



**Australian Government**

# **UEECD0031 Prepare engineering drawings using manual drafting and CAD for electrotechnology applications**

**Release: 1**

# UEECD0031 Prepare engineering drawings using manual drafting and CAD for electrotechnology applications

## Modification History

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

## Application

This unit involves the skills and knowledge required to prepare engineering drawings using manual drafting and computer-aided design (CAD) for electrotechnology/utilities applications.

It includes planning and producing electrotechnology/utilities engineering drawings. It also includes completing, reporting electrotechnology/utilities engineering drawings as well as using manual drafting methods, CAD equipment and software from specifications, layouts, sketches or verbal instructions.

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

## Pre-requisite Unit

UEECD0007 Apply work health and safety regulations, codes and practices in the workplace

UEECS0033 Use engineering applications software on personal computers

UEECD0019 Fabricate, assemble and dismantle utilities industry components

UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications

## Competency Field

Cross Discipline

## Unit Sector

Electrotechnology

## Elements and Performance Criteria

### ELEMENTS

Elements describe the essential outcomes.

### PERFORMANCE CRITERIA

Performance criteria describe the performance needed to demonstrate achievement of the element.

- |                                                                                      |            |                                                                                                                                                     |
|--------------------------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1 Plan<br/>electrotechnology/utilities<br/>engineering drawing</b>                | <b>1.1</b> | Work health and safety (WHS)/occupational health and safety (OHS) requirements and workplace procedures are identified and applied                  |
|                                                                                      | <b>1.2</b> | Hazards are identified, risks are assessed and control measures are implemented                                                                     |
|                                                                                      | <b>1.3</b> | Extent of work is determined from job specifications, discussions with relevant person/s, sketches, preliminary layouts and/or field investigations |
|                                                                                      | <b>1.4</b> | Relevant person/s is consulted to coordinate work                                                                                                   |
|                                                                                      | <b>1.5</b> | CAD software, tools and equipment required for work are obtained in accordance with workplace procedures                                            |
| <b>2 Produce<br/>electrotechnology/utilities<br/>engineering drawing</b>             | <b>2.1</b> | WHS/OHS risk control measures and procedures for carrying out the work are followed                                                                 |
|                                                                                      | <b>2.2</b> | Design, drawings and layouts required are determined from job specifications                                                                        |
|                                                                                      | <b>2.3</b> | Technical data of system components is interpreted to determine parameters included in drawings                                                     |
|                                                                                      | <b>2.4</b> | Relevant CAD software tools are used to produce drawings in accordance with workplace procedures                                                    |
|                                                                                      | <b>2.5</b> | Drawings are checked for accuracy and compliance with job specifications                                                                            |
|                                                                                      | <b>2.6</b> | Unplanned situations are responded to in accordance with workplace procedures and approval with authorised person/s                                 |
| <b>3 Complete and report<br/>electrotechnology/utilities<br/>engineering drawing</b> | <b>3.1</b> | Completed drawings are submitted to relevant person/s and checked for accuracy and compliance with job specifications                               |
|                                                                                      | <b>3.2</b> | Modifications are followed and drawings re-submitted for final approval                                                                             |
|                                                                                      | <b>3.3</b> | Completed drawings are filed in accordance with workplace procedures                                                                                |

## Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of

competency.

## Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the UEE Electrotechnology Training Package Companion Volume Implementation Guide.

Preparation of electrotechnology/utilities engineering drawing using manual drafting and CAD applications must include:

- auxiliary views
- care and use of equipment
- descriptive geometry/revolutions
- development layouts
- dimensioning/size description and tolerancing
- drawings, including component drawings for fabrication, assembly and sub-assembly drawings, installation drawings, fault location aids such as flow diagrams and modifications (version control), and conversion between drawing types
- drawing reproductions
- engineering drafting specifications, layouts, sketches or verbal instructions in conformance with Australian Standards and enterprise standards for electrotechnology/utilities applications
- fabrication drawings
- geometric construction
- graphs and charts
- ink overlay drawings production
- layout drawings
- manual drafting methods, techniques, procedures and devices
- maps and profiles design
- mechanical, fabrication and fluid power
- multi-view orthographic projections
- organisational procedures for collaborating with the client, key stakeholders and other staff in the selection of the preferred option
- organisational procedures for preparation and production of drawings, drawing sets, specifications, drafting documentation and operating and maintenance instructions/manuals for products and

