention Threshold (NRRIT) – roadside risk assessment tool
    - safety barriers (overview)
- sight distance:
    - driver eye height, driver reaction time. Longitudinal deceleration
    - consideration of sight distance in both the horizontal and vertical aspect
- horizontal alignments:
    - design controls
    - design procedure
    - tangents, including deflection angles that do not require curves
    - circular curves
- types of horizontal curves superelevation:
    - design procedure
    - linear method
    - maximum and minimum superelevation
    - length of superelevation
    - rate of rotation
    - relative grade
    - superelevation development lengths
    - positioning of superelevation with and without transitions
    - curve with adverse crossfalls
- aquaplaning
- vertical alignment:
    - design controls
    - design procedure
    - vertical design controls

- maximum and minimum grades
- vertical curves

- coordination of horizontal and vertical alignments
- earthworks considerations:
  - geotechnical considerations
  - material types
  - earthworks balance
  - extraction of quantities
- intersections:
  - overview of intersection types
  - intersection safety and safe system approach
  - design vehicles, design and checking vehicles, turn movements
  - sight distance requirements
  - auxiliary lanes
  - medians and median openings
  - rural and urban intersection treatments

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- suitable CAD system and data management software materials and consumables
- relevant plans, drawings, design requirement briefs instructions
- IRAP - International Road Assessment Program and AusRAP – Australian version of the International Road Assessment Program
- Austroads Guide to Road Design (AGRD) series and Department of Transport & Planning supplements
- Network Roadside Risk Intervention Threshold (NRRIT) – roadside risk assessment tool.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23936**
Unit title	**Produce drawings to enable road construction**
Application	This unit describes the performance outcomes, knowledge and skills required to complete typical road drawings required in the construction of urban and rural roads to comply with the relevant drawing presentation guidelines. It requires the ability to interpret and plot from survey data, plot horizontal alignment, tabulate and plot longitudinal section and cross section information and draw required intersections utilising computer aided drawing (CAD) software. The unit applies to a person working at paraprofessional level in a civil engineering environment where drawings of roads are prepared. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.	
1 Identify road project to be drawn	1.1	Established occupational health and safety/workplace health and safety (OHS/WHS) requirements and risk control measures and procedures are followed in the work area
	1.2	Existing drawings, relevant documentation, work specifications are sought and discussed with appropriate personnel
	1.3	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace
2 Plan drafting approach	2.1	Work specifications and related documentation required for the drawing project is collected and analysed

		2.2	Resources and equipment needed for the work are obtained and set up in accordance with enterprise procedures and checked for correct operation
3	Complete the drawings	3.1	Drafting references and equipment are used according to enterprise procedures
		3.2	Earthworks volumes are calculated and a mass haul diagram is plotted
		3.3	Survey data is interpreted and plotted
		3.4	Horizontal alignment, and longitudinal section information is tabulated and plotted
		3.5	Cross section information is tabulated and plotted
		3.6	Using existing plans, sections and collated details Intersections drawings are prepared
		3.7	Quality assurance checks are carried out in accordance with the checking plan
		3.8	Drawings are completed to comply with the relevant drawing presentation guidelines and enterprise procedures
		3.9	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures
		3.10	Drawings are reviewed with appropriate personnel and against work specifications and amended as required
4	Present and archive final drawings	4.1	File naming conventions, storage and back up processes are followed in accordance with enterprise procedure
		4.2	Drawings are outputted to printer/plotters or issued as PDF files
		4.3	Final drawings are presented and discussed with appropriate personnel in accordance with enterprise procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• calculate earthwork volume for haulage
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23936 Produce drawings to enable road construction	VU22493 Produce drawings to enable urban road construction	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23936 Produce drawings to enable road construction

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- prepare drawings to enable one (1) urban road construction and one (1) rural road construction. In doing so the learner must:
  - comply with job specifications of each road construction brief
  - undertake quality assurance checks in accordance with checking plan
  - comply with drawing conventions and relevant drawing presentation guidelines.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- features of the drawing presentation guidelines.
- survey data:
  - survey traverse - by co-ordinates
  - contours
  - topographical detail
  - cadastral information
  - benchmarks
  - reference pegs/offset pegs
- typical cross sections
- pavement details
- horizontal alignment:
  - features and services
  - service relocations
  - offsets/levels/kerb and channels
  - pavement contours
  - stormwater drainage
  - property access
  - ramped kerb crossings
  - footpaths/driveways
  - medians and traffic islands
  - intersections
  - channelisation

    - auxiliary lanes
    - roundabouts
    - line markings
    - road furniture
    - road-side safety barriers
    - signs
    - signalisation
    - street lighting
    - environmental zones/cultural heritage
    - impacted trees/vegetation
    - access locations for underground/overhead services
- longitudinal section information:
    - datum
    - grades
    - vertical intersection points
    - vertical curves
    - natural surface levels
    - finished surface levels
    - cut and fill data
    - cross drainage details
- cross section information:
    - natural surface
    - finished surface
    - crossfall
    - pavement boxes
    - batters
    - property boundaries
    - footpaths
    - kerb and channel
    - median/traffic islands
    - surfaces
    - road furniture
    - services
    - drainage
    - barriers
    - chainage
    - datum
- intersection drawings:
    - offsets/levels
    - kerb and channels
    - medians
    - traffic islands

- roundabouts
- pavement contours
- pavement markings.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- operational access to computed aided drafting (CAD) equipment and consumables
- relevant drawing presentation guidelines.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23935**
Unit title	**Produce structural steel drawings**
Application	This unit describes the performance outcomes, knowledge and skills required to produce drawings for structural steel elements, in accordance with accepted practice and Australian Standards. It requires the ability to interpret and apply relevant sections of the Australian Standard, and Australian Institute of Steel Construction (AISC) handbook, make calculations, set-up drafting and prepare the drawing/s in line with job specifications. The unit applies to a person working at paraprofessional level in an engineering environment where structural steel drawings are prepared. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/a
Unit Sector	N/a

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify structural steel elements to be drawn	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are determined 1.2 Drawings, relevant documentation, work requirements are identified and discussed with appropriate personnel 1.3 Appropriate project personnel are consulted to ensure the work is co-ordinated effectively with others in the work area 1.4 Resources and drafting equipment needed for the task are obtained in accordance with

			workplace procedures and checked for correct operation
2	Plan drafting approach	2.1	Project specifications and related documentation are analysed and discussed with appropriate personnel
		2.2	Relevant sections of the AISC handbook are analysed and applied and calculations preformed as required
		2.3	Design references and drafting equipment are set up to complete the drawings in accordance with workplace procedures and manufacturer's requirements
3	Complete the drawings	3.1	Drawings of structural steel elements are completed to conform to relevant Australian standard, AISC handbook, building regulations and workplace procedures
		3.2	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and in reference to job specifications and workplace procedures
		3.3	Drawings are reviewed with appropriate personnel against job specifications and amended as required
4	Compile, present and store results	4.1	Drafting references and equipment are maintained and stored in accordance with workplace procedures
		4.2	Drawings are presented to appropriate personnel in accordance with enterprise procedures
		4.3	Drawings are stored and archived according to enterprise procedures

Range of conditions

N/A

Foundation Skills

This section describes language, literacy, numeracy and employment skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Writing skills to:	• prepare and update supporting technical documentation
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• perform calculations to determine span, channel and beam sizes etc.
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate OHS/WHS procedures and practices in all workplace activities
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23935 Produce structural steel drawings	VU22490 Produce structural steel drawings	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23935 - Produce structural steel drawings
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • produce drawings of structural steel elements in accordance with job specifications, standard drafting conventions and relevant Australian standard and AISC Handbook on at least two (2) occasions each for a different structural steel requirement.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• steel sections handbooks in the identification of steel members and derivation of dimensions:
	  ○ universal beams
	  ○ taper flange beams
	  ○ universal columns
	  ○ channels (parallel and taper flange)
	  ○ angles (equal and unequal)
	• relevant data from Steel Structures Code AS4100
	• relevant data from the Australian Institute of Steel Construction (AISC) handbook including:
	  ○ geometrical details
	  ○ standard connections
	  ○ basic parameters
	• structural steel line diagrams:
	  ○ plans
	  ○ sections
	  ○ views
	• basic design information to correctly draw, label and dimension structural steel connections employing:
	  ○ details
	  ○ sections
	  ○ views
	  ○ symbols
	  ○ terminology
	  ○ line work

- lettering
- detailing:
  - base plates
  - column/bearer and beam/bearer joints
  - trusses
  - gusset plates
  - girts, purlins and bracing
- application:
  - centre of gravity lines
  - gauge lines
  - edge distances
  - bolt pitches
  - hole sizes
- detailing weld types and requirements for field and site welding:
  - fillet welds
  - butt welds
- specifications of appropriate protective coatings:
  - organic
  - inorganic
  - galvanised
- member lengths
- member marker system.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant machines, tools, materials and consumables
- relevant Australian Standards, AISC Handbook plans, drawings and job requirements.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23922**
Unit title	**Apply fluid mechanic principles in mechanical engineering**
Application	This unit describes the performance outcomes, knowledge and skills required to apply fluid mechanic principles in mechanical engineering. It requires the ability to use the principles of fluids and includes fluid components, fluid status, fluid flow, fluid power and forces developed by fluid flow. The unit also includes calculations to determine changes and forces, fluid flow and head loss in pipes and through open channels and to determine operational aspects of a pump in a system The unit applies to a person working at paraprofessional level in an industrial engineering environment where the application of fluid power is used to produce goods or services. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/a
Unit Sector	N/a

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. Assessment of performance is to be consistent with the assessment requirements.
1 Determine the application of fluid mechanic principles to engineering problems	1.1 Occupational health and safety/work health and safety (OHS/WHS) and environmental requirements for a given work area are clarified and followed 1.2 Safety hazards, which have not previously been identified, are documented and risk control measures devised and implemented in consultation with appropriate personnel 1.3 Engineering problem/s to be solved using fluid mechanic principles is determined from job instructions and discussions with

			appropriate personnel
		1.4	Specifications for the solution are drawn up and approved by the appropriate personnel
		1.5	Expert advice is sought with respect to the solution and in accordance with workplace procedures
		1.6	Resources and equipment needed for the task are obtained in accordance with workplace procedures
2	Apply fluid mechanic principles to the solution of engineering problems	2.1	Relevant OHS/WHS requirements for carrying out the work are followed
		2.2	Solution options are developed and evaluated and the most appropriate solution is chosen
		2.3	Appropriate computations are carried out to ensure that the solution meets the job's specifications
		2.4	Fluid mechanic system is sketched to specification
		2.5	Potential risks with respect to the application are analysed and management strategies are recommended to appropriate personnel
3	Review and validate the solution	3.1	Solution is reviewed with the appropriate personnel
		3.2	Fluid system is documented and approved by the appropriate personnel

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• Interpret job instructions and technical documentation
Oral communication skills to:	• relay information to team members using appropriate language

Numeracy skills to:	• carry out computations using fluid power principles
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications

Unit mapping

Code and title Current version	**Code and Title Previous version**	**Comments**
VU23922 Apply fluid mechanic principles in mechanical engineering	VU22479 Apply fluid mechanic principles in mechanical engineering	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23922 - Apply fluid mechanic principles in mechanical engineering

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- apply fluid mechanic principles to provide solutions to common engineering problems on at least three (3) occasions each in a different context

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- basic properties of fluids:
  - description of a fluid and the difference between solids and fluids, liquids and gases, hydraulics and pneumatics
  - chemical properties, reaction with metals, corrosiveness, flammability, toxicity, pollution and environmental effects
  - dissolves gases and particles in liquids (slurries)
  - foaming of liquids
  - vapour pressure of a liquid - saturation vapour pressure
  - temperature and pressure effects on the basic properties
  - ideal/perfect gases and liquids
  - gas laws for ideal gases
- fluids system components:
  - pipes, channels, tubes and ducts (rigid and flexible)
  - valves
  - filters and strainers for gases and liquids
  - gauges and instruments
  - pipe fittings
  - tanks and vessels
  - nozzles/spray heads
  - flow measurement instruments
  - pumps/compressors, motors/turbines
  - actuators - linear (cylinders) and rotary
  - selection of equipment and instruments considering properties and compatibility
- fluid statics

- pressure at a point, direction of pressure on a surface
- pressure variation with depth in a liquid
- Pascal's Principle
- manometer/piezometer calculations (vertical and inclined)
- forces due to fluid pressure on vertical, horizontal and inclined surfaces
- centre of pressure
- Archimedes Principle - buoyance, flotation, apparent weight and centre of buoyancy
- steady and unsteady flow, streamlines and eddies
- velocity - average or mean and local
- mass and volume flow rate
- conservation of mass leading to the Continuity Equation for fluid flow
- modification of the Continuity Equation for volume flow of liquids or gases with small changes in density
- Bernoulli Equation for ideal fluids, meaning of pressure, velocity and potential head.
- total head
- causes of head loss and modification of the Bernoulli Equation to include a head loss term for real fluids

- fluid power principles:
  - definition and units for work, torque and power
  - relationship between force, velocity and power and torque, angular velocity and power
  - work done by a gas expanding at constant pressure
  - relationship between fluid power, mass flow rate and head
  - relationship between fluid power, volume flow rate and pressure
  - efficiency of a pump or turbine
  - modification of the Bernoulli Equation to include a pump or turbine in the fluid circuit as well as a head loss term
- forces developed by flowing fluids:
  - impulse-momentum equation for fluid flow
  - force developed by a jet striking a stationary plate - perpendicular, inclined or curved
  - force developed by a jet striking a moving plate or blade
  - force developed by a jet striking a series of moving plates or blades
  - forces developed by a fluid flowing in a pipe or duct with changes in direction and/or cross section
- Reynold's Number and flow regime:

- Reynold's Number for fluid flow in a pipe given the flow rate and fluid properties
- characteristics of laminar, turbulent and mixed (transition) flow
- relationship between Reynold's Number and flow regime Upper and Lower Critical Reynold's Number
- non-circular pipes

- head loss in pipes and fittings:
  - Darcy Equation for head loss in a pipe
  - determination of the fraction factor using both Moody Diagram and formula
  - head loss through fittings using K factors
  - head loss through a piping system consisting of a single diameter pipe and a number of fittings
  - system head curve for a piping system consisting of a single diameter pipe and a number of fittings as well as reservoirs or tanks either vented or under pressure or vacuum
- pipe networks:
  - head loss through parallel and series pipes
  - reduction of a simple pipe network consisting of a number of parallel or series pipes to an equivalent single pipe system
- channel flow:
  - Chezy and Manning formula for flow rate through an open channel
  - flow rate given dimensions and inclination
  - optimum shape of section for both fixed and variable flow rates.
- fluid machinery:
  - positive displacement machines pumping systems
  - duty point for a rotodynamic pumping system by combining system head curve with pump performance curve
  - flow, head, power and efficiency at the duty point
  - energy cost of pumping
  - causes and effects of cavitation
  - avoidance of cavitation by attention to inlet system design
  - influence of fluid temperature and pressure on tendency for cavitation.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant machines, tools, materials and consumables

- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23952**
Unit title	**Produce an engineering design for drainage pipes and culverts**
Application	This unit describes the performance outcomes, knowledge and skills required to apply principles of design for drainage pipes and culverts for an urban or rural road using appropriate drainage standards. It requires the ability to apply the basic concepts in engineering hydrology to estimate flood flow magnitude and apply basic culvert and drainage design practices. The unit of competency applies to a person working at paraprofessional level in a civil engineering environment where the design of roads is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify drainage design requirements	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are obtained and interpreted and followed
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel

		1.3	Drainage design requirements are identified from documentation, work requests and/or discussion with appropriate personnel
		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace
2	Access drainage design references	2.1	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation
		2.2	On site reconnaissance to gather surveying data, measurements, photographs and other required information for the drainage design project is completed
		2.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
3	Prepare the design	3.1	Using the concepts in engineering hydrology to estimate flood flow magnitude and relevant Australian standards, a culvert with underground drainage network is developed
		3.2	Design is reviewed with appropriate personnel and amended as required to provide the optimum drainage solution
4	Present and store final design	4.1	File naming conventions, storage and back up processes are followed in accordance with workplace procedure
		4.2	Drawings are outputted to printer/plotters or issued as PDF files
		4.3	Final design is presented to appropriate personnel in accordance with workplace procedures

Range of conditions

The unit includes both desk and fieldwork.

