

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce mechanical engineering drawings using a CAD system	2.1	Describe 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)			
		2.2	Describe good housekeeping arrangements (such as cleaning down work surfaces; storage devices, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition)			
		2.3	Describe the methods and procedures used to minimise the chances of infecting a computer with a virus			
		2.4	Describe the implications if the computer they are using does become infected with a virus and who to contact if it does occur			
		2.5	Describe 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 limits and fits, contraction allowances, bearing selection, surface finish)			
		2.6	Describe the basic principles of engineering manufacturing operations, assembly and installation methods, and limitations of the equipment/processes that are used to produce the drawn item (such as machining methods, joining processes, fabrication, casting and forging), and how these can influence the way they present the drawing			
		2.7	Describe the functionality of the component being drawn, and its interrelationship with other components and assemblies			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	2.8	Describe the correct start-up and shutdown procedures to be used for the computer systems			
	2.9	Describe the identification of the correct drawing software package from the menu or operating 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)			
	2.10	Describe the use of software manuals and related documents to aid efficient operation of the relevant drawing system			
	2.11	Explain 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)			
	2.12	Describe the types of drawings that may be produced by the software (such as first and third angle drawings, sectional elevations, isometric or oblique drawings)			
	2.13	Explain how to set up the viewing screen to show multiple views of the drawing to help with drawing creation (to include isometric front and side elevations)			
	2.14	Describe the national, international and organisational standards and conventions that are used for the drawings			
	2.15	Explain how to set up the drawing template parameters (such as layers of drawings, scale, paper size, colour setup, line types, dimension system and text styles)			
	2.16	Describe the application and use of drawing tools (such as for straight lines, curves and circles; how to create hatching and shading on drawings; how to add dimensions and text to drawings; producing layers of drawings)			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		2.17 Explain how to access, recognise and use a wide range of standard components and symbol libraries from the CAD equipment			
		2.18 Describe the need for document control (such as ensuring that completed drawings are approved, labelled and stored on a suitable storage medium)			
		2.19 Explain how to save and store drawings, (such as determining document size; how to check that there is sufficient space to save the file in their chosen destination; saving and naming the file/drawing)			
		2.20 Describe the need to create backup copies, and to file them in a separate and safe location			
		2.21 Explain how to produce hard copies of the drawings, and the advantages and disadvantages of printers and plotters			
		2.22 Explain when to act on their own initiative and when to seek help and advice from others			
		2.23 Describe 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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(if sampled)

Unit 5: Producing Electrical or Electronic Engineering Drawings Using a CAD System

Unit reference number: R/504/6421

QCF level: 2

Credit value: 11

Guided learning hours: 61

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce electrical or electronic engineering drawings using a CAD system. It will prepare the learner 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.

Unit assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be found in Annexe A.

Additional assessment requirements have been published by Semta. Please refer to the Performing Engineering Operations NVQ assessment strategy in Annexe B.

Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Produce electrical or electronic engineering drawings using a CAD system	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.2 Prepare the CAD system for operation by carrying out all of the following: <ul style="list-style-type: none"> • 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) • Power up the equipment and activate the appropriate drawing software • Set up the drawing system to be able to produce the drawing to the appropriate scale • Set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen, digitiser/tablet, scanner, printer, plotter) • Set the drawing datum at a convenient point (where applicable) • Set up drawing parameters (to include layers, lines type, colour, text styles) to company procedures or to suit the drawing produced • Create a drawing template to the required standards, which includes all necessary detail (such as title, drawing number, scale, material, date) 			
	1.3 Plan the drawing activities before they start them			
	1.4 Use appropriate sources to obtain the required information for the drawing to be created			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 Use three of the following to obtain the necessary data to produce the required drawings: <ul style="list-style-type: none"> • Drawing brief/request • Drawing change or modification request • Manuals • Calculations (such as Ohm's law) • Sketches • Specifications • Electrical regulations • Previous drawings/designs • Standards • Standard reference documents (such as current carrying capacity of cables, electrical or electronic component catalogues) • Notes from meetings/discussions • Other available data 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 Take into account four of the following design features, as appropriate to the drawing being produced: <ul style="list-style-type: none"> • Function • Operating environment • Tolerances • Physical space/dimensions of circuit • Component orientation • Operating voltages • Cost • Interfaces • Power supplies • Connectors/test point access • Ergonomics • Lifetime of the product • Aesthetics • Safety • Types of components available/to be used • Position of circuit elements/components • Connections between components • Method of installation (such as conduit, trunking, traywork) • Type of cables (such as PVC, mineral insulated) 			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	1.6	...continued <ul style="list-style-type: none"> • Uses an appropriate type of circuit (such as digital, analogue, hybrid) • Uses appropriate technology of circuit design (such as single sided, double sided, multi-layer, flexi-rigid) • Meets signal integrity parameters (such as capacitance, inductance, resistance, insulation voltages) • Meets specified operating conditions (such as temperature, humidity, shock and vibration) • Any assembly/manufacturing schedule constraints (such as high profile components mounted after low profile SMT ones) 			
	1.7	Carry out all of the following before producing the engineering drawing: <ul style="list-style-type: none"> • Ensure that data and information are complete and accurate • Review the data and information to identify the drawing requirements • Recognise and deal with problems (such as information based, technical) 			
	1.8	Access and use the correct drawing software			
	1.9	Use appropriate techniques to create drawings, in the required formats, that are sufficiently and clearly detailed			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 Produce three of the following types of electrical or electronic engineering drawings: <ul style="list-style-type: none"> • Circuit diagrams • Wiring diagrams • Block diagrams • Schematics • System drawings • General assembly drawings • Panel assembly • Cable and routing • Circuit board assembly • Circuit board layout • Installation/commissioning • Manufacture of cable looms • Fault diagnostics (such as flow diagrams) • Modifications to equipment/systems (such as cable looms, cable routing and clipping, panels/sub-assemblies, installation of electrical systems) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.11 Produce electrical or electronic drawings which include ten of the following: <ul style="list-style-type: none"> • Straight lines • Dimensions • Angled lines • Text • Insertion of standard electrical or electronic components • Type and size of cables • Connection/termination details • Electrical/electronic symbols and abbreviations • Fault diagnosis (such as flow diagrams) • Curved/contour lines • Circles or ellipses • Hidden detail • Parts lists • Test points • Colour/component coding • Parts lists • Other specific electrical or electronic detail 			
	1.12 Use codes and other references that follow the required conventions			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	1.13	Produce drawings which comply with the following: <ul style="list-style-type: none"> • BS and ISO standards and procedures Plus one more from the following: <ul style="list-style-type: none"> • Organisational guidelines • Statutory regulations and codes of practice • CAD software standards • Other international standards 			
	1.14	Make sure that the drawings are checked and approved by the appropriate person			
	1.15	Save and store drawings in appropriate locations, to include carrying out all of the following: <ul style="list-style-type: none"> • Ensure that their drawing has been checked and approved by the appropriate person(s) • Check that the drawing is correctly titled and referenced • Save the drawing to an appropriate storage medium (such as hard drive, DVD, external storage device) • Create a separate backup copy, and place it in safe storage • Produce a hard copy printout of the drawing for file purposes • Register and store the drawings in the appropriate company information system (where appropriate) • Where appropriate, record and store any changes to the drawings in the appropriate company information system 			
	1.16	Save the drawings in the appropriate medium and location			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		1.17 Produce hard copies of the finished drawings			
		1.18 Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve			
		1.19 Shut down the CAD system to a safe condition on completion of the drawing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce electrical or electronic engineering drawings using a CAD system	2.1	Describe 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)			
		2.2	Describe 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)			
		2.3	Describe the methods and procedures used to minimise the chances of infecting a computer with a virus			
		2.4	Describe the implications if the computer they are using does become infected with a virus and who to contact if it does occur			
		2.5	Describe 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)			
		2.6	Describe the functionality of the circuit being drawn, and its interrelationship with other circuits and assemblies			
		2.7	Describe the correct startup and shutdown procedures to be used for the computer systems			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	2.8	Describe the 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)			
	2.9	Describe the use of software manuals and related documents to aid efficient operation of the relevant drawing system			
	2.10	Explain 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)			
	2.11	Describe the 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)			
	2.12	Describe the national, international and organisational standards and conventions that are used for the drawings			
	2.13	Explain 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)			
	2.14	Describe 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)			
	2.15	Explain how to access, recognise and use a wide range of standard components and symbol libraries from the CAD equipment			
	2.16	Describe 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)			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	2.17	Describe their understanding of the electrical or electronic equipment and circuits being worked on, and the function of the individual components within the circuits			
	2.18	Describe the selection of the various components and cables being used (with regard to their operating ranges and current carrying capacity)			
	2.19	Describe the use of specific regulations and standard reference tables when selecting components and cables			
	2.20	Explain how power cables might affect/corrupt signal transmission, and the need to consider this in siting and routing cables			
	2.21	Describe the basic calculations that may be required to be carried out to verify the acceptability of components and circuits (such as Ohm's Law)			
	2.22	Explain how to save and store drawings (such as determining document size; how to check that there is sufficient space to save the file in their chosen destination; saving and naming the file/drawing)			
	2.23	Describe the need to create backup copies, and to file them in a separate and safe location			
	2.24	Explain how to produce hard copies of the drawings, and the advantages and disadvantages of printers and plotters			
	2.25	Explain when to act on their own initiative and when to seek help and advice from others			
	2.26	Describe 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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Unit 6: Producing CAD Models/Drawings Using a CAD System