systems

- organisational procedures for processing, filing and saving all graphics, specifications, instructions and related documentation in correct format and location in accordance with worksite procedures
- pattern development
- pictorial drawings
- pipe/plumbing drawings
- safety precautions when working with CAD equipment
- sectional views/conventions
- sketching methods, techniques, procedures and devices including freehand sketching
- specifications obtained from design information, customer requirements, sketches, preliminary layouts and/or field investigations
- structural steel and sheet metal drawings
- technical drawing equipment, including CAD applications, peripherals and devices
- technical illustrations
- thread representations
- type, form and size of materials from information, abbreviations and symbols supplied on electrotechnology/utilities related engineering drawings, briefs and/or specifications
- working drawings

## Unit Mapping Information

This unit replaces and is equivalent to UEENEEE190A Prepare engineering drawings using manual drafting and CAD for electrotechnology/utilities applications.

## Links

Companion Volume implementation guides are found in VETNet - -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6>

# **Assessment Requirements for UEECD0031 Prepare engineering drawings using manual drafting and CAD for electrotechnology applications**

## **Modification History**

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

## **Performance Evidence**

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least two separate occasions and include:

- applying modifications to original drawings and resubmitting for approval
- applying relevant work health and safety (WHS)/occupational health and safety (OHS) requirements, including implementing risk control measures
- checking drawings for accuracy and compliance with job specifications
- completing and reporting electrotechnology/utilities engineering drawings
- determining job specifications from designs, drawings and layouts
- filing completed drawings
- obtaining specifications from design information, customer requirements, sketches, preliminary layouts and/or field investigations
- planning and producing electrotechnology/utilities engineering drawings
- preparing and modifying preliminary electrotechnology/utilities drawings and diagrams using computer-aided design (CAD) equipment and software
- responding to unplanned situations
- submitting completed drawings
- using CAD equipment and related computer commands
- working with relevant person/s.

## **Knowledge Evidence**

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of:

- drawing fundamentals, including:
  - principles, purpose and classification of drawings
  - basic drawing terms and conventions
  - symbols, codes and abbreviations used in drafting drawings
  - tools and equipment used in drafting drawings

- drawing forms; sheet size and format, metric, imperial and copy fold information
- drawing routines, signatures, approvals, dates, numbers and numbering systems, design considerations/specifications, materials or component specifications, lists, titles, proprietary information, fasteners, representations, notes, charts and graphs, modifications and revision conventions
- fundamentals of drafting documentation, including contents, version control, indexing and product identification (e.g. logo, trademark and software warning plates)
- delineation: line conventions and lettering, multi- and sectional view drawings, pictorial drawings, types and application of engineering drawings, conventional representations, microfilming, descriptive geometry and revolutions
- measurements: types, forms, units, symbols, reading and transfer
- sketching techniques (e.g. freehand lettering)
- basic drafting skills (e.g. drafting by hand, working with triangles, and working with a T square)
- basic drawing layout (e.g. borders and information blocks)
- line types and weights
- geometric construction principles
- use of drawing instruments and equipment to produce basic technical drawings
- drawings instruments and media usage
- usage of reproducible drawings with mechanical pencils
- lettering, including:
  - principles, concepts and applications of lettering
  - terms, conventions and codes related to lettering
  - construction of vertical or inclined, single-stroke gothic lettering, numerals and fractions, including proper spacing and guidelines
  - proper lettering instruments selection
  - usage of lettering techniques for notes and titles on drawings
  - text style, text composition, and text placement selection and application
- sketching, including:
  - principals, practices and rules for sketching in relation to proportion, placement of the views, and drawing medium
  - concepts and applications of sketching
  - terms, conventions and codes related to sketching
  - sketches used in industry
  - usage of sketching aids for creative communication
  - sketching types and their applications
  - line techniques in sketching simple objects
  - estimation and proportion techniques usage
  - views selection for requisite applications
  - blocking technique for size, shape and details
  - surface shading techniques