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret task related documentation, relevant data, job instructions, drawings and OHS/WHS procedures
Writing skills to:	• prepare technical documentation and reports
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• make computations and analyse data
Learning skills to:	• assess the nature and scope of the project and identify priorities and procedures within timeframes
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• co-ordinate design inputs and design resources
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23952 Produce an engineering design for drainage pipes and culverts	VU22547 Produce an engineering design for drainage pipes and culverts	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23952 - Produce an engineering design for drainage pipes and culverts
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must on at least two (2) occasions each in a different location: • carry out an on-site reconnaissance and gather required data and information for the design of a culvert and drainage system • design a culvert and drainage system solution to meet specific requirements for each location. One of the two designs is to include an underground stormwater system.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• hydrological cycle including:
	  ○ historic rainfall data
	• meteorology including:
	  ○ elements
	  ○ meteorology measuring gauge results to be recorded and graphed, over the period of duration of the module
	• rain gauging including:
	  ○ mass curve and hydrograph
	  ○ intensity
	• stream flow including:
	  ○ factors affecting run-off
	  ○ stream flow components
	  ○ stream flow monitoring equipment
	  ○ flood hydrograph
	  ○ use of flood hydrograph software
	  ○ stage discharge
	• flood estimation including:
	  ○ factors affecting (rainfall, catchment)
	  ○ peak flow
	  ○ run-off hydrograph
	  ○ flood routing

- flood frequency analysis
- retarding basin
- channel flow regulation (irrigation)
- reservoir storage
- erosion control (systems)

- data collection including:
  - terminology associated with drainage design
- development of a logical plan of action in approaching design task
- the information required to undertake design including:
  - topographic and base maps, cadastral plans, subdivision plans
  - aerial photographs
  - flood flow, flood level data rainfall data
  - rainfall intensity/ frequency/ duration curves
  - rainfall coefficients
  - drainage design charts, pipes, channels and pits
  - data related to runoff, soil types, geology, stream
  - pattern, vegetation, land use
  - existing drainage lines, outfalls, channels, water-courses, existing drainage locations and levels
  - location and levels of other services
  - sources for the design data
- major and minor floods including:
  - storm event ranking frequency and annual exceedance probability (AEP)
  - review the Water Cycle
  - Identify factors increasing and decreasing run-off
  - show relationship between flood magnitude
  - definition of minor, major, rare and extreme floods
  - level of public protection afforded by minor and major flood control design
- control measures for floods of greater magnitude including:
  - roadway reserves, flood-ways in footways and reserves
  - retention, detention and retardation techniques
- rational method for design of peak discharge including:
  - theory of method based on completely impervious catchment and continuity of flow
  - rational method formula and define terms
  - direct relationship between discharge area
  - coefficient of runoff and equivalent area

    - formula in terms of above for litres and cubic metres/second
    - relationship between intensity, frequency and duration
    - peak discharge occurs when design storm duration equals time of flow from most remote point
- calculation of design discharge from single use catchment given the area, runoff coefficient and time of concentration:
    - intensity/ frequency/ duration for design
- weighted coefficient of runoff for a multi-use catchment
- the design discharge from multi-use catchment given areas, coefficient and time of concentration:
    - equivalent areas making up the catchment area can be summed to give total area weighted coefficient.
- coefficient of run off based on percentage of impervious area
- rural catchment areas including:
    - state data required for design
    - the topographic plan - ridges, valleys, watercourses
    - properties of contours
    - e catchment boundaries along ridge lines
    - trace boundary from outlet to ridge line by crossing contours at right angles
    - calculation of design discharge:
    - selection of appropriate recurrence interval
    - determination of intensity from adopted Tc
    - calculation of discharge using adopted Cr and area
    - comparison with streamflow flood records if available
- culvert design including:
    - design data - roadway and stream at site
    - determination of depth and velocity of discharge flow in natural waterway
    - derivation of tail water depth
    - selection of culvert slope compatible with site conditions
    - determination of culvert length through embankment
    - setting of allowable headwater depth - U/S water level
    - establishment of freeboard requirement
    - trial culvert type and cover requirements
    - critical depth of flow
    - use of the Austroads Guide to Road Design (AGRD) Part 5 procedure and design charts to establish maximum headwater level
    - headwater level, cover, outlet velocity for acceptability

- modification of culvert trail size and recompute as required
- design data in a form suitable for transfer to working drawings

- determination of flow time in gutters or channels including:
  - minimum times for design
  - roof to gutter time
- determination of time of entry including:
  - overland (roof) time plus channel time to inlet
  - calculation of full area and part area coefficients
  - coefficient of runoff for project
  - determination of full area and part area coefficients for all internal and external land uses contributing to development outlet
- pipe and pipe layout including:
  - location of road drainage lines
  - pit locations (AGRD Part 5A)
  - easement drainage locations
  - catchment areas
  - time of concentration
  - peak discharge calculation
  - pipe design
  - review of pipeline shock losses.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions relevant tools, equipment, materials and consumables
- Australian Rainfall and Runoff (ARR), Austroads Guide to Road Design (AGRD) relevant plans, drawings and instructions.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23953**
Unit title	**Produce an advanced engineering design for a reinforced concrete structure**
Application	This unit describes the performance outcomes, knowledge and skills required to prepare an advanced engineering design for a reinforced concrete structure. It requires the ability to analyse and design complex flexural reinforced concrete members from first principles, using appropriate design aids. The unit of competency applies to a person working at paraprofessional level in a civil engineering environment where the design of reinforced concrete structures is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify reinforced concrete structure to be designed	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) and environmental requirements for a given work area are determined and 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 Design requirements are identified from documentation, work requests or discussions with appropriate personnel

		1.5	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace
		1.6	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan design approach	2.1	Documentation relating to design project is collected and analysed
		2.2	Appropriate engineering design calculations are performed to meet the requirements of the structure
3	Complete the design	3.1	Using relevant Australian standards and references the design of the reinforced concrete structure is developed to meet the requirements of the work brief
		3.2	Design references and equipment are used, according to relevant standards, manufacturer's manuals and workplace procedures
		3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
		3.4	Design is reviewed with appropriate personnel and amended as required to provide the optimum structure
4	Present and store final design	4.1	Final design of the reinforced concrete structure is presented to appropriate personnel in accordance with workplace procedures
		4.2	Results are stored and archived according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret task related documentation, specifications, drawings and OHS/WHS procedures
Writing skills to:	• prepare technical documentation and reports
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• perform engineering design calculations
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• source appropriate resources and equipment to undertake design task
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23953 Produce an advanced engineering design for a reinforced concrete structure	VU22543 Produce an advanced engineering design for a reinforced concrete structure	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23953 - Produce an advanced engineering design for a reinforced concrete structure
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • complete an engineering project including the analysis and design of an advanced flexural reinforced concrete members of a concrete structure using appropriate design aids on at least two (2) occasions each in a different context.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• serviceability deem-to-comply conditions for:
	  ○ rectangular beams
	  ○ one-way slabs
	  ○ two-way slaps
	• simplified deflection calculation
	• design of two-way rectangular slabs
	• arrangement of reinforcement
	• design of reinforced strip and axially loaded pad footings for:
	  ○ bending
	  ○ bending shear
	  ○ punching shear
	• selection of starter bars
	• constructability of reinforcement placement
	• design of unreinforced footings
	• design of loaded short stubby column using:
	  ○ rectangular sections reinforced on two faces
	  ○ rectangular sections reinforced on four faces
	  ○ circular section.

Assessment Conditions	Assessment should be conducted in a workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy and work procedures and instructions

- relevant machines, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23954**
Unit title	**Produce an engineering design for a sewerage reticulation scheme**
Application	This unit describes the performance outcomes, knowledge and skills required to apply principles of engineering design for a sewerage reticulation scheme using appropriate design standards. It requires the ability to conduct an on-site reconnaissance to gather survey data, apply hydrology principles, sewerage reticulation design procedures and use relevant charts from drainage design manual. The unit applies to a person working at paraprofessional level in a civil engineering environment responsible for the development of sewerage reticulation design solutions. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify sewerage reticulation scheme to be designed	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are determined and followed
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel
	1.3 Design requirements are identified from documentation, job brief and discussions with appropriate personnel

		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site
		1.5	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan design approach	2.1	On site reconnaissance to gather surveying data, measurements, photographs and other required information for the design project is carried out
		2.2	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
		2.3	Design references are consulted and required documentation is collated for the design task in accordance with workplace procedures
		2.4	Computer aided design (CAD) software and drafting system is set up according to operating procedure
3	Develop the design	3.1	Design solution for the sewerage reticulation scheme is prepared to conform to relevant Australian standards and regulations to meet the job brief
		3.2	Completed design is reviewed with appropriate personnel and amended as required to provide optimum solution
4	Present design solution and store equipment	4.1	Design solution is presented and discussed with appropriate personnel
		4.2	Design references and equipment are maintained and stored in accordance with workplace procedures

Range of conditions

This unit includes both desk and field work

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret task related documentation, relevant data, job instructions, drawings and OHS/WHS procedures
Writing skills to:	• prepare technical reports and workplace documentation
Oral communication skills to:	• relay information to team members using appropriate language for the audience
Numeracy skills to:	• analyse data and make computations
Learning skills to:	• assess the nature and scope of the brief and identify priorities and procedures within timeframes
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• set up and use design aids

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23954 Produce an engineering design for a sewerage reticulation scheme	VU22549 Produce an engineering design for a sewerage reticulation scheme	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23954 - Produce an engineering design for a sewerage reticulation scheme
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • carry out an on-site reconnaissance and gather required data and information for two (2) proposed sewerage reticulation schemes • apply principles of design for an engineering sewerage reticulation scheme in accordance with appropriate design standards and design brief on at least two (2) occasions.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• instrumentalities:
	  ○ list of Authorities including agencies
	  ○ sewerage reticulation
	  ○ sewerage treatment
	  ○ roles, jurisdiction and statutory powers of the above
	• job brief:
	  ○ data required for design and specification
	  ○ topographic detail
	  ○ soil conditions
	  ○ underground services
	  ○ easements
	  ○ obstructions
	• horizontal alignment:
	  ○ standard practice and factors affecting location of sewers
	  ○ along streets/rear of properties
	  ○ along easements
	  ○ other services
	  ○ curved sewers
	  ○ access
	• sewerage authority drawings:
	  ○ existing mains
	  ○ existing sewerage pipes

- standard symbols for all features

- vertical alignment:
  - allotment categories
  - allotment controls
  - area to be controlled
  - control surface level
  - minimum depths
  - minimum grades
  - boundary trap
- fixing of vertical alignment:
  - minimum depth and clearance from other services
  - fixture controls
  - property branch sewers
  - invert level (IL) of end fitting
  - access chambers, inspection shafts, pipeline ends
  - final invert levels, grades surface levels, chainages, type of pipes
- working drawings:
  - plan and longitudinal sections
  - use of standard symbols
- testing:
  - initial test (air test)
  - acceptance test
  - visual inspection
  - exfiltration test
  - maintenance tests
  - TV inspection
  - infiltration
- septic tanks:
  - principles of treatment methods
  - components of a septic tank
  - design according to the Septic Tank Code
- package plants:
  - role of the package treatment plant
  - permanent facility
  - temporary element in a larger scheme
  - principle of operation
  - commercial availability

- sizes v. community population

- small treatment plants:
  - the need for treatment
  - function of the elements
  - design for 500 people
  - loading rates
  - disinfection
  - sludge disposal
  - location/security
  - sketch of layout.