Unit reference number: R/504/6452

QCF level: 2

Credit value: 11

Guided learning hours: 61

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce CAD models/drawings using a CAD system. It will prepare the learner 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.

Unit assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be found in Annexe A.

Additional assessment requirements have been published by Semta. Please refer to the Performing Engineering Operations NVQ assessment strategy in Annexe B.

Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Produce CAD models (drawings) using a CAD system	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Prepare the CAD system for operation, by carrying out all of the following: <ul style="list-style-type: none"> • Check that all the equipment is correctly connected and in a safe, PAT tested and usable working condition (such as cables undamaged, correctly connected, safely routed) • Power up the equipment and activate the appropriate modelling software • Set up the modelling environment and select a suitable template/folder • Set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen, digitiser/tablet, scanner, printer, plotter) • Set the drawing datum at a convenient point (where applicable) • Create a modelling template to the required standards, which includes all necessary detail (such as title, file/drawing number, material, date) 			
		1.3	Plan the modelling activities before they start them			
		1.4	Use appropriate sources to obtain the required information for the model to be created			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		1.5 Use three of the following to obtain the necessary data to produce the required model: <ul style="list-style-type: none"> • Model brief/request • Change order/modification request • Manuals • Calculations • Sketches • Specifications • Regulations • Sample component • Previous models/designs • Standards reference documents (such as limits and fits, tapping drill charts) • Notes from meetings/discussions • Other available data 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 Take into account three of the following, as appropriate to the model being produced: <ul style="list-style-type: none"> • Function • Quality • Manufacturing method • Ergonomics • Materials • Cost • Lifetime of the product • Tolerances • Clearance • Aesthetics • Physical space • Operating environment • Interfaces • Safety 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 Take into account three of the following, as appropriate to the model being produced: <ul style="list-style-type: none"> • Function • Quality • Manufacturing method • Ergonomics • Materials • Cost • Lifetime of the product • Tolerances • Clearance • Aesthetics • Physical space • Operating environment • Interfaces • Safety 			
	1.8 Carry out all of the following before producing the engineering model: <ul style="list-style-type: none"> • Ensure that the data and information they have is complete and accurate • Review the data and information to identify the model requirements • Recognise and deal with problems (such as lack of, or incorrect, information and technical issues) 			
	1.9 Access and use the correct modelling software			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		1.10 Use appropriate techniques to create models that are sufficiently and clearly detailed			
		1.11 Use one of the following modelling tools: <ul style="list-style-type: none"> • Surface modelling • Solid modelling • Wire frame modelling 			
		1.12 Use all of the following CAD operations to highlight design areas in the modelling environment: <ul style="list-style-type: none"> • Pan • Isometric • Zoom 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.13 Produce models which include the use eight of the following from the part feature menu: <ul style="list-style-type: none"> • Extrude • Revolve • Hide • Fillet • Shell • Solid model • Wire frame • Rib • Cut/remove • Mirror • Radius • Rectangular pattern • Circular pattern • Other specific feature 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.14 Modify parts in the assembly environment using the following feature: <ul style="list-style-type: none"> • Constrained parts and assemblies Plus eight more from the following: <ul style="list-style-type: none"> • Straight lines • Dimensions • Angular surfaces • Text • Surface texture • Insertion of standard components • Symbols and abbreviations • Curved surfaces • Circles or ellipses • Material colour • Hidden detail • Hatching and shading • Parts lists • Other specific detail 			
	1.15 Produce a model for export to one of the following manufacturing systems: <ul style="list-style-type: none"> • CNC machine • 3D printer • Other specific system 			
	1.16 Use codes and other references that follow the required conventions			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.17 Produce models which comply with one or more of the following: <ul style="list-style-type: none"> • Organisational guidelines • Statutory regulations and codes of practice • CAD software standards • BS and ISO standards • Other international standard 			
