

SEMPEO2-32 - SQA Unit Code FP3C 04

Producing electrical or electronic engineering drawings using a CAD system



Overview

This standard covers a broad range of basic competences that you need to set up and operate a computer aided drawing (CAD) system to produce detailed drawings for electrical or electronic engineering activities. It will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or it will provide a basis for the development of additional skills and occupational competences in the working environment.

The types of drawing produced will include circuit and wiring diagrams, block diagrams, schematics, electrical cabling/routeing, installation, assembly of panels and sub-assemblies and system design/modification.

You will be given a specific drawing brief or a request for change/modification to an existing design, and you will be required to access these requirements and to extract all necessary information in order to carry out the drawing operations. You will need to select the appropriate equipment and drawing software to use, based on the type and complexity of the drawing functions to be carried out. You will be expected to use current British, European, International and company standards to produce a drawing template for a range of paper sizes, and must include the drawing title, scale used, date of drawing, and other relevant information.

You will then be expected to produce fully detailed drawings to enable the electrical or electronic circuits to be assembled, installed, maintained, commissioned or modified. On completion of the drawing activities, you will be expected to return all documentation, reference manuals or specifications to the designated location, to shut down the CAD system correctly and to leave the work area in a safe and tidy condition.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for working with the CAD equipment. You will need to take account of any potential difficulties or problems that may arise with the computer hardware, software or drawing procedures, and to seek appropriate help and advice in determining and implementing a suitable solution. You will work under a high level of supervision, whilst taking responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide an understanding of your work, and will enable you to apply safely the appropriate computer aided drawing procedures and techniques for electrical or electronic engineering drawings.

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You will understand the computer system and software used, and its application, and will know about the various tools and techniques used to produce the drawings, to the required depth to provide a sound basis for carrying out the activities to the required specification.

You will understand the safety precautions required when working with the computer drawing system. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

Specific Standard Requirements

In order to prove your ability to combine different electrical/electronic drawing features, at least one of the drawings produced must be of a significant nature, and must have a minimum of **seven** of the features listed in scope 6

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Performance criteria

You must be able to:

- P1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
- P2 plan the drawing activities before you start them
- P3 use appropriate sources to obtain the required information for the drawing to be created
- P4 access and use the correct drawing software
- P5 use appropriate techniques to create drawings, in the required formats, that are sufficiently and clearly detailed
- P6 use codes and other references that follow the required conventions
- P7 make sure that the drawings are checked and approved by the appropriate person
- P8 save the drawings in the appropriate medium and location
- P9 produce hard copies of the finished drawings
- P10 deal promptly and effectively with problems within your control, and seek help and guidance from the relevant people if you have problems that you cannot resolve
- P11 shut down the CAD system to a safe condition on completion of the drawing activities

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Knowledge and understanding

You need to know and understand:

- K1 the specific safety precautions to be taken when working with computer systems (to include safety guidance relating to the use of visual display unit (VDU) equipment and work station environment (such as lighting, seating, positioning of equipment), repetitive strain injury (RSI); the dangers of trailing leads and cables; how to spot faulty or dangerous electrical leads, plugs and connections)
- K2 good housekeeping arrangements (such as cleaning down work surfaces; putting storage devices, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition)
- K3 the methods and procedures used to minimise the chances of infecting a computer with a virus
- K4 the implications if the computer you are using does become infected with a virus and who to contact if it does occur
- K5 the relevant sources and methods for obtaining any required technical information relevant to the drawing being produced (such as drawing briefs, specification sheets, request for changes or modifications to drawings; technical information such as cable current carrying capacity, component values or coding systems, component pin configurations)
- K6 the functionality of the circuit being drawn, and its interrelationship with other circuits and assemblies
- K7 the correct startup and shutdown procedures to be used for the computer systems
- K8 identification of the correct drawing software package from the menu or windows environment; the various techniques that are available to access and use the CAD software (such as mouse, menu or tool bar, light pens, digitisers and tablets, printers or plotters, and scanners)
- K9 the use of software manuals and related documents to aid efficient operation of the relevant drawing system
- K10 how to deal with system problems (such as error messages received, peripherals which do not respond as expected, obvious faults with the equipment or connecting leads)
- K11 types of electrical or electronic drawings that may be produced by the software (such as circuit and wiring diagrams, block and schematic diagrams, assembly and installation drawings)
- K12 the national, international and organisational standards and conventions that are used for the drawings
- K13 how to set up the drawing template parameters (such as layers of drawings, scale, paper size, colour set-up, line types, dimension system and text styles)

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- K14 the application and use of drawing tools (such as for straight lines, curves and circles; how to add dimensions and text to drawings, producing layers of drawings)
- K15 how to access, recognise and use a wide range of standard components and symbol libraries from the CAD equipment
- K16 the factors to be taken into account when producing electrical drawings (such as safety requirements, operating parameters of components, position of components in relation to other sources or circuits, possibility of external interference)
- K17 an understanding of the electrical or electronic equipment and circuits being worked on, and the function of the individual components within the circuits
- K18 the selection of the various components and cables being used (with regard to their operating ranges and current carrying capacity)
- K19 the use of specific regulations and standard reference tables when selecting components and cables
- K20 how power cables might affect/corrupt signal transmission, and the need to consider this in siting and routing cables
- K21 the basic calculations that may be required to be carried out to verify the acceptability of components and circuits (such as Ohm's Law)
- K22 how to save and store drawings (such as determining document size; how to check that there is sufficient space to save the file in your chosen destination; saving and naming the file/drawing)
- K23 the need to create backup copies, and to file them in a separate and safe location
- K24 how to produce hard copies of the drawings, and the advantages and disadvantages of printers and plotters
- K25 when to act on your own initiative and when to seek help and advice from others
- K26 the importance of leaving the work area and equipment in a safe condition on completion of the drawing activities (such as correctly isolated, removing and disposing of waste)