Assessment Conditions

Assessment should be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant design aids and equipment, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23955**
Unit title	**Apply principles of mechanics to engineering structures**
Application	This unit describes the performance outcomes, knowledge and skills required to perform analysis concerned with the mechanical properties of materials as they relate to problems of strength and stability of mechanical structures. It requires the ability to calculate different kinds of loading on structural elements. This unit of competency applies to a person working at paraprofessional level in a structural/civil engineering environment where analysis of structures is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Establish mechanical properties of materials for engineering structures	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) and environmental requirements for a given work area are determined and followed
	1.2 Mechanical properties of materials are identified from documentation, work requests or discussions with appropriate personnel
	1.3 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site

		1.4	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan approach to analyse the properties of materials	2.1	Documentation relating to the material properties is collected and analysed
		2.2	Design references are utilised to assist with the analysis and to conform to Australian standards, manufacturer manuals, in accordance with workplace procedures
		2.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel and workplace procedures
3	Complete the analysis	3.1	Design references are used according to relevant Australian standards and manufacturer manuals
		3.2	Calculations are performed where required to determine loading on structural elements
		3.3	Analysis of mechanical properties of materials as they relate to the strength and stability of mechanical structures is completed
		3.4	Analysis is reviewed with appropriate personal and amended if required to provide optimum results
		3.4	Results are recorded and applied according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation and work-related instructions
Writing skills to:	• prepare workplace documentation
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• analyse problems related to the strength and stability of engineering structures
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23955 Apply principles of mechanics to engineering structures	VU22546 Apply principles of mechanics to engineering structures	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23955 - Apply principles of mechanics to engineering structures
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria foundation skills in this unit. In doing so the learner must: • perform analyses concerned with the mechanical properties of materials on three (3) occasions each in a different context.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• load analysis:
	  ○ relationship between dead load and live load
	  ○ the significance of wind load and the factors affecting wind load
	  ○ the variation of load due to liquid pressure with wind load
	  ○ the common terms used in the Standard
	  ○ calculation of dead load using the values of density given in the Standard
	  ○ selection of appropriate value of live load from the Standard
	  ○ combined effect of dead load and live load on a structural element
	  ○ definition of different terms in the Standard
	  ○ effects of internal pressure and external pressure
	  ○ calculation of wind load using the simplified procedure
	  ○ consideration of worse possible case
	  ○ variation of pressure due to fluid
	  ○ resultant force and the line of action of the resultant moment created
	  ○ modes of failure
	• properties of materials:
	  ○ stress and strain
	  ○ allowable stress
	• centrally loaded connections:
	  ○ bolted connections
	  ○ shear, tensile and bearing stresses
	  ○ centrally loaded welded connections

    - fillet and butt welds
    - modes of weld failure
    - size and length of welds
    - punching of plates
- thin walled pressure vessels:
    - define thin wall
    - longitudinal stress
    - hoop stress
- properties of plane figures:
    - first moment of area
    - second moment of area
- simple beams (point and distributed loads):
    - shear force diagrams
    - bending moment diagrams
    - bending stress
    - deflection by formula
- torsional stress:
    - torque diagrams
    - angle of twist
    - torsional shear stress
- thermal stress:
    - coefficient of linear expansion
    - thermal stresses in single members
- advanced properties of materials:
- stress and strain energy:
    - strain energy
    - resilience
    - impact loads
- bending and shear in beams:
    - further SF and BM diagrams
    - axial bending stress in beams
    - curvature and bending moment
    - shear stress in beams
    - shear stress formula
    - distribution of shear stress over section
    - shear flow
- combined stresses:

- combined axial and bending stress
- combined axial and pressure stress
- combined bending and torsional stress
- combined bending and shear stress
- principle stress
- Mohr's Circle

- buckling of columns:
  - effective length of columns
  - slenderness ratio
  - failure criteria
- beam deflection:
  - Macaulay's method
  - moment area method.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant tools, materials and consumables
- relevant plans, drawings and instructions Australian standards and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23956**
Unit title	**Apply principles of soil mechanics to civil engineering**
Application	This unit describes the performance outcomes, skills and knowledge required to take representative soil samples and carry out standard tests to evaluate and classify soils in accordance with relevant Australian standards and guidelines It requires the ability to plan soil testing activities, take representative soil samples, set up, calibrate and operate testing equipment, perform tests, analyse test results and classify soils in accordance relevant Australian standard. The unit of competency applies to a person working at paraprofessional level in a civil engineering environment where sampling and classification of soils by standard testing procedures are performed. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	MEM23004 – Apply technical mathematics
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify soils to be tested and analysed	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are obtained and followed
	1.2 Relevant documentation, and work requests are discussed with appropriate personnel

		1.3	Resources needed for the task are obtained in accordance with workplace procedures
2	Plan tests and set up equipment	2.1	Required tests are confirmed against job instructions
		2.2	Representative soil/s sample/s are collected and prepared for testing in accordance Australian standard and workplace procedures
		2.3	Testing equipment is checked for calibration and conformance to relevant Australian standard
		2.4	If appropriate, the origin of the soils to be tested is identified and recorded
3	Conduct test and analyse results	3.1	OHS/WHS requirements for operating testing equipment are followed
		3.2	Tests are conducted according to job requirements relevant Australian standard, guidelines and workplace procedures
		3.3	Tests equipment is operated in accordance with manufacturer requirements
		3.4	Test results are analysed and soil samples classified in accordance with Australian standard, guidelines and workplace procedures
4	Document and report results	4.1	Test results are recorded and reported according to workplace procedures
		4.2	Results are stored and archived according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare technical and workplace documentation relating to soil testing
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23956 Apply principles of soil mechanics to civil engineering	VU22562 Apply principles of soil mechanics to civil engineering	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23956 - Apply principles of soil mechanics to civil engineering
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • take soil samples from four (4) different locations, and carry out testing processes • analyse test results and classify soil samples from each location in accordance with the appropriate Australian standard and guidelines.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• origin and the process of soil formations
	• soil parameters and classification of soil:
	  ○ soil particle density test
	  ○ Atterberg limits test
	  ○ sieve analysis test
	  ○ linear shrinkage and moisture content tests
	• mass volume relationship of soil
	• properties of soil:
	  ○ compaction test
	  ○ shear strength test
	  ○ permeability test
	  ○ swell tests
	  ○ California bearing ratio (CBR) test
	• consolidation of fine grained soils
	• soil stabilisation and related parameters
	• Australian Standard – Soil testing series AS1289

Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy and work procedures and instructions • soil sampling and testing equipment, materials and consumables • soil samples from four (4) different locations • relevant plans, instructions, Australian standard, guidelines specifications/manuals and workplace procedures.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23957**
Unit title	**Produce an engineering design for a reinforced concrete structure**
Application	This unit of competency describes the performance outcomes, knowledge and skills required to produce a design for a flexural reinforced concrete structure consistent with requirements of a project brief. It required the ability to apply relevant design principles and aids to develop flexural reinforced concrete structures such as suspended slabs, beams, columns and footings. The unit applies to a person working at paraprofessional level in a civil engineering environment where design of reinforced concrete structures is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify reinforced concrete structure to be designed	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are determined and followed
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel

		1.3	Design requirements for the reinforced concrete structure are identified from the design brief
		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace
		1.5	Resources and equipment needed for the design are obtained in accordance with workplace procedures
2	Plan design approach	2.1	Documentation relating to design project is collected and analysed
		2.2	Design brief is reviewed and discuss with relevant personnel
		2.3	Design references are reviewed to plan the design, so it will conform to relevant Australian standards and design principles
3	Complete the design	3.1	Design references and equipment are used according to relevant Australian standards, manufacturer's manuals and workplace procedures
		3.2	The design is completed to conform to relevant Australian and/or local standards or regulations, in accordance with workplace procedures
		3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
		3.4	Design is reviewed with appropriate personnel and amended as required to provide the optimum structure
4	Present and store final design	4.1	Final design of the reinforced concrete structure is presented to appropriate personnel in accordance with workplace procedures
		4.2	Results are stored and archived according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret a design brief and related technical documentation
Writing skills to:	• prepare and update design documentation
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• perform engineering design calculations related to design brief
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23957 Produce an engineering design for a reinforced concrete structure	VU22550 Produce an engineering design for a reinforced concrete structure	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23957 - Produce an engineering design for a reinforced concrete structure
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • design flexural reinforced concrete structure using appropriate design aids which complies to a job brief, relevant Australian standards and building codes on two (2) occasions and in two (2) different contexts.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• loads
	• moments
	• shear forces
	• ultimate strength theory for bending using rectangular stress block
	• moment capacity
	• rectangular beam design from first principles:
	  ○ durability, exposure classifications and minimum concrete cover
	• design aids for rectangular beam design
	• strength equations:
	  ○ for doubly reinforced beams
	  ○ for T-beams and L-beams
	• T-beams and L-beams
	• length for tension and compression reinforcement
	• reinforcement:
	  ○ hooks and cogs
	  ○ curtailment of reinforcement
	  ○ arrangement of reinforcement
	• shear:
	  ○ shear equations
	  ○ design of shear reinforcement
	• shear reinforcement and appropriate design aids.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant design equipment, tools, materials and consumables
- relevant Australian Standards, plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23958**
Unit title	**Analyse and design foundations and footings**
Application	This unit describes the performance outcomes, knowledge and skills required to analyse the requirements and design the foundations and footings of a substantial engineering structure in accordance to a project brief. It requires the ability to calculate stresses in soil mass, determine pile type and underpinnings and prepare sketches and drawings. The unit applies to a person working at paraprofessional level in a civil engineering environment. As a member of a project team, the person is responsible for the design of elements of infrastructure such as buildings or other civil construction projects. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	MEM23004 - Apply technical mathematics
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Determine footings to be designed	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are clarified and followed
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel

		1.3	Foundation and footing requirements are determined from documentation, work requests and/or discussions with appropriate personnel
		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace
2	Plan design approach	2.1	Documentation relating to the design project is collected and analysed
		2.2	Design references and drafting equipment are set up to develop the design in accordance with workplace procedures
3	Complete the design	3.1	Design references and equipment are used according to manufacturer's manuals and workplace procedures
		3.2	Calculations are performed to determine foundations and footing requirements
		3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
		3.4	The design is completed to conform with relevant Australian standard, regulations and building codes
		3.5	Design outcomes are analysed and examined with appropriate personnel and against project design brief and amended as required
4	Present and store final design	4.1	Final foundation and footing design is presented to appropriate personnel
		4.2	Final design is stored and archived according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare workplace and technical documentation
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• calculate stresses in soil and settlements
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate OHS/WHS procedures and practices in all project activities
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23958 Analyse and design foundations and footings	VU22558 Analyse and design foundations and footings	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23958 - Analyse and design foundations and footings
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • complete an engineering project brief including the analysis and design of foundations and footings for a building structure using appropriate design aids and AS 2870 on two (2) occasions and in two (2) different contexts.
Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of: • footings and foundation types • AS2870 ‘Residential Slabs and Footings’ • principles of soil dynamics • water table, slopes and rocks • stresses in soil mass • cantilevers and gravity retaining walls • pile types • underpinning • excavation trenching • development of geotechnical model • deriving characteristics of geotechnical parameters • safety in design workshops
Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy and work procedures and instructions • suitable computer aided drafting (CAD) equipment and data management software, materials and consumables • AS 2870, relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23934**
Unit title	**Produce reinforced concrete drawings**
Application	This unit described the performance outcomes, knowledge and skills required to produce drawings for the detailing of reinforced concrete components of a building, in accordance with standards in AS1100.501, AS3600 and AS2807.1. This unit of competency applies to a person working at paraprofessional level in a civil engineering environment where technical drawings of reinforced concrete elements of a building are prepared. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/a
Unit Sector	N/a

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. Assessment of performance is to be consistent with the assessment requirements.	
1	Identify reinforced concrete components to be drawn	1.1	Occupational, health and safety/workplace, health and safety (OHS/WHS) requirements for a given work area are obtained and followed
		1.2	Drawings, relevant documentation and work requests are identified and discussed with appropriate personnel
		1.3	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved with the project and on the work site
2	Plan drafting approach	2.1	Project specifications and related documentation are analysed and discussed with appropriate personnel.

		2.2	Drafting equipment is set up to complete the drawings, in accordance with enterprise procedures and manufacturer requirements
3	Complete the drawings	3.1	Drawings of concrete reinforced components are prepared in accordance with relevant drafting and concrete structures Australian Standards, building regulations and codes and workplace procedures
		3.2	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
		3.3	Drawings are reviewed against job specifications with appropriate personnel and amended as required
4	Present and archive final drawings	4.1	Drawings are presented to appropriate personnel and signed off in accordance with workplace procedures
		4.2	Drawings are stored and archived according to workplace procedures

Range of conditions

Nil

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation, building codes and Australian Standards
Oral communication skills to:	• relay information to team members and relevant personnel using appropriate language
Numeracy skills to:	• to calculate required dimensions and elevations of reinforced components
Problem-solving skills to:	• address technical contingencies and risks

Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	**Code and Title Previous version**	**Comments**
VU23934 Produce reinforced concrete drawings	VU22489 Produce reinforced concrete drawings	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23934 - Produce reinforced concrete drawings

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- produce drawings of reinforced concrete components in accordance with a design brief, appropriate drafting conventions and Australian Standards on three (3) occasions and in three (3) different contexts.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- AS3600 Concrete Structures Code, AS2807.1 Residential Reinforced Concrete Code, Concrete Institute of Australia (CIA) Reinforced Concrete Detailing Manual and current local practice in placement of reinforcement:
  - pad footings
  - slabs on ground
  - columns
  - simply supported beams
  - walls
- drawing conventions for concrete outline using plans, sections, views and details for:
  - AS1100.501
  - footing types
  - floor slab systems
  - beams
  - columns
  - walls, penetrations and openings
  - expansion and contraction joints
- labelling and dimensioning requirements of reinforcement:
  - main
  - distribution
  - shear
- drawing conventions for:
  - bar types and shapes
  - hooks

    - cogs
    - bends
- systems of bar marking to identify reinforcement
- display of bars and fabric with reference to:
    - other reinforcement
    - other elements of the structure
    - requirements of appropriate cover
- bar schedules and calculation of steel quantities:
    - item numbering systems
    - colour tagging system
    - bar sizes/grade
    - quantities
    - dimensions
    - shape
    - tonnage
- AS3600 Concrete Structures Code to determine splice and anchorage lengths for various conditions.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to.