	1.18 Make sure that models are checked and approved by the appropriate person			
	1.19 Save the models in the appropriate file type and location			
	1.20 Save and store models in appropriate locations, to include carrying out all of the following: <ul style="list-style-type: none"> • Ensure that their model has been checked and that it complies to their company QA procedure • Check that the model is correctly titled, referenced and annotated • Save the model to an appropriate storage medium (such as hard drive, DVD, external storage device) • Create a separate backup copy, and place it in safe storage • Register and store the models in the appropriate company information system (where appropriate) • Record and store any changes to the models in the appropriate company information system (where appropriate) 			
	1.21 Produce hard copies of the finished models, with sufficient detail to allow production			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.22	Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve			
		1.23	Shut down the CAD system to a safe condition on completion of the modelling activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce CAD models (drawings) using a CAD system	2.1	Describe 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)			
		2.2	Describe the importance of 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)			
		2.3	Describe the relevant sources and methods for obtaining any required technical information relevant to the model being produced (such as drawing briefs, specification sheets, request for changes or modifications to models; technical information such as limits and fits, contraction allowances, bearing selection, surface finish)			
		2.4	Describe the identification of the correct 3D 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)			
		2.5	Describe the correct start-up and shutdown procedures to be used for the computer systems			
		2.6	Explain how to access the specific computer modelling software to be used, and the use of the help file to aid efficient operation of the relevant drawing system			
		2.7	Explain 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)			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	2.8	Describe the documentation required for particular applications (such as design briefs, specification sheets, request for change orders)			
	2.9	Describe the types of drawings that may be produced by the modelling software			
	2.10	Explain how to set up the viewing screen to show multiple views of the component to help with drawing creation (to include isometric front and side elevations)			
	2.11	Describe the national, international and organisational standards and conventions that are used for the models/drawings			
	2.12	Describe the application and use of modelling tools (such as for straight lines, curves and circles; how to add dimensions and text to drawings)			
	2.13	Explain how to access, recognise and use a wide range of standard components and symbol libraries from the CAD equipment			
	2.14	Describe the applications of different 3D modelling programmes (such as surface, solid and wire frame)			
	2.15	Explain how to produce models with sufficient information to allow them to be successfully exported to the manufacturing system used			
	2.16	Describe the need for document control (such as ensuring that completed models are approved, labelled and stored on a suitable storage medium)			
	2.17	Explain why it is necessary to be able to recall previous issues of modified models			
	2.18	Describe the need to create backup copies, and to file them in a separate and safe location also filing and storing hard copies for use in production			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Explain how to produce hard copies of the drawings, and the advantages and disadvantages of printers and plotters			
		2.20	Explain when to act on their own initiative and when to seek help and advice from others			
		2.21	Describe 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)			

Learner name: _____

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Assessor signature: _____

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Internal verifier signature: _____

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Unit 7: Producing Engineering Project Plans

Unit reference number: Y/504/6453

QCF level: 2

Credit value: 8

Guided learning hours: 37

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce engineering project plans. It will prepare the learner 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.

Unit assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be found in Annexe A.

Additional assessment requirements have been published by Semta. Please refer to the Performing Engineering Operations NVQ assessment strategy in Annexe B.

Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Produce engineering project plans	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Produce detailed engineering project plans for one of the following: <ul style="list-style-type: none"> • Manufacturing operations • Research and development • Cleaning of equipment • Maintenance of equipment • Testing and trialling • Process procedures • Installation of equipment • Modification or repair 			
		1.3	Determine the scope of the project and the processes required to achieve it			
		1.4	Collect all the information needed to prepare the project plan			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
		1.5 Prepare for the project planning activity by carrying out all of the following: <ul style="list-style-type: none"> • Determine and set the aims and objectives of the project • Obtain all essential information and data needed to produce the project plans • Collect relevant information on the engineering requirements, operations, methods and resources • Determine the availability of the resources required • Ensure that health and safety regulations and safe working practices are taken into account • Present the engineering plans in the appropriate formats 			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	1.6	Determine the resources required to include five of the following: <ul style="list-style-type: none"> • People required who have the necessary skills and knowledge • The raw materials required (such as types of material, forms of material, amounts of material) • Mechanical fasteners required (such as nuts, bolts, rivets, cable clips) • Bought-in standard components required (such as bearings, electrical or electronic components, fluid power components) • Equipment required (such as hand tools, power tools, machinery, lifting and handling equipment) • Measuring or test equipment required (such as mechanical measuring, electrical measuring) • Consumable materials required (such as welding accessories, masking mediums, oil) • Any outside support services required (such as material treatments like hardening or plating) • Special/specific safety equipment required (such as fume extraction) 			
	1.7	Identify the specific operations to be carried out, and determine their sequence			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 Produce detailed work instructions of the specific processes required, to include all of the following: <ul style="list-style-type: none"> • Details of the drawing/specification to be used (such as drawing number, maintenance manual) • Specific materials required for this part of the process/operation • The specific tools and equipment required for each operation being carried out • The specific operations to be carried out • The specific sequence in which the operations must be carried out • The specific time to produce/complete the operations • Quality control checks that need to be implemented 			
	1.9 Identify health and safety issues, and safe working practices and procedures that must be followed			
	1.10 Estimate timescales required and costs to complete the project			
	1.11 Prepare a detailed project plan which accurately reflects the project aims and objectives			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.12 Produce engineering project plans that include both of the following: The use of a Gantt Chart showing estimates of the timeframe for the project, to include all of the following:</p> <ul style="list-style-type: none"> • Start time of the project • Outcomes to be achieved at milestones • Completion date of the project <p>And an estimate of the likely costs of the project, to include all of the following:</p> <ul style="list-style-type: none"> • Material costs (to include raw, consumable, bought-in) • Labour costs (based on the estimated working time and a fixed manufacturing cost figure) • Overhead costs 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.13 Prepare engineering project plans that include all of the following: <ul style="list-style-type: none"> • The aims and objectives of the engineering project being undertaken • Description of the activities to be carried out • The sequence in which the activities will take place • The documentation to be used (such as drawings, specifications, quality assurance) • Tooling requirements (such as jigs, fixtures, cutting tools, moulds) • Resources required • The timescales to be met • Any special requirements that must be met (such as details of health and safety issues) • Outcomes in terms of quality, cost and delivery (when needed) • People involved, and their responsibilities (such as decision maker, individuals that must be consulted/informed, people who can give advice) • How the project will be proved and evaluated 			
	1.14 Ensure that project plans include any relevant regulations, standards and guidelines, including all of the following: <ul style="list-style-type: none"> • Health and safety requirements • BS and ISO standards and procedures • Company policy and procedures 			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		1.15 Record and present the plans to the appropriate people, using the following methods: <ul style="list-style-type: none"> • Verbal report Plus one more method from the following: <ul style="list-style-type: none"> • Written or typed report • Specific company documentation • Computer based presentation 			
		1.16 Obtain approval for the project plan from the appropriate people			
		1.17 Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce engineering project plans	2.1	Explain how to access information on health and safety regulations and guidelines relating to the engineering activities to be used and project plans being produced			
		2.2	Describe the implications of not taking account of legislation, regulations, standards and guidelines when producing the engineering project plans			
		2.3	Explain how to obtain information on the engineering requirements, and the type of information that is available (such as customer specifications and instructions, quality control requirements, product drawings/specification, manufacturing methods)			
		2.4	Explain how to access and use the appropriate information and documentation systems			
		2.5	Describe the types of data that should be included in the engineering project plans (such as aims and objectives of the project, activities to be carried out, sequence in which they must be carried out, timescales, resource requirements, health and safety issues)			
		2.6	Explain how to extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work being planned			
		2.7	Describe the materials, formats, codes and conventions that are used in preparing the engineering project plans			
		2.8	Describe the main project planning methods and techniques in use, and what problems could occur with them			
		2.9	Describe the factors to be taken into account when preparing the project plans, especially those covering working conditions and safety			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	2.10	Describe the main types of resource involved with the various types of engineering activity (such as raw materials, bought-in components, plant and equipment, lifting and handling equipment, tooling and measuring and test equipment)			
	2.11	Describe the obvious (and hidden) costs of resources/activities			
	2.12	Describe the normal timescales for carrying out specific engineering activities, and how and why they vary			
	2.13	Explain how to arrive at an estimate of timescales for the project, and the need to set milestones for achievement			
	2.14	Explain how to estimate the likely costs of the project (including the cost of raw materials, people and overheads)			
	2.15	Describe the products (or assets) involved in the activity being planned, and how to determine their availability			
	2.16	Describe the development of the engineering project plans (to include both master documents and working instructions, along with their purpose, content and status)			
	2.17	Explain how to write project plans that specify quality, cost and delivery requirements (including allocation of responsibilities and milestone targets)			
	2.18	Explain how to prepare the plans (to include the structure, style, clarity and compliance with relevant standards)			
	2.19	Describe the process used in the organisation to validate the engineering plans produced			
	2.20	Describe the procedures for changing the plans, and why control procedures are used			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		2.21 Describe the procedures and process for project plan approval, and why these procedures and processes are used			
		2.22 Describe the importance of maintaining records, what needs to be recorded and where records are kept			
		2.23 Explain why contingency plans need to be drawn up			
		2.24 Describe the different ways of presenting information to different people			
		2.25 Describe the importance of providing the right information at the right time			
		2.26 Describe the typical of problems that can occur during the implementation of the plan, and how these problems can be rectified			
		2.27 Explain when to act on their own initiative and when to seek help and advice from others			