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Additional Information

Scope/range related to performance criteria

You must be able to:

1. Prepare the CAD system for operation by carrying out **all** of the following:
 - 1.1 check that all the equipment is correctly connected and in a safe and usable working condition (such as cables undamaged, correctly connected, safely routed, PAT tested)
 - 1.2 power up the equipment and activate the appropriate drawing software
 - 1.3 set up the drawing system to be able to produce the drawing to the appropriate scale
 - 1.4 set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen, digitiser/tablet, scanner, printer, plotter)
 - 1.5 set the drawing datum at a convenient point (where applicable)
 - 1.6 set up drawing parameters (to include layers, lines type, colour, text styles) to company procedures or to suit the drawing produced
 - 1.7 create a drawing template to the required standards, which includes all necessary detail (such as title, drawing number, scale, material, date)

2. Use **three** of the following to obtain the necessary data to produce the required drawings:
 - 2.1 drawing brief/request
 - 2.2 specifications
 - 2.3 drawing change or modification request
 - 2.4 electrical regulations
 - 2.5 manuals
 - 2.6 previous drawings/designs
 - 2.7 calculations (such as Ohm's law)
 - 2.8 standards
 - 2.9 sketches
 - 2.10 standard reference documents (such as current carrying capacity of cables, electrical or electronic component catalogues)
 - 2.11 notes from meetings/discussions
 - 2.12 other available data

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3. Take into account **four** of the following design features, as appropriate to the drawing being produced:
 - 3.1 function
 - 3.2 operating voltages
 - 3.3 ergonomics
 - 3.4 operating environment
 - 3.5 cost
 - 3.6 lifetime of the product
 - 3.7 tolerances
 - 3.8 interfaces
 - 3.9 aesthetics
 - 3.10 physical space/dimensions of circuit
 - 3.11 power supplies
 - 3.12 safety
 - 3.13 component orientation
 - 3.14 connectors/test point access
 - 3.15 types of components available/to be used
 - 3.16 method of installation (such as conduit, trunking, traywork)
 - 3.17 position of circuit elements/components
 - 3.18 type of cables (such as PVC, mineral insulated)
 - 3.19 connections between components
 - 3.20 uses an appropriate type of circuit (such as digital, analogue, hybrid)
 - 3.21 uses appropriate technology of circuit design (such as single sided, double sided, multi-layer, flexi-rigid)
 - 3.22 meets signal integrity parameters (such as capacitance, inductance, resistance, insulation voltages)
 - 3.23 meets specified operating conditions (such as temperature, humidity, shock and vibration)
 - 3.24 any assembly/manufacturing schedule constraints (such as high profile components mounted after low profile SMT ones)

4. Carry out **all** of the following before producing the engineering drawing:
 - 4.1 ensure that data and information are complete and accurate
 - 4.2 review the data and information to identify the drawing requirements
 - 4.3 recognise and deal with problems (such as information based, technical)

5. Produce **three** of the following types of electrical or electronic engineering drawings:
 - 5.1 circuit diagrams
 - 5.2 general assembly drawings
 - 5.3 installation/commissioning
 - 5.4 wiring diagrams

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- 5.5 panel assembly
 - 5.6 manufacture of cable looms
 - 5.7 block diagrams
 - 5.8 cable and routeing
 - 5.9 fault diagnostics (such as flow diagrams)
 - 5.10 schematics
 - 5.11 circuit board assembly
 - 5.12 system drawings
 - 5.13 circuit board layout
 - 5.14 modifications to equipment/systems (such as cable looms, cable routeing and clipping, panels/sub- assemblies, installation of electrical systems)
6. Produce electrical or electronic drawings which include **ten** of the following:
- 6.1 straight lines
 - 6.2 curved/contour lines
 - 6.3 dimensions
 - 6.4 circles or ellipses
 - 6.5 angled lines
 - 6.6 hidden detail
 - 6.7 text
 - 6.8 parts lists
 - 6.9 insertion of standard electrical or electronic components
 - 6.10 test points
 - 6.11 type and size of cables
 - 6.12 colour/component coding
 - 6.13 connection/termination details
 - 6.14 parts lists
 - 6.15 electrical/electronic symbols and abbreviations
 - 6.16 fault diagnosis (such as flow diagrams)
 - 6.17 other specific electrical or electronic detail
7. Save and store drawings in appropriate locations, to include carrying out **all** of the following:
- 7.1 ensure that your drawing has been checked and approved by the appropriate person(s)
 - 7.2 check that the drawing is correctly titled and referenced
 - 7.3 save the drawing to an appropriate storage medium (such as hard drive, DVD, external storage device)
 - 7.4 create a separate backup copy, and place it in safe storage
 - 7.5 produce a hard copy printout of the drawing for file purposes
 - 7.6 register and store the drawings in the appropriate company information system (where appropriate)
 - 7.7 where appropriate, record and store any changes to the drawings

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in the appropriate company information system

8. Produce drawings which comply with the following:
 - 8.1 BS and ISO standards and proceduresPlus **one** more from the following:
 - 8.2 organisational guidelines
 - 8.3 statutory regulations and codes of practice
 - 8.4 CAD software standards
 - 8.5 other international standards

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