- OHS/WHS policy and work procedures and instructions
- operational access to CAD hardware and software and consumables
- access to relevant documentation including manual and Australian Standards.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23959**
Unit title	**Produce an engineering design for a steel structure**
Application	This unit describes the performance outcomes, knowledge and skills required to complete an engineering project which includes the design for a steel structure. It requires the ability to locate and use appropriate design references, perform engineering calculations and apply design principles for a range of steel structure components. The unit applies to a person working at paraprofessional level in a civil engineering environment where design of steel structures is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify steel structure to be designed	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are determined and followed
	1.2 Design requirements for the steel structure are identified from the design brief and instructions
	1.3 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace

		1.4	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan design approach	2.1	Design project documentation is collected and analysed
		2.2	Design references and equipment are set up to complete the design, in accordance with relevant Australian standards regulations and workplace procedures
		2.3	Decisions for dealing with unexpected situations are made from discussion with appropriate personnel, job specifications and workplace procedures
3	Complete the design	3.1	Design aids and references are used in accordance with relevant Australian standards, manufacturer manuals and workplace procedures
		3.2	Calculations are preformed to determine dimensions of individual components, loads and stresses applied to the steel structure
		3.3	Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes
		3.4	Steel structure design is completed to conform to relevant Australian standards, regulations and design brief
		3.5	Completed design is reviewed against job specifications with appropriate personnel and amended as required to provide optimum solution
4	Present results and store equipment	4.1	Final design is presented and discussed with appropriate personnel
		4.2	Design references and equipment are maintained and stored in accordance with workplace procedures
		4.3	Final design is archived according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• Interpret workplace and technical documentation
Writing skills to:	• prepare technical documentation relating to the design brief
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• calculate load and geometric measurements of steel structures
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23959 Produce an engineering design for a steel structure	VU22551 Produce an engineering design for a steel structure	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23959 - Produce an engineering design for a steel structure
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • design a steel structure in accordance with job specifications and relevant Australian standards on two (2) occasions and in two (2) different contexts.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• loads on structures:
	  ○ AS 1170 Part 1 to determine design dead and live loads
	  ○ loads on beams, where loads are transmitted through panel areas
	  ○ loads on frames where loads are transmitted through panel areas
	  ○ wind loads on buildings as per AS 1170 Part 2
	• beams (plated):
	  ○ geometric properties of (plated) beam sections
	  ○ plated beam bending, shear and deflection
	• column design:
	• effective lengths of columns with and without lateral restraints
	• connections:
	  ○ bolted connection for concentric load
	  ○ welded connection for concentric and eccentric loads
	  ○ flange plate connections using continuous and intermittent welds
	• column base plates:
	  ○ base plate for a simple connection
	  ○ base plate for a moment connection
	• biaxial bending:
	  ○ stresses caused by biaxial bending in a beam
	• tension members:

- structural members subjected to tensile forces

- pin Jointed frames:
  - effective lengths of members in pin-jointed frames
  - members in pin jointed frames using safe load tables
- welded plate girders:
  - welded plate girder
  - local web crushing and buckling
  - load bearing stiffeners
- combined tension and bending:
  - structural member in combined tension and bending
- purlins and girts:
  - purlins and girts using cold-formed steel section

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant design aids and equipment, tools, materials and consumables
- relevant Australian Standards, plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23960**
Unit title	**Apply environmental and heritage solutions to civil engineering projects**
Application	This unit describes the performance outcomes, knowledge and skills required to consider and manage environmental and heritage values as part of a civil engineering project. It requires the early consideration of environment and heritage values and assessments and their potential impact on a civil engineering project, prepare for and manage an environmental and heritage study and select and integrate an appropriate solution. The unit applies to a person working in a civil engineering office as a paraprofessional, where environmental and heritage management form an integral part of a civil engineering project solution. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify environmental and heritage impact	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) and environmental and heritage requirements for a given work area are determined and followed
	1.2 Established OHS/WHS requirements and risk control measures and procedures are followed in preparation of the work area
	1.3 Environmental and heritage impact of an engineering project is identified with reference

			to documentation, legal authorisation permits/consents, work requests and discussions with appropriate personnel
		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site
		1.5	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Select appropriate environmental and heritage solutions	2.1	Environmental and heritage studies are conducted with respect to a civil engineering project taking into account legal and regulatory requirements
		2.2	Environmental and heritage studies are analysed and the optimum outcomes selected
		2.3	Decisions for dealing with unexpected situations are made following discussions with appropriate personnel, and with respect to job specifications, any legal authorisation and workplace procedures
3	Integrate and document environmental and heritage solutions	3.1	Environmental and heritage conditions and procedures are incorporated into the engineering project in discussion with appropriate personnel and according to workplace procedures
		3.2	Any relevant environmental and heritage permits, consents and/or other approvals s are obtained
		3.3	A Construction Environmental Management Plan (CEMP) for the engineering project is drawn up
		3.4	Completion of work tasks are documented and reported to appropriate personnel.

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare and update relevant documentation
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23960 Apply environmental and heritage solutions to civil engineering projects	VU22545 Apply environmental solutions to civil engineering projects	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23960 - Apply environmental and heritage solutions to civil engineering projects
Performance Evidence	The learner must be able to demonstrate competency in all the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • Carry out an environmental and heritage study on two (2) occasions and in two (2) different contexts, analyse the results and prepare a Construction Environmental Management Plan (CEMP) for each context.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• environment of the earth:
	  ○ atmosphere
	  ○ hydrosphere
	  ○ lithosphere
	  ○ climate
	  ○ ecosystems
	• engineering in the context of the natural environment and culture heritage values:
	  ○ roads
	  ○ towns and cities
	  ○ dam building
	  ○ communication
	  ○ power generation and distribution
	  ○ water distribution
	  ○ sanitation/sewerage
	  ○ industrial centres
	  ○ railways
	  ○ mining
	  ○ quarrying
	• environment degradation:
	  ○ air pollution
	  ○ water pollution
	  ○ land abuse

    - agriculture
    - soil erosion
    - vegetation removal
    - habitat loss and severance
    - land fill
    - land contamination
    - salinity
    - soil stability
    - waste disposal
    - resources
    - aesthetics
    - visual impact
    - noise
    - offensive odour
    - social disruption
    - flora and fauna
    - contaminated land
    - dust
    - water discharge/onsite wastewater management systems
- environment and heritage controls:
    - heritage permits/consents
    - Aboriginal Cultural Heritage Management Plans (CHMP)
    - heritage impact statements
    - standard measurement
    - monitoring controls
    - evaluation and remedial measures
    - environmental incidents
- heritage regulation in Victoria
- role of Heritage Victoria
- role of First Peoples – State Relations
- role of Registered Aboriginal Parties
- Victorian Heritage Register
- Victorian Heritage Inventory
- heritage overlays
- Victorian Aboriginal Heritage Register
- environment restoration:
    - reclamation of an environment
    - revegetation of an environment

- restoration of an environment
- rehabilitation of an environment
- contaminated site management
- general construction site management
- soil conservation
- soil salinity
- monitoring post restoration

- environment and heritage case study:
  - environment and heritage issues
  - carrying out an investigation
  - monitoring the situation
  - compiled data
  - viable engineering solution/s.
- elements of a Construction Environmental Management Plan (CEMP)

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant tools, materials and consumables
- on-line access to various heritage registers
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23961**
Unit title	**Analyse the strength of civil structural elements**
Application	This unit of competency describes the performance outcomes, knowledge and skills required to calculate different kinds of loadings and actions on structural elements. It requires the ability to conduct an analysis of beam and column structures involving calculation of such features as support reactions, shear and bending moments. This unit of competency applies to a person working at paraprofessional level in a civil engineering environment where analysis of the strength of civil structures is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	MEM23109 - Apply engineering mechanics principles
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Plan analysis approach	1.1 OHS/WHS requirements for carrying out the work are followed
	1.2 Site information relating to analysis project is collected and reviewed.
	1.3 References and Australian Standards for the project are consulted to complete the structural analysis

2	Complete the analysis	2.1	Calculations are performed to determine the structural integrity of the civil structural design elements
		2.2	Analysis is completed as determined by relevant Australian standard
		2.3	Results are recorded, analysed, examined and applied according to workplace procedures
		2.4	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
3	Confirm analysis and computations	3.1	Structural analysis and computations for the civil structural design are checked and confirmed with appropriate personnel
		3.2	Analysis is documented and approved according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation and relevant Australian Standards
Writing skills to:	• prepare technical documentation analyses findings
Oral communication skills to:	• relay information to team members using appropriate language

Numeracy skills to:	• perform necessary geometric and load calculations of civil structural elements
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23961 Analyse the strength of civil structural elements	VU22561 Analyse the strength of civil structural elements	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23961 - Analyse the strength of civil structural elements
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • analyse the strength of the elements of a civil structure on two (2) occasions and in two different contexts in accordance with the appropriate Australian standard.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• use of relevant Australian Standards:
	  ○ permanent and imposed actions
	  ○ load combinations
	  ○ wind actions
	  ○ overview and simplified applications
	• loading due to fluid pressure and failure modes
	• in plane:
	  ○ bending of beams
	  ○ shear of beams
	  ○ bending moment
	  ○ deflection of beams
	• compression members:
	  ○ overview of buckling failure
	  ○ Euler's Equation
	  ○ effective lengths
	  ○ failure modes
	• action of members within a frame structure
	• fixed and continuous beams:
	  ○ behaviour and analysis
	• slope deflection equations and its application
	• moment distribution method and its application
	• introduction to software analyse

- analysing strength of structural components.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals and Australian Standards

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23923**
Unit title	**Solve engineering problems using algebra**
Application	This unit describes the performance outcomes, knowledge and skills required to solve engineering problems using algebra in engineering designs. The unit applies to paraprofessionals and technologists required to solve mathematical problems in an engineering/manufacturing or related industry. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify a need for applying key algebraic concepts	1.1 Determine data available for analysis 1.2 Define key algebraic concepts and knowledge appropriate for analysis.
2 Apply algebra techniques	2.1 Apply appropriate algebraic techniques required to solve a problem 2.2 Check answer by appropriate means 2.3 Interpret answer to determine information required by problem definition
3 Develop algebraic outcome/result	3.1 Use appropriate data presentations to communicate the solutions to relevant stake holders 3.2 Check outcome has addressed problem

Range of conditions

Nil

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• report and present data and quantitative information
Oral communication skills to:	• relay information to team members using appropriate language
Learning skills to:	• identify and define problems
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23923 Solve engineering problems using algebra	VU22482 Use advanced mathematics for engineering	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23923 - Solve engineering problems using algebra

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit.

- identify appropriate algebraic techniques for four (4) engineering related problems and in doing so the learner must:
    - apply the appropriate techniques to the problems
    - check answers have addressed the problems
    - communicate the outcomes of the analysis in a suitable way for the stakeholders.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- numbers:
    - types of numbers & notation(revise)
    - negative numbers
    - radicals and surds
    - introduction to errors
    - matrix (add/subtract/multiply)
- basic algebra:
    - expanding and factorising (revise)
    - binomial theorem
    - adding/subtracting/multiplying/dividing algebraic expressions
    - solving quadratic equations (revise)
    - completing the square
- sequences and series:
    - arithmetic sequences and series
    - geometric sequences and series
- functions and relations:
    - set notations and sets of numbers
    - interval notations
    - domain and range
    - function definitions
    - one-to one function

- function notations
- piecewise defined functions

- linear relations:
  - graphing straight lines (revise)
  - parallel and perpendicular lines
  - Families of straight lines
  - modelling exercises (applications)

- quadratic relations:
  - graphing quadratic function
  - quadratic transformations
  - the discriminant
  - solving quadratic in-equations
  - modelling exercise (applications)

- cubic polynomials:
  - the language of polynomials
  - the remainder theorem and factor theorem
  - division of polynomial (long division)
  - solving cubic equations
  - graphing cubic polynomials
  - quadratic transformations
  - modelling exercise (applications)
- other functions and relations:
  - rectangular hyperbolas
  - the truncus
  - the graphs of $y = \sqrt{x}$
  - the circle
  - inverse function

- exponential functions and logarithms:
  - graphs of exponential functions
  - solving exponential equations and inequalities
  - logarithm laws
  - using logarithms to solve exponential equations and inequalities
  - graphs of logarithm functions
  - exponential modelling (applications)

- circular functions:
  - trigonometric ratios

- circular measure (radian-degree)
- unit circle definition
- symmetric properties (including extra values, complementary relations)
- pythagorean identity
- graphs of sine, cosine and tangent functions $y = \text{asin}\, n(x + e) + c$
- solving trigonometric equations
- general solution for trig. Function
- circular modelling (applications)

- introduction to 2D vectors:
  - 2D vectors
  - adding and subtracting vectors
  - scalar multiplication
  - resolving vectors
  - magnitude of a vectors
  - unit vectors

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- relevant equipment, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23941**
Unit title	**Design basic mechanical engineering systems**
Application	This unit of competency describes the performance outcomes, knowledge and skills required to design basic mechanical engineering systems. It requires the ability to use codes, catalogues and design handbooks to extract information to make appropriate calculations and/or selections. This is based on skills encompassing project management, client liaison, design options, tender documentation and technical reporting. The unit of competency applies to a person working at paraprofessional level in an engineering workplace which engages in the design and implementation of mechanical systems. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Write a specification for a mechanical engineering system	1.1 Occupational Health and Safety/Workplace Health and Safety (OHS/WHS) requirements for a given workplace are determined and followed
	1.2 In consultation with the client the system requirements are identified
	1.3 Functional analysis is performed and all variables which will affect the design, including

			OHS/WHS and environmental requirements, are identified
		1.4	Specification document is prepared for client and clarified with appropriate personnel
		1.5	Appropriate personnel are consulted to ensure system requirements are accurately identified
2	Analyse component and assembly design conditions	2.1	Conditions of operation and mechanical variables and design parameters are identified
		2.2	Load conditions, working stresses and other relevant factors are calculated using formulae appropriate to the task
		2.3	Design loads and working stresses are determined using suitable factor of safety selected from codes or reference manuals
		2.4	Suitability of components to carry specified load under specified conditions is determined using appropriate formulae
3	Select mechanical components and materials	3.1	Components and materials are selected appropriate to design specifications, calculated design loads, working stresses and factor of safety
		3.2	Standard formulas and standard tabulated data are used to size engineering components
		3.3	Mechanical components are selected from applicable reference documents to meet the design specification, calculations and to satisfy cost reliability and life requirements
4	Apply mechanical engineering system design processes	4.1	Most suitable design to meet the system requirements is selected using proven design techniques
		4.2	Linear and geometric tolerances are determined to ensure functionality and design performance
		4.3	Feasibility of proposed design is determined based on calculations and relevant diagrams/drawings
		4.4	System design is optimised using relevant calculations

		4.5	Appropriate personnel are consulted to ensure the design meets clients requirements and safety factors
		4.6	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
5	Document design	5.1	Preliminary, general arrangement, design and detail drawings are prepared as required to Australian Standards and workplace requirements
		5.2	Preliminary, general arrangement, design and detail drawings are prepared as required to Australian Standards and workplace requirements
		5.3	Design documentation and reports are prepared with all relevant design information

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• perform design related calculations
Problem-solving skills to:	• perform functional analysis and select relevant components

Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23941 Design basic mechanical engineering systems	VU22538 Design mechanical engineering systems	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23941 - Design basic mechanical engineering systems

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- design basic mechanical engineering systems on two (2) occasions and in two (2) different contexts, including:
  - writing specifications
  - analysing components and assembly design conditions
  - selecting mechanical components and materials
  - designing mechanical engineering systems and
  - documenting mechanical engineering designs.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- design principles and procedures:
  - stress and strain including:
    - tension
    - compression
    - bearing
    - shear
  - fatigue and stress concentration factor including:
    - factor of safety
    - fits and tolerances
    - Australian Standards
    - material specifications
    - drawing requirements
- levers:
  - lever designs including:
    - bell crank lever
    - materials used
    - allowable stress
- keys and splines:
  - characteristics and merits of types in common use
  - standard proportions of keys
  - shear stress
  - bearing stress
  - length of keys and splines

- couplings
    - types
    - analysis of components
    - stresses including:
        - shear
        - bearing
        - bending
    - standard proportions of flanged couplings and knuckle joints:
        - proportion of hub and key
- journal bearings:
    - elementary journal bearing design
    - bearing clearance
    - length to diameter ratio
    - bearing pressure
    - position of oil holes and grooves
    - heat generated and dissipated:
        - allowable operating temperatures of lubricants
- rolling contact bearings including:
    - bearing types and size
    - combined bearing load
    - axial and radial loads
    - static and dynamic capacity
    - requisite bearing life for different types of machines
    - permissible speeds of operation
- bolted connections including:
    - types
    - standard bolt sizes
    - allowable stresses
    - fabrication of joints
    - modes of failure
    - analysis of eccentrically loaded joints
- welded connections including:
    - practical and design consideration of
    - welded connections
    - allowable stresses on welds
    - design of fillet and butt welds
    - eccentrically loaded joints
    - effect of symmetric and unsymmetrical weld patterns