- geometric construction, including:
  - principles, concepts and applications of geometric construction
  - terms, conventions and shapes related to geometric construction
  - drawing techniques of lines, angles, circles, arcs, tangents and polygons
  - geometric construction to single-view and multi-view drawings
  - graphic geometric controls
  - intermediate CAD commands
  - plotting and printing equipment set-up and configuration
- multi-view orthographic projections and Australian/New Zealand and industry standards, including:
  - principals of multi-view orthographic projections
  - terms, conventions and codes related to multi-view drawings
  - applications and use of orthographic projections/drawings (e.g. 3<sup>rd</sup> angle)
  - types and usage techniques of orthographic projection
  - sketching techniques related to orthographic views
  - rules for orthographic projection
  - working drawing problems and specifications
  - views visualisation and selection
  - 1<sup>st</sup> and 3<sup>rd</sup> angle projection drawings
  - lines, lettering, and drawing medium types
  - fractional, decimal, and metric equations solutions
  - concepts of units of measurement usage related to multi-view orthographic projections
  - sectional and/or auxiliary views uses, identification and analysis
  - rules for sections and auxiliary views
  - geometric figures visualisation and drawing in two dimensions
  - geometric figures classification and comparison
  - circle properties and relationships, and circle problem solving
  - drawing from a view of a model (e.g. orthographic projection)
- auxiliary views, including:
  - principles, terms and conventions usage in auxiliary views
  - use and application of auxiliary views
  - primary auxiliary view construction
  - secondary auxiliary view construction
- descriptive geometry/revolutions, including:
  - principles, terms and conventions usage in descriptive geometry/revolutions
  - graphic solutions of points, lines and planes
  - graphic solutions of intersections (e.g. lines, planes and solids)
  - true length of lines, bearing and slope of lines
  - graphic solutions of solids
  - drawings construction using the revolution method

- sectional views/conventions, including:
  - principles, terms, symbols and conventions of sectional views
  - use and application of sectional views
  - drawing standard sectional views
  - use of conventional breaks
  - symbols used to represent different materials
  - use of cutting plans
- pictorial drawings introduction and production to Australian/New Zealand and industry standards, including:
  - principals, concepts and applications of pictorial drawings
  - terms, symbols, conventions and codes usage in pictorial drawings
  - types and usage techniques of pictorial drawings
  - line of sight application
  - isometric view usage
  - pictorial drawing types, usage and selection
  - pictorial drawings sketching
  - pictorial working drawing problems and specifications
  - axonometric, oblique and perspective drawings construction
  - calculations in projection plane angles
  - standards for drawing pictorial drawings
  - application of properties and relationships of triangles to solve geometric shapes
  - conversion of an angular dimension of an orthographic to a linear dimension in a pictorial drawing
  - drawing techniques of pictorial representations
- dimensioning/size description and tolerancing as applied to drafting, including:
  - principles, terms, symbols and conventions used in dimensioning and tolerancing
  - terms, conventions and codes related to dimensioning
  - dimensioning drawing construction using Australian/New Zealand Standards
  - types and usage techniques of dimensioning
  - application of dimensioning to object drawings
  - geometric dimensioning and tolerancing
  - lines used in dimension drawings construction
  - dimensioning practices applications
  - dual dimensioning
  - tolerancing applications
  - dimensioning verification requirements
  - formulas for positional tolerancing
  - form, orientation, profile and runout
- development layouts of various shaped objects to Australian/New Zealand and industry standards, including:

- principals and concepts of development layouts of various shaped objects
- terms, conventions and codes related to surface developments
- surface development uses in Australian/New Zealand and industry standards
- basic three-dimensional geometric shapes visualisation in a two-dimensional plane
- cut out and construct models for checking accuracy
- rules to surface developments to produce stretch-outs
- layout drawings production to Australian/New Zealand and industry standards, including:
  - principals, concepts and applications of layout drawings
  - terms, conventions and codes related to layout drawings
  - layout drawings types and differences
  - rules for layout drawings
  - concepts of units of measurement usage related to layout drawings
- technical illustrations drawing to Australian/New Zealand and industry standards, including:
  - principals, concepts and purpose of technical illustrations
  - terms, conventions, symbols and codes related to technical illustrations
  - types and usage techniques of illustrations
  - rules for technical illustration application
  - techniques and applications for creating illustrations
  - illustration types usage and selection
  - illustration working drawing problems and specifications
  - techniques and applications in the use of drawing instruments to prepare illustrations
  - surface shading purpose and types, selection and analysis
  - techniques and applications in airbrush renderings to detailed illustrations
  - techniques and applications of CAD practices to technical illustrations
  - techniques and applications of line-shaded illustrations
  - concepts of units of measurement usage related to illustrations
  - solutions for illustrations using fractional, metric and decimal equations
- graphs and charts production to Australian/New Zealand and industry standards, including:
  - principals, concepts and applications of basic graphs, charts and diagrams production
  - terms, conventions and codes related to basic graphs, charts and diagrams production
  - graphs, charts and diagrams production types, usage and variations
  - data configuration for graphic representation
  - graph type selection per specifications and data
  - basic graphic charts and diagrams interpretation
  - charts and diagrams construction
- thread representations, including:
  - principles, concepts and applications of threaded fasteners
  - terms, conventions and codes related to threaded fasteners
  - types and usage techniques of threaded fasteners

- drawing of threads using simplified and schematic types of thread representation
- working drawings, including:
  - principles, concepts and applications of working drawings
  - terms, conventions and codes related to working drawings
  - types and usage techniques of working drawings
  - title block, bill of materials and schedules used in working drawings
  - working drawing production requirements
- care and use of equipment, including:
  - principles, concepts and applications of various drafting instruments, equipment and materials
  - types and usage techniques of drafting instruments, equipment and materials
  - drawing materials selection for specific types of drafting projects
  - drawing instruments usage as a means of technical drawings preparation for accuracy and readability
  - CAD station components identification
  - CAD set-up requirements to complete a basic drafting problem
- CAD basics, including:
  - principles, terms, symbols and conventions usage in CAD
  - concepts and applications of CAD and related application commands
  - types of CAD hardware
  - CAD standards, including file presentation; layering standards; sorting graphic data, including data groups, principal data and supporting data; layering naming convention; colour assignment standard (layer colours and pen weights); provision for creation of new layers; blocks standards - real blocks object, common block objects, symbol objects, block library and block naming; text style standards - text styles naming, text height; dimension styles standards - dimension style naming; line-type (LT) standards; title blocks and graphic scales - title block set-up, information title blocks, drawing scales; systems of measurement and preferred scales - drawing scales
  - disk operating system (DOS) and windows application definitions
  - techniques and practices in the application of program assist and editing commands
  - view and display commands (e.g. zooming and panning)
  - query commands to extract drawing data
  - techniques and practices in the application of changes to text styles, text entering and editing
  - existing drawing modifications
  - working with multiple drawings using cut and paste, and so on
  - components and symbol libraries creation, editing and retrieval
  - plotting drawings to the proper scale
  - scaling techniques applications
  - layering techniques applications
  - LT scale usage

- drawing techniques application
- drawing setups to applicable standards (e.g. settings, layers, line types and widths)
- two-dimensional drawing creation
- cartesian, polar, absolute, and relative coordinates usage in drawing lines and shapes
- techniques and practices in the application of geometric construction
- techniques and practices in the application of text to a drawing
- techniques and practices in altering font options
- techniques and practices in the application of laying out, drawing and completing orthographic drawings
- techniques and practices in the application of drawing objects in isometric using isometric drawing commands
- techniques and practices in the application of completing primary auxiliary drawings on CAD equipment
- techniques and practices in the application of CAD to draw screw threads
- techniques and practices in the application of making, setting and using layers and blocks
- basic production fabrication drawings to Australian/New Zealand and industry standards, including:
  - principles, terms, symbols, codes and conventions usage in production of fabrication drawings
  - types and usage techniques of detailed and assembly drawings
  - detailing: including principals, concepts and applications of detailing; terms, conventions and codes related to detailing; detailing types, application and selection; different fabrication processes and identification of machine parts; rules for drawing machine part details; concepts of units of measurement usage related to detailing; application of properties and relationships of triangles and circles to solve geometric shapes related to detailing
  - assembly drawings: including principals, concepts and applications of assembly drawings; terms, conventions and codes related to assembly drawings; different assembly processes and identification of machine part assemblies; rules for drawing assembly drawings; concepts of units of measurement usage related to assembly drawings; application of properties and relationships of triangles and circles to solve geometric shapes related to assembly drawings
  - machine assembly drawing production
  - detail drawings standard machine fits applications
  - drawings for welded component parts
  - parts list (e.g. balloons) development
  - file and/or drawing for CAD/computer-aided manufacturing (CAM) applications
  - gears drawings
  - CAM drawings
  - threads and fasteners (e.g. bolts, pins and keys) use and applications
  - drawings for metal bending and fabricating
  - standard fits, finishes, and tolerances to a machine drawing application

- manufacturing processes (e.g. machine, metal forming and computer numerically controlled (CNC))
- pattern development, including:
  - principles, concepts and purpose of pattern development
  - terms, conventions and codes related to pattern development
  - types and usage techniques of pattern development and related drawings
  - application of pattern development and intersection techniques
  - intersections of geometric surfaces development techniques and applications
  - flat surfaces development techniques and applications
  - construct of objects from the intersection
- maps and profiles design and production to Australian/New Zealand and industry standards, including:
  - principals, concepts and applications of maps and profiles design and production
  - terms, conventions and codes related to maps and profiles design and production
  - maps and profiles design and production types and uses
  - rules for cartography
  - components selection and transit usage
  - symbols usage and applications for topography
  - application of properties and relationships of triangles to solve geometric problems, trigonometric relations to solve right triangles, law of sines and cosines to solve triangles
- pipe/plumbing drawing basics, including:
  - principles, purpose, terms and conventions usage in pipe/plumbing drawings
  - applicable codes, symbols and abbreviations
  - piping symbols, fittings, fixtures and valves
  - types of piping systems and usage techniques in pipe drawings
  - principles of pneumatics and hydraulics
  - pneumatics and hydraulic schematics production
  - plumbing schematics production
  - techniques and applications in creating drawings of piping symbols and systems
- structural steel, welding and sheet metal drawing basics, including:
  - principles, terms and conventions usage in structural steel, welding and sheet metal drawings
  - applicable codes (e.g. WHS/OHS, Standards Australia/New Zealand, building codes and regulations, related standards and codes)
  - classification of major structural and welding components
  - rules and symbols used in structural and welding drawings
  - structural steel shapes
  - steel-framing materials
  - detail and assembly drawings (including beam connections) with bill of materials
  - steel frame plan drawings production

- types and usage techniques of structural and welding drawings
- techniques and applications in creating structural drawings using measuring, labelling, and symbol procedures
- techniques and applications used in drafting the processes for joining metal and standard symbols for welding
- techniques and applications in creating welding drawings complete with weld symbols
- sheet metal layout methods and procedures
- representative sheet metal drawings
- sheet metal drawings for CAD/CAM applications
- ink overlay drawings produced to Australian/New Zealand and industry standards, including:
  - principals, concepts and applications of ink overlay drawings production
  - terms, conventions and codes related to ink production
  - drawing specifications identification and analysis
  - rapid graph equipment usage procedures
- drawings reproductions to Australian/New Zealand and industry standards, including:
  - principals, concepts and applications of drawing reproductions
  - terms, conventions and codes related to processes related to drawing reproductions
  - rules for reproducing drawings
  - various machines usage and selection in the reproduction process
- CAD software and functions
- drawing fundamentals
- electrotechnology/utilities engineering drawings and diagrams
- relevant risk mitigation processes including risk control measures
- relevant WHS/OHS legislated requirements
- relevant workplace documentation
- relevant workplace policies and procedures
- sketching techniques.

## Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must occur in workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated workplace operational situations that replicate workplace conditions.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or other simulations
- relevant and appropriate materials, tools, equipment and personal protective equipment (PPE) currently used in industry
- applicable documentation, including workplace procedures, equipment specifications, regulations, codes of practice and operation manuals.

## Links

Companion Volume implementation guides are found in VETNet - -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6>