- helical springs (round wire)
    - types:
        - allowable working stresses
    - stiffness
    - wahl correction factor
    - deflection
    - spring rate
    - spring index
    - spring ends
    - typical specifications required for manufacture
    - spring design by nomograms
- translation screws:
    - types
    - screw proportions
    - coefficient of friction
    - efficiency
    - conditions for self-locking
    - stresses in screw threads
    - bearing pressures
    - depth of nut
    - column effect
- design documentation
    - document types
    - components and elements of design documents
    - sequence and structure of information
    - use of tables graphs and charts
    - style and language
    - report terminology
- translation screws
    - types
    - screw proportions
    - coefficient of friction
    - efficiency
    - conditions for self-locking
    - stresses in screw threads
    - bearing pressures
    - depth of nut
    - column effect

- design documentation
    - document types
    - components and elements of design documents
    - sequence and structure of information
    - use of tables graphs and charts
    - style and language
    - report terminology.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals and Australian Standards.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23942**
Unit title	**Apply finite element analysis**
Application	This unit describes the performance outcomes, skills and knowledge required to apply finite element analysis to engineering applications using a general purpose finite element analysis software package. This unit applies especially to the determination of stresses, displacements and natural frequencies. This unit applies to a person working in a mechanical/structural/civil engineering workplace where analysis of machine parts and/or structures is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Setup a finite element model	1.1 Analysis task for the engineering part or structure is determined by using documentation, drawings, work requests or discussions with appropriate personnel
	1.2 Nodes and elements of part or structure to be analysed are created to determine finite element model
	1.3 Finite element model is refined by applying all relevant internal and external parameters and conditions

		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with other involved in the workplace
		1.5	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Produce solution or results file(s)	2.1	Appropriate solver for the type of analysis being undertaken is selected
		2.2	Solver parameters are adjusted as necessary, to optimise the solution
		2.3	Solver is run and solution file is generated
		2.4	Solver log file is inspected for warnings and errors and corrective action taken
		2.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
3	Extract and interpret results	3.1	Results are extracted from results file and displayed
		3.2	Results are verified to required certainty level
		3.3	Results are recorded, analysed and reported to appropriate personnel in accordance with workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret and evaluate documentation, specifications, and drawings for finite element analysis purposes
Writing skills to:	• prepare analysis documentation
Oral communication skills to:	• relay information to team members using appropriate language
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• apply boundary conditions to suit type of analysis required, including axisymmetric analysis
Technology skills to:	• effectively use a Finite Element Analysis software, including pre-processor and post processor

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23942 Apply finite element analysis	VU22537Apply finite element analysis	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23942 - Apply finite element analysis

Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundational skills in this unit. In doing so the learner must:
	• on two (2) separate occasions and in two (2) different contexts, apply finite element analysis including:
	  ○ modelling a wide range of shapes and structures
	  ○ choosing element type and controlling element shape to minimise calculation errors
	  ○ using library files
	  ○ selecting efficient modelling techniques including importation of geometry from other software packages
	  ○ applying appropriate boundary conditions
	  ○ verifying results
	  ○ presenting software generated results
	  ○ identifying areas of excessive stress and/or deformation and to recommend modifications.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of: • finite element analysis • advanced modelling techniques • Cartesian, Polar and Spherical coordinate systems • stress concentration • dead loads, live loads, wind loads, structural and non-structural mass • material libraries • types of beam, plate, and brick elements • properties of materials; stress, strain, modulus of elasticity, modulus of rigidity, Poisson's ratio, allowable stress • equivalent stresses based on Von Mises criterion and Tresca criterion • shear force and bending moment diagrams, bending stress and torsional stress • heat transfer modes; conduction, convection, and radiation • thermal stress

- accuracy checking methods including use of strain gauges.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant computer hardware, software, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23943**
Unit title	**Set up and implement mechatronics engineering systems**
Application	This unit describes the performance outcomes, knowledge and skills required to plan and construct a mechatronics engineering system. It requires the ability to interface the system with a standard industrial programmable controller for a complete operating system and includes commissioning, monitoring and troubleshooting requirements. The unit applies to a person working at paraprofessional level in an industrial engineering or manufacturing workplace where mechatronics is applied to form part of the production of goods or services. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify principal mechatronics applications within the manufacturing and engineering industry	1.1 Principal mechatronics applications in manufacturing and engineering are identified, as required 1.2 Principles and features of mechatronics are provided, as required 1.3 Advantages and disadvantages of mechatronics for given manufacturing applications are identified
2	2.1 Relevant occupational health and safety/work health and safety (OHS/WHS) requirements for

	Plan the implementation of a mechatronics system		carrying out the work are incorporated into the plan
		2.2	Specifications, installation and set-up requirements are determined from workplace documentation and discussion with appropriate personnel
		2.3	Stages and activities required for implementation are identified and documented according to workplace procedures
		2.4	Resources, components and equipment needed for the installation are selected and sourced according to design specification and workplace 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	Plan is reviewed to improve outcomes and overcome possible problems
3	Construct mechatronics systems	3.1	Relevant OHS/WHS requirements for carrying out the work are followed
		3.2	Resources, components and equipment are obtained and coordinated in accordance with workplace 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 workplace 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 workplace procedures
4	Program system controllers	4.1	Relevant OHS/WHS 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 workplace procedures
		4.6	Program is downloaded and tested for conformance with operational specifications
5	Commission mechatronics system	5.1	Relevant OHS/WHS 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	Relevant OHS/WHS 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 workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare technical documentation
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• diagnose and rectify faults in a mechatronics system
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• develop plans and processes for mechatronics system implementation • incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• set up and configure machines and equipment to meet specific requirements

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23943 Set up and implement mechatronics engineering systems	VU22563 Set up mechatronics engineering systems	Equivalent

Assessment Requirements

Title

Assessment Requirements VU23943 - Set up and implement mechatronics engineering systems

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- plan and construct least one (1) mechatronics engineering system and interface it with a standard industrial programmable controller for a complete operating system.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- 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
- monitoring and 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.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23944**
Unit title	**Plan and manage a robotics system**
Application	This unit describes the performance outcomes, knowledge and skills required to select, install and commission robots for industrial application. It requires the ability to plan and select the components, install the system, program and interface with the controller, troubleshoot and perform diagnostic testing. The unit of competency applies to a person working at paraprofessional level in an engineering/manufacturing workplace where industrial robots are being installed, commissioned and managed as part of the production process. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Determine robot system requirements	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements and environmental requirements for a given work area are clarified and followed
	1.2 Robot system requirements and parameters are established from discussions with appropriate personnel, job specifications and relevant workplace documentation

		1.3	Functional specifications and other factors affecting the selection of robot system are identified
		1.4	System options and alternatives are identified and evaluated with appropriate personnel
		1.5	Most appropriate robot system is selected based on relevant scientific principles, production requirements, functional specifications/factors and discussions with appropriate personnel
		1.6	Appropriate calculations and assumptions are used to enable methods, processes & construction techniques choices
2	Plan robot system installation	2.1	OHS/WHS requirements for carrying out the work are followed
		2.2	Plan for implementation of the robot system is prepared, based on identified system requirements
		2.3	Installation and set-up requirements to establish system equipment within given environment are determined and incorporated into plan
		2.4	Resources and equipment needed for the installation are obtained and coordinated in accordance with workplace procedures
		2.5	Plan is reviewed to improve outcomes and overcome possible problems
3	Perform on-line programming of robot systems	3.1	OHS/WHS requirements for carrying out the work are followed
		3.2	On-line programming requirements are identified
		3.3	Program plan is developed
		3.4	Programming method is selected, in accordance with established procedures
		3.5	Coordinates are calculated for tool path or robot functions
		3.6	Program is written in required language and in accordance with standard operating procedures

		3.7	Safety features are incorporated in robot program
		3.8	Operation sheet is prepared, in accordance with established procedures
4	Perform off-line programming (OLP) of robot systems	4.1	OHS/WHS requirements for carrying out the work are followed
		4.2	Suitability for off-line programming is identified, with regard to robot type and kinematics as well as technical and economic considerations of OLP
		4.3	Computer Aided Design (CAD) model of the work cell is produced
		4.4	Robot-work interaction is simulated on CAD-system
		4.5	OLP program is developed and verified on CAD-system
		4.6	OLP is downloaded in the robot controller
		4.7	OLP verification and calibration procedures are undertaken to ensure the OLP meets the robot-work interaction requirements
5	Manage robot system	5.1	Operational procedures and functional requirements of robot system are identified and clarified with appropriate personnel
		5.2	Proven planning, control and organising techniques are applied to effectively manage the robot system and environment
		5.3	OHS/WHS and industrial relations issues for all staff operating in a robot system environment are identified and managed
		5.4	Staff training and development needs are identified and training initiated according to workplace procedures
		5.5	Robot system maintenance is scheduled in accordance with workplace requirements, maintenance systems and manufacturer recommendations

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare technical documentation relating to the installation and commissioning of robotics systems
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• perform numerical calculations to determine coordinates for tool path and robotic functions
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members involved in the robotics system installation
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts • set up and configure machines and equipment

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23944 Plan and manage a robotics system	VU226564 Plan and manage a robotics system	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23944 - Plan and manage a robotics system

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- select, install and commission robots for two (2) industrial applications each in a different context, including:
  - installing robot and peripherals
  - performing on-line and off-line programming; and
  - implementing an operational robot system.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- robot selection criteria and procedures:
  - classification and application of industrial robots
  - features and components/mechanisms of robots
  - end effectors and applications
  - robot movements
  - drive systems
  - robot specifications, incl. capabilities, operating conditions, limitations
  - technical and economic considerations of OLP
  - pre-selection planning
  - criteria in selecting a robot
- robot Installation:
  - pre-installation planning
  - installation
  - layout
  - system documentation
  - safety factors esp to AS2939 -1987
- interfacing:
  - interfacing with the robot controller
  - external memory
  - sensor
  - other peripherals

    - program control of interfacing
- robot sensors:
    - type of sensors
    - sensor interfacing and compatibility
    - sensor programming
- trouble-shooting and diagnostic:
    - control system
    - diagnostic function
    - trouble-shooting and fault isolation
    - procedures
- maintenance:
    - preventative maintenance
    - maintenance scheduling
    - maintenance procedures
- programming robots:
    - on-line methods and procedures, incl. manual, walkthrough, lead through, off-line, optical/vision or sensor systems
    - industrial and special applications eg palletising, machine interfacing
    - input/output signals
    - synchronisation
    - sub-routines
    - robots in FMS
- Computer Aided Design/Off-Line Programming (CAD/OLP):
    - commercial software for 3D-modelling
    - part/component 3D-graphical representation in CAD format
    - robot and robot movement modelling
    - robot geometries and kinematic data from software libraries and robot supplier/manufacturer data
    - work points, motion type, path representation on computer model
    - OLP verification in CAD-format
    - post-processors for transfer of CAD-based OLP into robot-language format
    - verification of OLP in robot controller
    - calibration of OLP to compensate for robot repeatability, component variations and part positioning tolerances
- OHS/WHS and human resources management:
    - OHS/WHS issues relating to robot systems

- risk identification and control
- industrial relations issues
- staff training within the scope of this unit.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant machines, tools, robotic hardware/software equipment, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23962**
Unit title	**Design timber structures**
Application	This unit describes the performance outcomes, knowledge and skills required to design timber structures. It requires the ability to analyse the requirements from a project brief and design a timber structure using appropriate design aids. The unit applies to a person working at paraprofessional level in a civil engineering environment. As a member of a project team, the person is responsible for the design of timber buildings and other civil construction projects. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify timber structure to be designed	1.1 Occupational Health and Safety/Workplace Health and Safety (OHS/WHS) requirements and environmental requirements for a given work area are determined and followed
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel
	1.3 The design is identified from documentation, work requests or discussions with appropriate personnel

		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site
		1.5	Resources and design equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan design approach	2.1	OHS/WHS requirements for carrying out the work are incorporated into the design plan
		2.2	Documentation relating to design project is collected and analysed
		2.3	Design references and equipment are set up in accordance with workplace procedures.
3	Complete the design	3.1	Design references and equipment are used according to manufacturer manuals and workplace procedures
		3.2	Calculations are performed to determine loads and stresses to determine beams columns and connection requirements
		3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
		3.4	The design is completed to conform with relevant Australian standard, regulations and building code
		3.5	Design outcomes are analysed and examined with appropriate personnel and against project design brief and amended as required
4	Present and archive final designs	4.1	Design references and equipment are maintained and stored in accordance with workplace procedures
		4.2	Results are recorded, analysed and reported to appropriate personnel, in accordance with workplace procedures
		4.3	Designs are stored and archived according to workplace procedures

Range of Conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical information and Australian Standard
Writing skills to:	• prepare technical documentation and reports in accordance with workplace procedures
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• calculate loads and stresses of timber structures
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Self-management skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title Current version	Code and Title Previous version	Comments
VU23962 Design timber structures	VU22559 Design timber structures	Equivalent

Assessment Requirements Template

Title	Assessment Requirements for VU23962- Design timber structures
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • design a timber structure on two (2) occasions and in two (2) different contexts using a design brief and appropriate design aids and in accordance with Australian standards, regulation and relevant building codes.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• design principles and types for timber structure
	• timber classifications and specifications
	• Australian standard AS1720
	• commercial timber sizes
	• loads on structures
	• design of:
	  ○ beams
	  ○ columns
	  ○ connections
	• tension members.

Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy and work procedures and instructions • suitable Computer Aided Drafting/Design (CAD/D) and data management hardware/software, materials and consumables • design brief, relevant plans, drawings and instructions and manufacturer specifications/manuals. **Assessor requirements:** • Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23963**
Unit title	**Produce an engineering design for a stormwater reticulation scheme**
Application	This unit describes the performance outcomes, knowledge and skills required to apply principles of design for a stormwater reticulation scheme using appropriate design standards. It requires the ability to conduct an on-site reconnaissance, apply hydrology principles and use relevant charts from drainage design manual and other design aids. The unit applies to a person working at paraprofessional level in a civil engineering environment responsible for the development stormwater reticulation design solutions. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify stormwater reticulation scheme to be designed	1.1 Occupational Health and Safety/Workplace Health and Safety (OHS/WHS) requirements and environmental requirements for a given work area are interpreted and followed
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel

		1.3	Design requirements are identified from documentation, work requests or discussions with appropriate personnel
		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site
		1.5	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan design approach	2.1	OHS/WHS requirements for carrying out reconnaissance at the work site are followed
		2.2	On site reconnaissance to gather surveying data, measurements, photographs and other required information for the design project is carried out
		2.3	Design references are consulted and required documentation is gathered to complete the design task in accordance with workplace procedures
		2.4	Computer aided design and drafting system (CADD) is set up according to operating procedure
		2.5	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
3	Complete the design	3.1	Design solution is prepared to conform to relevant standards and regulations in accordance with workplace procedures
		3.2	Unexpected situations are dealt with in accordance with work plan and discussions with appropriate personnel
		3.3	Completed design is reviewed with appropriate personnel and amended as required to provide optimum solution
4	Compile, document and present design	4.1	Design solution is presented and discussed with appropriate personnel
		4.2	Design references and equipment are maintained and stored in accordance with workplace procedures

4.3	Work completion is notified to appropriate personnel and required documentation completed accordance with workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret task related documentation, relevant data, job instructions, drawings and OHS/WHS procedures
Writing skills to:	• complete required workplace documentation
Oral communication skills to:	• relay information to team members
Numeracy skills to:	• make computations related to the design of a stormwater reticulation scheme
Learning skills to:	• assess the nature and scope of new concepts and identify priorities and procedures within timeframes
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity

Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts • set up and use design aids

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23963 Produce an engineering design for a stormwater reticulation scheme	VU22548 Produce an engineering design for a stormwater reticulation scheme	Equivalent

Assessment Requirements Template

Title	Assessment Requirements for VU23963 - Produce an engineering design for a stormwater reticulation scheme
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must on at least two (2) occasions each in a different context: • carry out an on-site reconnaissance and gather required data and information for a proposed stormwater reticulation scheme • design a stormwater reticulation scheme to meet relevant Australian standards, regulations and work requirements.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• data collection relevant to stormwater reticulation scheme
	• urban runoff and flow:
	  ○ revise rational method
	  ○ partial area effect
	  ○ circumstances when partial area has an effect
	  ○ kinematic wave formulation for overland flow
	  ○ variation with intensity, average rainfall intensity (ARI)
	• time of entry:
	  ○ overland (roof) time plus channel time to inlet
	  ○ generalise coefficient of runoff for project
	• pipe and pipe layout
	• pit locations
	• catchment areas
	• time of concentration
	• design aids:
	  ○ use of computer methods
	  ○ use of commercial software and programs
	  ○ commercial drainage design and analysis programs to design small urban stormwater reticulation scheme.

Assessment Conditions	Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and workplace procedures and instructions
- relevant tools, materials and consumables
- CADD hardware and software
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23945**
Unit title	**Generate design solutions**
Application	This unit describes the performance outcomes, skills and knowledge required to create design solutions in the engineering and manufacturing industry context which are economically viable, environmentally conscious, ergonomically appropriate and equitable for those producing the product as well as the end user. It requires the ability to work from a design brief, undertake research, explore ideas and options, collaborate with others at various stages in the design process and develop and present a solution. The unit applies to a person working at paraprofessional level and responsible for creating design solutions in an engineering and manufacturing industry context No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Research the scope of design for the engineering and manufacturing industry	1.1 Research typical design applications in industry areas
	1.2 Identify the role of the designer in the industrial setting
	1.3 Research environmental and sustainability issues in the industry
	1.4 Identify key issues pertinent to the industry

		1.5	Research materials, tools and equipment applicable to design in the industry
2	Define the design problem	2.1	Determine user/client needs and requirements
		2.2	Define the design problem
		2.3	Clarify specifications, parameters and constraints of the design problem in consultation with relevant stakeholders
3	Undertake research to inform the design solution	3.1	Collect and evaluate sources of relevant information to assist in solving the design problem
		3.2	Consider historical, current trends and futures perspectives that might inform the design solution
		3.3	Identify environmental conditions and consequences pertinent to the design solution
		3.4	Consider social, economic, ethical and cultural issues pertinent to the design solution
		3.5	Collate research information to inform development of design solution
4	Communicate and collaborate with others	4.1	Develop working relationships with stakeholders and peers in the design process
		4.2	Inform interested stakeholders of the progress and associated implications of the design process
		4.3	Obtain input regularly throughout developmental stages to ensure that design process and outcomes are continuously improved
		4.4	Negotiate additional requirements or modifications to the design and undertake any necessary amendments
5	Formulate a range of approaches to the design problem	5.1	Reflect on and integrate ideas generated from research and consultation
		5.2	Apply principles of functionality, ergonomics, aesthetics and sustainability to the development of the design solution options
		5.3	Document design options in accordance with project requirements

6	Select most appropriate design solution	6.1	Identify the social and environmental consequences of design solution
		6.2	Identify the functional and aesthetic qualities of the design solution
		6.3	Determine the feasibility, desirability and appropriateness of the proposed design solution in light of original design requirement
		6.4	Identify advantages and disadvantages of potential design solution
		6.5	Adjust and refine design solution based on research, consultation with others, reflection and initial need
		6.6	Document preferred design solution in accordance with project requirements

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare workplace documentation and reports
Oral communication skills to:	• collaborate with relevant stakeholders, request advice, receive feedback and work with a range of people about the design requirements and solutions
Numeracy skills to:	• perform calculations, take measurements, assess sizes and determine costs

Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23945 Generate design solutions	VU22540 Generate design solutions	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23945 - Generate design solutions

Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so learner must:
	• develop two (2) design solutions each from a separate design brief, which demonstrates the ability to:
	  ○ undertake research to inform the solution
	  ○ communicate and collaborate with others throughout the design process
	  ○ formulate a range of ideas and concepts
	  ○ select and present the most appropriate solution.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• the design process - from a concept to realisation, including:
	  ○ design brief
	  ○ research methods
	  ○ key design principles including; functionality, ergonomics aesthetics, sustainability
	  ○ consultation and collaboration
	  ○ exploration of ideas and concepts
	  ○ material selection and method/s of manufacture
	  ○ costings
	  ○ selecting and presenting the final solution
	• historical and contemporary influences on design
	• role of the industrial designer and other design practitioners
	• copyright, moral rights and intellectual property issues and legislation.

Assessment Conditions	Assessment must be conducted in workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy and work procedures and instructions • design brief and internet • relevant tools, materials and consumables

- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23924**
Unit title	**Plan for the implementation of mechanical drive systems**
Application	This unit describes the performance outcomes, knowledge and skills required to plan for the implementation of mechanical drive systems. It requires the ability to use catalogues and drawings of components including shafts, couplings, belts, chains, gears variable speed drives, brakes, clutches, bearings, winch equipment, reciprocating drives/linear to rotational. The unit applies to a person working at paraprofessional level in a civil engineering environment responsible for the development of designs and implementation plans of mechanical drive systems. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.	
1	Plan a mechanical drive system and implementation plan	1.1	Requirements for the mechanical drive system are determined from documentation, reports, or clients and from discussions with appropriate personnel
		1.2	A draft implementation brief is prepared and approved by the appropriate personnel
		1.3	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site
		1.4	Resources and equipment needed for the task are obtained in accordance with enterprise procedures and checked for correct operation and safety
2	Draw a mechanical drive system	2.1	Occupational Health and Safety/Workplace Health and Safety (OHS/WHS) requirements

			for the given work area are determined and followed
		2.2	Drawings of the mechanical drive system are prepared to meet specifications
		2.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and enterprise procedures
3	Present and document system drawings and implementation plan	3.1	Final drawings of the system together with the implementation plan are presented to the relevant personnel
		3.2	Drawings and implementation plan for the mechanical drive system are documented and stored in accordance with enterprise procedure

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare workplace and technical documentation
Oral communication skills to:	• relay information to team members in an engineering environment
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23924 Plan for the implementation of mechanical drive systems	VU22476 Plan for the implementation of mechanical drive systems	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23924 - Plan for the implementation of mechanical drive systems

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- Draw the components and prepare an implementation plan for two (2) mechanical drive systems each in a different context and in accordance to work instructions.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- mechanical drive components:
  - shafting/couplings
  - keys and keyways
  - splines
  - rigid/flexible couplings
  - couplings selection
  - fluid coupling
  - gearing
  - chain drives
  - belt drives
  - bearings
  - winch equipment
  - reciprocating drive/linear to rotational drive
- drafting mechanical drive systems:
  - belt drives
  - chain drives
  - gear drives
  - drive shafts
  - reduction box assembly
  - machine drive system bases.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant tools, materials and consumables

- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23946**
Unit title	**Use extended features of computer aided drafting (CAD)**
Application	This unit describes the performance outcomes, knowledge and skills required to coordinate computer aided drafting (CAD) operations in the use of customisation techniques to suit a particular context. It requires the ability to use the extended features in the CAD applications software including language programming, macros/icon files, configuration of peripherals, and the creation of complex menus The unit of competency applies to a person working at paraprofessional level in an engineering design and development environment where CAD applications to optimise productivity by customising CAD software to suit a specified task or tasks is performed. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify customisation options for a given context	1.1 Occupational Health and Safety/Workplace Health and Safety (OHS/WHS) requirements for a given work area are determined and followed
	1.2 Most appropriate CAD application software features are selected for the customisation task
	1.3 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace

		1.4	Resources and equipment needed for the customisation task are obtained in accordance with workplace procedures and checked for correct operation
2	Customise CAD application software	2.1	Customisation task of CAD application software for the required context is carried out
		2.2	Customisation task of CAD application software is tested, and performance evaluated
		2.3	Decisions and methods for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
3	Validate and document customised CAD operation	3.1	Customisation of CAD application software is demonstrated to appropriate personnel and validated
		3.2	Customisation task is documented, and appropriate personnel notified in accordance with workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation
Writing skills to:	• prepare workplace and technical documentation
Oral communication skills to:	• relay information to team members using appropriate language

Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23946 Use extended features of computer aided drafting (CAD)	VU22567 Use extended features of computer aided drafting (CAD)	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23946 - Use extended features of computer aided drafting (CAD)

Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:
	• use customisation and implementation techniques on at least two (2) separate occasions, including:
	  ○ CAD language programming
	  ○ macros/icon files
	  ○ configuration of CAD peripherals
	  ○ creation of complex CAD menus.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• principles of menu structure
	• customisation techniques:
	  ○ user define applications
	  ○ function keys
	  ○ line types
	  ○ patterns
	  ○ screen
	  ○ tablet
	  ○ button
	  ○ pull down menu
	  ○ icon menu
	• Customisation task include but not limited to:
	  ○ CAD language programming
	  ○ text editing
	  ○ macros and icon files
	  ○ configuring CAD peripherals
	  ○ complex CAD menus
	  ○ rendering/texture mapping
	  ○ importing/exporting files

- applying style features
- text editing software:
  - commands
  - menus
  - keystrokes
  - special software function keys
  - read
  - modification of help
  - modification of assistance screens
- macro and icon files:
  - techniques for creation
  - techniques for customisation
- configuring software:
  - procedures related to CAD peripherals
- procedures for creation of complex CAD menus:
  - screen and digitising tablet menus
  - compile files to operate screen
  - tablet menus
- file transfer procedures
- information on CAD consumables.

Assessment Conditions

Assessment should be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- CAD hardware and software
- relevant tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23947**
Unit title	**Implement advanced materials science principles to engineering applications**
Application	This unit describes performance outcomes, knowledge and skills required to apply advanced principles of materials science to engineering applications. It requires the ability to identify properties of materials, conduct metallographic investigations and undertake material testing tasks. The unit applies to a person working at paraprofessional level in an engineering environment where sound knowledge and skills in the science of materials for engineering applications are required No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Determine the requirements for applying advanced principles of materials science to an engineering application	1.1 Occupational Health and Safety/Workplace Health and Safety (OHS/WHS) for a given work area are clarified and followed
	1.2 Materials science task is determined through request or design brief and clarified with appropriate personnel
	1.3 Expert advice is sought with respect to the materials science task and according to workplace procedures, where appropriate

		1.4	Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel
		1.5	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Select the appropriate testing regime	2.1	Industry codes, regulations and technical documentation relevant to the materials science task are interpreted and implemented
		2.2	Tables and graphs are used to obtain computational data, where appropriate
		2.3	Appropriate assumptions underlying the materials science task are made and recorded
		2.4	Resources required are identified, obtained and checked as fit for the purpose
		2.5	Appropriate computational method is selected and justified
3	Undertake metallographic investigations	3.1	OHS/WHS requirements for carrying out the work are followed
		3.2	Metallographic investigations and/or material testing tasks are performed and results recorded
		3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, design brief and workplace procedures
4	Verify and document solutions	4.1	Results are verified, interpreted and discussed with appropriate personnel
		4.2	Results are graphed or charted, where appropriate
		4.3	Results are recorded, stored and archived according to workplace procedures

Range of conditions

Material science tasks may include but are not limited to:

- metallographic investigations
- testing of metallic coatings and coating systems
- failure and fracture analysis
    - thermal fatigue
    - mechanical fatigue
- tensile testing

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret technical documentation such as material data sheets
Writing skills to:	• prepare workplace and technical documentation
Oral communication skills to:	• relay information to team members involved with the work tasks
Numeracy skills to:	• perform a range of computations related to material suitability for a specified application • produce graphs and charts related to material performances
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity

Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23947 Implement advanced materials science principles to engineering applications	VU22541Implement advanced materials science principles to engineering applications	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23947 - Implement advanced materials science principles to engineering applications

Performance Evidence

The learner must be able to demonstrate competency in all the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- apply advanced principles of materials science involving data interpretation, metallographic investigations and/or material testing, interpretation and recommendations to an engineering problem on at least two (2) occasions each in a different context.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- structure of crystalline materials:
  - crystal structures
  - crystal systems
  - crystallographic planes and directions
  - review of developing microstructures
  - determination of crystal structures
  - structure of non-crystalline solids
- imperfections in crystalline materials:
  - point defects
  - impurities in solids
  - solid solutions
  - linear defects
- microscopic examination:
  - metallography
  - optical microscopy
  - electron microscopy
  - microphotography
- diffusion:
  - mechanisms
  - applications
- dislocations and strengthening mechanisms:
  - definitions and characteristics of dislocations
  - slip

    - plastic deformation of polycrystalline materials
    - strengthening mechanisms in metals
    - strain hardening
- review of recrystallisation and grain growth
- structure and properties of ceramic materials:
    - crystal structures
    - types and application of engineering ceramics
- structure and properties of polymeric materials:
    - molecular structure
    - saturated and unsaturated molecules
    - polymerisation
    - crystalline and non-crystalline polymers
    - mechanical properties of crystalline and non-crystalline polymers
    - melting and glass transition temperatures
- elastomersphase diagrams:
    - phases
    - microstructure
    - equilibrium
    - equilibrium phase diagrams
    - binary isomorphous systems
    - non-equilibrium cooling
    - binary eutectic systems
    - development of microstructure in eutectic alloys
- iron-carbon alloys:
    - phase equilibrium diagram
    - development of microstructures of plain carbon steels
- heat treatment of plain carbon steels:
    - phase transformations
    - isothermal transformation diagrams
- thermal processing heat treatment of alloy carbon steels:
    - influence of alloying elements
    - secondary hardening
- heat treatment of aluminium alloys:
    - precipitation hardening
    - solution heat treatment
    - precipitation heat treatment

- surface engineering of metal alloys:
    - diffusion
    - selective processes
    - vapour coating
- composite materials:
    - fibre reinforced materials
    - laminate
    - metal matrix composite (MMC)
    - ceramic matrix composite (CMC)
    - sandwich panel
    - strength of materials for fibre composite structures
- failure of materials:
    - fundamentals
    - ductile fracture
    - brittle fracture
    - fracture mechanics
    - impact fracture
    - fatigue
    - creep.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- relevant testing and related resources, materials and consumables
- relevant graphs, charts, drawings, instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23925**
Unit title	**Design and prototype components or small structures using engineering design principles**
Application	This unit describes the performance outcomes, knowledge and skills required to design and prototype components or small structures using engineering design principles. It requires the ability to develop a concept proposal, prepare drawings and produce a prototype or model of the proposed design. The unit applies to a person working in an engineering, manufacturing or construction environments at paraprofessional level, where the design and prototyping of components and/or small structures is undertaken. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Prepare concept proposal	1.1 Design task is determined through a work order and clarified with the appropriate personnel
	1.2 Alternate design solutions are explored and evaluated in conjunction with the appropriate personnel
	1.3 Where required appropriate expert advice is sought with respect to the design task and in accordance with enterprise procedures
	1.4 Concept proposal is prepared, including evaluation of alternate approaches, relevant

			codes and regulations, and reviewed with appropriate personnel
		1.5	Final design specifications are established and confirmed with appropriate personnel
2	Set up for model or prototype production	2.1	Resources required are identified, obtained and checked as fit for purpose
		2.2	Relevant codes of practice, regulations and technical documentation required for the production of the model or prototype are interpreted
		2.3	Work plan is prepared showing the sequence of operations to produce the model or prototype
3	Produce model or prototype	3.1	Relevant occupational health and safety/work health and safety (OHS/WHS) and environmental requirements are identified and followed
		3.2	Sequence of tasks are carried out in accordance with the work plan
		3.3	Work output is inspected for compliance at each stage of the process to ensure consistency with the design specifications
		3.4	Unexpected problems are discussed with the appropriate personnel and corrective action taken
4	Review model or prototype design	4.1	Model or prototype is reviewed with the appropriate personnel to ensure it is consistent with the job specifications and fit for purpose
		4.2	Final design is presented for approval and signed off according to enterprise procedures
5	Clean up work area and maintain equipment	5.1	Work area is cleared of waste, cleaned and secured following enterprise procedures
		5.2	Equipment and tooling are cleaned and inspected for serviceable conditions, maintained and stored following enterprise procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Writing skills to:	• prepare technical and workplace documentation
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23925 Design and prototype components or small structures using engineering design principles	VU22478 Design and prototype components and/or small structures using engineering design principles	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23925 - Design and prototype components or small structures using engineering design principles
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • develop a work plan and produce a prototype or model of a component or small structure using engineering design principles and consistent with job specifications on at least two (2) occasions.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• design fundamentals:
	  ○ needs analysis
	  ○ design goals
	  ○ systematic design procedures
	  ○ design specifications
	  ○ feasibility
	  ○ constraints
	  ○ cost
	• engineering objectives in design:
	  ○ materials:
	  ○ metal/non-metal
	  ○ strength
	  ○ rigidity
	  ○ elasticity
	  ○ joints
	  ○ manufacturability
	  ○ assembly
	  ○ safety
	• detail design:
	  ○ drawings
	  ○ folding and filing methods
	  ○ parts lists
	  ○ projection

    - lines
    - sectioning
    - dimensioning
    - ISO Standard for technical drawings
    - tolerances and fits
    - surface finish indications
    - measurements
- prototype and model production:
    - fundamentals
    - manufacturing methods
    - manufacturing materials
    - manufacturing assembly
    - safety issues
- final design documentation.

Assessment Conditions

Assessment should be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- technical drawing hardware/software
- operational access to relevant tools/equipment, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23926**
Unit title	**Apply pneumatic principles to achieve an engineering task**
Application	This unit describes the performance outcomes, knowledge and skills required to apply pneumatic principles to achieve an engineering task. It requires the ability to plan, construct, test and maintain a pneumatic system and machine control circuitry. The unit of competency applies to a person working at paraprofessional level in an industrial engineering or manufacturing enterprise where the application of pneumatics technology forms part of production of goods or services. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	N/A
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.	
1	Prepare to apply pneumatic principles to engineering tasks	1.1	Applications of pneumatics to engineering activities are investigated
		1.2	Pneumatic units, terms and symbols are recognised and used correctly
		1.3	Pneumatic circuit diagrams are interpreted and the operation of the circuit explained to appropriate personnel in the workplace
		1.4	Concept/principles of pneumatics and circuit design are applied as appropriate to the given engineering task
		1.5	Potential pneumatic hazards are identified and reported according to enterprise procedures
2	Determine pneumatic requirements when planning engineering task	2.1	Occupational health and safety/workplace health and safety (OHS/WHS) and risk control measures are applied when working

			with pneumatics
		2.2	Pneumatic circuits and operating parameters are developed and constructed for the given engineering task
		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	Pneumatic requirements for the engineering task are confirmed 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 pneumatic pressure and flow
		2.7	Pneumatic measurements and calculations are performed and interpreted correctly
		2.8	Unexpected situations are resolved with appropriate personnel, and in accordance with workplace procedures
3	Install and test pneumatic equipment and devices	3.1	OHS/WHS) and risk control measures are applied for the work task
		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 is installed and set up to operate safely for the purpose intended according to manufacturers' operating instructions
		3.4	Testing and fault tracing on pneumatic components and systems is safely performed
		3.5	Preventative maintenance requirements are identified and a routine maintenance plan is prepared
		3.6	Work completion notification is carried out in accordance with enterprise procedure

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret pneumatic equipment and components in manufacturers' catalogues
Writing skills to:	• complete workplace documentation
Oral communication skills to:	• to consult with other team members involved in the task
Numeracy skills to:	• perform calculations and use measuring devices
Learning skills to:	• assess the nature and scope of the task and identify priorities and procedures within timeframes
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title Current version	**Code and Title Previous version**	**Comments**
VU23926 Apply pneumatic principles to achieve an engineering task	VU22500 Apply pneumatic principles to achieve an engineering task	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23926 - Apply pneumatic principles to achieve an engineering task

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- apply pneumatic principles by planning, constructing and testing a pneumatic system and machine control circuitry to achieve an engineering task on two (2) occasions each in a different context.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- pneumatic circuitry/plant:
  - applications of pneumatics to engineering
  - cascade/stepper circuit design
  - machine control circuits
- safety circuits
- special machines/equipment:
  - integral machine circuits
  - production aids
- surface preparation
- system analysis:
- circuitry
- circuit documentation:
  - motion diagrams
  - written forms
  - fluid logic componentry
  - fluid logic circuitry
- design concepts
- maintenance and servicing:
  - maintenance requirements:
  - preventative
- safety:
  - hazards
  - risk control measures
  - treatment aids
  - machine safe operation
  - personal protective equipment and safety devices.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- Pneumatic components and machine control circuitry
- operational access to relevant tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23948**
Unit title	**Apply advanced statics principles to engineering problems**
Application	This unit describes the performance outcomes, knowledge and skills required to apply advanced static concepts and principles to solve complex engineering issues. It requires the ability to apply principles of advanced statics in the design of an engineering solution and includes two and three dimensional force analysis and associated diagrams for structures and mechanical componentry. The unit applies to a person working in an engineering, manufacturing and construction environment where the application of advanced statics can provide solutions to a wide variety of engineering problems. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	• MEM23109 Apply engineering mechanics principles • MEM23007 Apply calculus to engineering tasks
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Determine the extent of advanced statics required for the analysis	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements for a given work area are clarified and followed
	1.2 Engineering problem is determined through request, design brief or equivalent and clarified with appropriate personnel
	1.3 Expert advice is sought with respect to the engineering problem and in according to workplace procedures

		1.4	Resources and equipment required are identified, obtained and checked as fit for the purpose
2	Determine which principles of advanced statics should be used in the analysis or design of a solution	2.1	Industry codes, regulations and technical documentation relevant to the engineering problem are collated and interpreted
		2.2	Need for tables and graphs to obtain computational data is determined and they are used where appropriate
		2.3	Appropriate assumptions underlying the engineering problem are made and recorded
		2.4	Most appropriate analytical, computational or design methodology is selected and can be justified
3	Verify, document and interpret analysis and/or design	3.1	Results of the analysis or design are recorded and documented in accordance with requirements and workplace procedures
		3.2	Results are graphed and/or charted and interpreted, where appropriate
		3.3	Formal report to present outcomes is prepared according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret industry codes, regulations and technical documentation
Writing skills to:	• complete workplace documentation

	• present results in graphs, charts and tables to requirements
Oral communication skills to:	• relay information to team members using appropriate language
Problem-solving skills to:	• solve engineering problems involving the analysis of two dimensional force and couple systems
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• select the most appropriate computational method to analyse and solve the engineering problem • incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping

Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23948 Apply advanced statics principles to engineering problems	VU22535 Apply advanced statics principles to engineering problems	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23948 - Apply advanced statics principles to engineering problems
Performance Evidence	The learner must be able to demonstrate competency in all the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • apply advanced statics to solve engineering problems on three (3) occasions and in three (3) different contexts involving two and three dimensional force analysis in structures and mechanical componentry.
Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of: • two dimensional force analysis • three dimensional force analysis • free body diagrams of two and three dimensional systems • shear force, bending moments and torque diagrams for two and three dimensional force systems. • application of tables and graphs for recording statistical results • considerations for selecting advanced statistical principles to achieve a design solution
Assessment Conditions	Assessment should be conducted in a workplace or simulated environment that replicates workplace conditions with access to: • OHS/WHS policy and work procedures and instructions • relevant materials and consumables • relevant plans, drawings and instructions and manufacturer specifications/manuals. **Assessor requirements:** • Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23964**
Unit title	**Produce advanced engineering drawings for a reinforced concrete structure**
Application	This unit describes the performance outcomes, knowledge and skills required to produce advanced drawings of reinforced concrete structures, in accordance with required practices and conventions. as outlined in AS1100.501. It requires the ability to read and interpret job specifications, building codes for preparing technical drawings consistent with appropriate design criteria in line with Australian Standard (AS) 3600. The unit applies to a person working at paraprofessional level in a civil engineering environment where drawings of advanced reinforced concrete structures are prepared. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify reinforced concrete structure to be drawn	1.1 Occupational health and safety/ workplace health and safety (OHS/WHS) requirements for a given work area are determined and followed
	1.2 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel

		1.3	Job requirements are identified from documentation, work requests or discussions with appropriate personnel
		1.4	Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the workplace
		1.5	Resources and drafting equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan drafting approach	2.1	Project specifications and related documentation are analysed and discussed with other project personnel
		2.2	Design references are assembled and drafting equipment is set up in accordance with manufacturer's requirements and workplace procedures
3	Complete the drawings	3.1	Drawings of concrete reinforced components are prepared to conform with relevant Australian Standards building regulations and workplace procedures
		3.2	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
		3.3	Drawings are reviewed against job specifications with appropriate personnel and amended as required
4	Present and archive final drawings	4.1	Drafting references and drafting equipment are maintained and stored in accordance with workplace procedures
		4.2	Drawings are presented to appropriate personnel and signed off in accordance with workplace procedure.
		4.3	Drawings are stored and archived according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret building codes, Australian Standards and technical documentation
Writing skills to:	• prepare related workplace documentation
Oral communication skills to:	• consult and relay information to team members using appropriate language
Numeracy skills to:	• calculate material quantities
Learning skills to:	• assess the nature and scope of the task and identify priorities and procedures within timeframes
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23964 Produce advanced engineering drawings for a reinforced concrete structure	VU22552 Produce advanced engineering drawings for a reinforced concrete structure	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23964 - Produce advanced engineering drawings for a reinforced concrete structure
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must: • produce advanced drawings of reinforced concrete structures in accordance with job requirements, building regulations, appropriate drafting convention and Australian Standards on two (2) occasions each in a different context.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• AS 3600 and Concrete Institute of Australia (CIA) Reinforced Concrete Detailing Manual in the placement of reinforcement to:
	  ○ pile caps
	  ○ suspended slabs, continuous and simply supported
	  ○ continuous beams
	• concrete outlines using plans, sections, elevations and details for:
	  ○ footings
	  ○ suspended slabs
	  ○ beams
	  ○ columns
	  ○ stairs
	  ○ retaining walls
	• labelling and dimensioning conventions for reinforcement:
	  ○ main
	  ○ secondary
	  ○ distribution
	  ○ shear
	  ○ temperature
	  ○ nominal
	• drawing standard AS1100.501 for:
	  ○ bar types and shapes
	  ○ hooks
	  ○ cogs

    - bends
- display of bars and fabric with reference to:
    - other reinforcement
    - other elements of the structure
- appropriate cover
- bar marking to identify reinforcement
- AS 3600 to determine:
    - splice lengths
    - anchorage lengths
- construction requirements:
    - AS 3600.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and job instructions
- relevant drawing equipment, materials and consumables
- relevant Australian Standards and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23965**
Unit title	**Produce advanced engineering drawings for a steel structure**
Application	This unit describes the performance outcome knowledge and skills required to complete a structural steel drawing in accordance with accepted practice as outlined in Australian Standard (AS) 1100.501. It requires the ability to interpret and apply relevant sections of AS 4100 and Australian Institute of Steel Construction (AISC) Handbook, perform calculations and prepare detailed drawings of structural steel members in accordance with job specifications. The unit applies to a person working at paraprofessional level in a civil engineering environment where drawings of steel structures are prepared. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Identify steel structure to be drawn	1.1 Occupational health and safety/workplace health and safety (OHS/WHS) requirements for a given work area are determined
	1.2 Drawings, relevant documentation and work requests are identified and discussed with appropriate personnel
	1.3 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved at the work site

		1.4	Resources and equipment needed for the task are obtained in accordance with workplace procedures and checked for correct operation and safety
2	Plan drafting approach	2.1	Project specifications and related documentation required for the drawings are collected and analysed
		2.2	Relevant sections of the AISC Handbook and AS 4001 are analysed and calculations preformed as required
		2.3	Drafting references and equipment are set up to complete the design and detailed drawings in accordance with workplace procedures and manufacturer requirements
3	Complete the drawings	3.1	Drafting references and equipment are used according to manufacturer manuals and workplace procedures
		3.2	Drawings of steel structural and individual components are prepared to conform with Australian drafting and steel structure standards, AISC Handbook requirements and relevant and building regulations
		3.3	Decisions for dealing with unexpected situations are made from discussions with appropriate personnel, job specifications and workplace procedures
		3.4	Final drawings are reviewed with appropriated personnel and against job specifications and amended as required
4	Present and archive final drawings	4.1	Drafting references and equipment are maintained and stored in accordance with workplace procedures
		4.2	Drawings are presented and signed off by appropriate personnel accordance with workplace procedures
		4.3	Drawings are stored and archived according to workplace procedures

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret building codes, Australian Standards and technical documentation
Writing skills to:	• complete relevant workplace documentation
Oral communication skills to:	• relay information to team members using appropriate language
Numeracy skills to:	• perform calculations to determine span, beam sizes, spacing, footing plates
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of digital tools and electronic applications required in own role in a range of contexts

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23965 Produce advanced engineering drawings for a steel structure	VU22553 Produce advanced engineering drawings for a steel structure	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23965 - Produce advanced engineering drawings for a steel structure

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- prepare detailed drawings of steel structures in accordance with relevant Australian standards, building regulations and AISC Handbook on two (2) occasions each for a different context.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- section tables:
  - universal beams
  - universal columns
  - parallel flange channels
  - taper flange channels
  - equal angles
  - unequal angles
  - rolled hollow sections
- data from AS 4100 and design capacity tables for structural steel in the selection and specification of bolts and welds
- structural steel members using plans, sections, elevations and details for:
  - braced frames
  - portal frames
  - trusses
- design data for:
  - tension members
  - compression members
  - beams
  - shear connections
  - moment connections
- drawing standards AS 1100.501 for:
  - symbols
  - terminology

    - line-work
    - lettering
- detailing of:
    - structural steel members
    - connections
    - base plates
    - bracing
- dimensioning:
    - centre of gravity lines
    - gauge lines
    - edge distances
    - bolt pitches
    - hole sizes
- weld types:
    - fillet welds
    - butt welds
- protective coatings:
    - organic
    - inorganic
    - galvanised
- construction requirements as per AS4100.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- manual or computer aided drafting equipment, references and consumables
- relevant Australian Standards, AISC handbook, plans, drawings and job instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23927**
Unit title	**Conduct and analyse precision engineering measurements**
Application	This unit describes the performance outcomes, knowledge and skills required to conduct precision measurements and analyse the results. It requires the ability to use precision measuring equipment, maintaining measuring equipment and the analysis/interpretation of measurement results. The unit applies to a person working at paraprofessional level in an engineering workplace where precision measurements are undertaken with a range of measuring devices and where the results of these measurements are analysed and interpreted as part of quality control processes. No licensing or certification requirements apply to this unit at the time of accreditation.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/a

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. Assessment of performance is to be consistent with the assessment requirements.	
1	Select appropriate measuring technique and equipment	1.1	Extent of the measurement task is determined from documentation or reports and discussed with appropriate personnel
		1.2	Appropriate technique and measuring equipment is selected according to requirements and enterprise procedures
		1.3	Appropriate personnel are consulted to ensure that the work is co-ordinated effectively with others involved at the workplace
		1.4	Resources for measurement task are obtained in accordance with enterprise procedures
		1.5	Measuring equipment is checked for calibration,

			correct operation and safety
2	Conduct measurement	2.1	Occupational health and safety/ Work health and safety (OHS/WHS) requirements for carrying out the work are followed
		2.2	Measuring equipment is set up according to manufacturer specifications and enterprise procedures
		2.3	Measurements are conducted to the accuracy required using appropriate techniques and recorded
		2.4	Dimensions are determined or verified using calculations, where required
		2.5	Decisions and methods of dealing with unexpected situations are selected on the basis of safety and specified work outcomes
3	Maintain measuring equipment	3.1	Measuring equipment is set, adjusted and maintained to required accuracy, using manufacturer specifications and/or enterprise procedures
		3.2	Measuring equipment is stored to manufacturer requirements and/or enterprise procedures
4	Analyse and interpret results	4.1	Measurement results are analysed and interpreted against specifications
		4.2	Measurement results are documented and appropriate personnel are notified in accordance with enterprise procedures

Range of conditions

Measuring equipment may include:

- strip gauges
- engineering square
- vernier scaled measuring equipment
- angle dekkor
- sine bars
- dividing heads
- rotary tables
- precision levels
- micrometres
- height gauges
- hardness testers
- texture measuring equipment

Foundation Skills

This section describes language, literacy, numeracy and employment skills that are essential to performance and not explicit in the performance criteria.

Skill	Description
Reading skills to:	• interpret drawings, specifications and other applicable reference documents
Writing skills to:	• prepare relevant workplace documentation
Oral communication skills to:	• work effectively with others involved in conducting the precision measurement task
Numeracy skills to:	• verify and calculate dimensions and tolerances
Problem-solving skills to:	• address technical contingencies and risks
Teamwork skills to:	• communicate and work cooperatively and collaboratively with team members
Planning and organising skills to:	• incorporate all OHS/WHS procedures and practices in all activity
Technology skills to:	• use main features and functions of measuring equipment, digital tools and electronic applications required

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23927 Conduct and analyse precision engineering measurements	VU22521 Conduct and analyse precision engineering measurements	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23927 - Conduct and analyse precision engineering measurements

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must:

- conduct and analyse precision engineering measurements on four (4) occasions and on each occasion using different measuring equipment.

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- mechanical measuring devices
- calibration and adjustments
- accuracy, resolution and precision of measurements
- errors of measurements
- environmental conditions affecting measurements
- measurement techniques and procedures
- units and sub-units of measurements (metric and imperial)
- manufacturers specifications
- storage of precision measuring devices.

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions
- operational access to a range of precision measuring instruments, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer specifications/manuals.

Assessor requirements:

- Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23928**
Unit title	**Prepare and document a work plan to fabricate an engineering product or component**
Application	This unit of competency describes the knowledge and skills required to prepare and document a work plan to fabricate an engineering component or tool. It includes defining the problem, identifying and reviewing specifications, determining resources, sequencing the production tasks and reviewing the plan against the required outcome. This unit applies to an entry level engineering worker required to apply basic job task planning skills in an engineering or manufacturing environment. No occupational licensing, legislative or certification requirements apply to this unit at the time of publication.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.	
1	Identify task requirements	1.1	Identify task outcomes and task requirements and clarify with appropriate personnel
		1.2	Identify and follow established Occupational Health and Safety/Work Health and Safety (OHS/WHS) requirements and risk control measures and procedures in preparation of the work task.
		1.3	Access and interpret relevant documentation to plan and carry out the task
		1.4	Identify factors affecting performance of the task and account for where possible
2	Prepare work plan to manufacture engineering components	2.1	Identify, order and document steps and activities required to fabricate engineering components to ensure efficient and effective use of resources and time

		2.2	Identify and document resources needed for the task
		2.3	Identify enterprise work procedures and include in the plan where necessary
		2.4	Check documented work plan for accuracy against task requirements and specifications
3	Review work plan	3.1	Check task outcomes against job specifications and task instructions
		3.2	Check available resources with appropriate personnel
		3.3	Revise work plan, where required, to better meet object task requirements and required outcome

Range of conditions

N/A

Foundation Skills

Foundation Skills describe the language, literacy, numeracy and employability skills that are essential to performance.

Skill	Description
Reading skills to:	• interpret documentation
Numeracy skills to:	• check the work plan for accuracy
Problem-solving skills to:	• revise work plan to meet object task requirements
Self-management skills to:	• follow enterprise work procedures • follow OHS/WHS requirements
Digital literacy skills to:	• Access reference manuals and catalogues

Unit mapping		
Code and title Current version	**Code and Title Previous version**	**Comments**
VU23928 Prepare and document a work plan to fabricate an engineering product or component	VU22473 Prepare and document a work plan to fabricate an engineering product or component	Equivalent

Assessment Requirements

Title

Assessment Requirements for VU23928 - Prepare and document a work plan to fabricate an engineering product or component

Performance Evidence

The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must on at least two (2) occasions:

- demonstrate the ability to prepare a documented work plan to fabricate an engineering component according to specification and job instructions on at least two occasions
- 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

Knowledge Evidence

The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:

- Occupational Health and Safety, including:
  - workplace safety procedures
  - risk assessment and hazard control
  - personal protective equipment and safety devices
  - personal responsibilities
- Document interpretation including:
  - work instructions and procedures
  - sketches and drawings
  - reference manuals and catalogues
  - enterprise work procedures
  - Work plans including:
  - information contained in a work plan
  - ordering workflow into logical steps
- Factors affecting task performance including:
  - wrong or damaged parts
  - unexpected or potential delays
  - environmental factors – weather, noise, dust etc.
  - hazards
  - insufficient or incorrect information
  - material shortages
- Resources needed including
  - work orders and cutting lists
  - specifications and reference documents
  - work procedures
  - job samples
  - tools and equipment
  - materials, parts and consumables

- measuring devices
- safety equipment

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and job instructions
- operational access to relevant programming software /hardware, machines, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer's specifications/manuals

Assessor requirements

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

Unit code	**VU23949**
Unit title	**Program and set up co-ordinate measuring machines (CMM)**
Application	This unit of competency describes the knowledge and skills required to develop programs for co-ordinate measuring machines (CMM), setting up measurement probes and preparing the CMM for measurement data acquisition of engineering components. The unit of competency applies a person working at paraprofessional level in an engineering/manufacturing enterprise where co-ordinate measuring machines need to be programmed, set up and prepared for measuring tasks in support of the design and/or production of engineering components to specified tolerances and quality standards. No occupational licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.
Pre-requisite Unit(s)	Nil
Competency Field	Nil
Unit Sector	N/A

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. Assessment of performance is to be consistent with the assessment requirements.
1 Develop a co-ordinate measuring machine (CMM) part program	1.1 Determine Occupational Health and Safety/Workplace Health and Safety (OHS/WHS) requirements and environmental requirements for a given work area 1.2 Follow established OHS/WHS requirements and risk control measures and procedures in preparation of the work area. 1.3 Determine co-ordinate measuring machine (CMM) parts program from documentation or

			reports and discuss with appropriate personnel.
		1.4	Develop CMM parts program using real parts and/or computer aided design (CAD) part models according to specifications and workplace procedures.
		1.5	Use efficiently integrated program development environment and parts libraries.
		1.6	Create single/multiple Direct Computer Control (DCC) alignment.
		1.7	Consult with appropriate personnel to ensure that the work is co-ordinated effectively with others involved at the work site.
		1.8	Obtain resources for CMM operation in accordance with workplace procedures.
2	Set up co-ordinate measuring machine	2.1	Follow OHS/WHS requirements for carrying out the work.
		2.2	Document previously not identified safety hazards, and devise and implement risk control measures in consultation with appropriate personnel.
		2.3	Determine probe selection and configuration according to job specifications and workplace procedures.
		2.4	Adjust probe or probes according to manufacturer’s specifications and workplace procedures.
		2.5	Check probe angles for compliance and adjust as required
		2.6	Re-set CMM and check calibrations according to workplace procedures.
3	Prepare co-ordinate measuring machine for measurement	3.1	Follow OHS/WHS requirements for carrying out the work.
		3.2	Determine the most appropriate method of clamping/support to minimise distortion and maximise measuring access.
		3.3	Correctly setup and orient components/fixtures/clamping devices.

		3.4	Discuss decisions and methods for dealing with unexpected situations with appropriate personnel and select methods on the basis of safety and specified work outcomes.
4	Conduct trial run	4.1	Follow OHS/WHS requirements for carrying out the work.
		4.2	Run and verify parts program in accordance with job specifications and workplace procedures.
		4.3	Measure parts in accordance with workplace procedures.
		4.4	Interpret results and identify and report non-conforming and out of tolerance measurements.
		4.5	Correctly back up and shut down parts program, and remove components, fixtures and clamps.
		4.6	CMM, accessories and surrounds are left in a clean and safe condition.

Range of conditions

N/A

Foundation Skills

This section describes foundation skills that are essential to performance and not explicit in the performance criteria**.**

Skill	Description
Reading skills to:	• interpret job specification
Writing skills to:	• document control measures
Numeracy skills to:	• interpret measurements as required
Learning skills to:	• set up co-ordinate measuring machine

Self-management skills to:

- follow OHS/WHS requirements

Unit mapping		
Code and title **Current version**	**Code and Title** **Previous version**	**Comments**
VU23949 Program and set up co-ordinate measuring machines (CMM)	VU22573 Program and set up co-ordinate measuring machines (CMM)	Equivalent

Assessment Requirements

Title	Assessment Requirements for VU23949 - Program and set up co-ordinate measuring machines (CMM)
Performance Evidence	The learner must be able to demonstrate competency in all of the elements, performance criteria and foundation skills in this unit. In doing so the learner must be able to: • implement OHS/WHS workplace procedures and practices including the use of risk control measures • program and set up for co-ordinate measuring machines (CMM), configure measurement probes and preparing the CMM for measurement data acquisition of engineering components on two occasions each in a different context.

Knowledge Evidence	The learner must be able to demonstrate essential knowledge required to effectively do the task outlined in elements and performance criteria of this unit, manage the task and manage contingencies in the context of the work role. This includes knowledge of:
	• Occupational Health and Safety, including:
	  ○ workplace safety procedures
	  ○ risk assessment and hazard control
	  ○ personal protective equipment and safety devices
	  ○ personal responsibilities
	• Environmental requirements including:
	  ○ liquid waste
	  ○ solid waste
	  ○ gas, fume, vapour, smoke emissions, including fugitive emissions
	  ○ excessive energy and water use
	  ○ excessive noise
	• Co-ordinate measuring machine including:
	  ○ control
	  ▪ manual
	  ▪ motor drive
	  ▪ computer controlled
	  ▪ networked
	  ○ orientation/application
	  ▪ vertical
	  ▪ horizontal
	  ▪ gantry
	  ▪ high accuracy

- Workplace procedures include:
  - the use of tools and equipment
  - instructions, including job sheets, plans, drawings and designs
  - reporting and communication
  - manufacturers' specifications and operational procedures
  - operational procedures
- Resources include:
  - relevant Australian and international standards
  - parts specifications
  - online and/or offline CMM integrated programming capability
  - appropriate computer hardware and network connections
  - Co-ordinate measuring machines and manuals
- Probe include:
  - touch trigger
  - proximity
  - displacement measures
  - scanning
  - manual probes
- Motorised probes including:
  - touch trigger
  - proximity
  - displacement measures
  - scanning
  - manual probes

Assessment Conditions

Assessment must be conducted in a workplace or simulated environment that replicates workplace conditions with access to:

- OHS/WHS policy and work procedures and instructions.
- relevant equipment, machines, tools, materials and consumables
- relevant plans, drawings and instructions and manufacturer's specifications/manuals

Assessor requirements

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.