Learner name: _____

Date: _____

Learner signature: _____

Date: _____

Assessor signature: _____

Date: _____

Internal verifier signature: _____

Date: _____

(if sampled)

Unit 8: Using Computer Software Packages to Assist with Engineering Activities

Unit reference number: D/504/6454

QCF level: 2

Credit value: 8

Guided learning hours: 37

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to use computer software packages to assist with engineering activities. It will prepare the learner 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.

Unit assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be found in Annexe A.

Additional assessment requirements have been published by Semta. Please refer to the Performing Engineering Operations NVQ assessment strategy in Annexe B.

Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Use computer software packages to assist with engineering activities	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Check that all connections to the computer and peripherals are correctly connected and in a safe working condition			
		1.3	Prepare the computer system for operation, by carrying out all of the following: <ul style="list-style-type: none"> • 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) • Power up the equipment and, where appropriate, log in as a user • Check that all peripheral devices are operating correctly (such as keyboard, mouse, light pen, web camera, digitiser/tablet, scanner, printer/plotter) • Create and maintain folders and files, in accordance with organisational procedures 			
		1.4	Power up the equipment, using the correct operating procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Use appropriate sources to obtain the required information for the activities to be undertaken			
		1.6	Access the correct application software for the activities undertaken			
		1.7	Use appropriate techniques to create files and documents, in the required formats, that are sufficiently and clearly detailed			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.8 Use all of the following software packages:</p> <p>Word-processing:</p> <p>Produce three of the following types of documentation:</p> <ul style="list-style-type: none"> • Standard letter • Memorandum • Facsimile • Curriculum vitae (CV) • Project report • Instruction manual • Work timetable • Layouts/templates • Macros • Other specific application <p>Database:</p> <p>Create and use a database for two of the following applications:</p> <ul style="list-style-type: none"> • Personnel details list • Address list (such as for mail merging) • Customer/sales details • Stock control (such as tools or consumables) • Plant maintenance information • Fault diagnosis information • Other specific application 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.8 ...continued</p> <p>Spreadsheet: Create and use spreadsheets for two of the following applications:</p> <ul style="list-style-type: none"> • Budgeting • Cost analysis (such as transport, photocopying, materials) • Wages • Project costing • Other specific application <p>Graphics: Use graphics software to produce two of the following types of documentation:</p> <ul style="list-style-type: none"> • Preparing visual aids for a presentation • Producing advertising material • Producing technical information • Producing logbook entries • Other specific application <p>Electronic communication: Use two of the following methods :</p> <ul style="list-style-type: none"> • Company e-mail system • Internet e-mail • Mobile text messaging • Web camera chat/conferencing 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.9 Carry out all of the following whilst using the software packages:</p> <ul style="list-style-type: none"> • Ensure that they have all the required information/data for the activities to be carried out • Open or create a suitable word processing file/format document which will display the information effectively • Create a suitable spreadsheet/worksheet which contains a suitable number of cells and rows of the required width • Where appropriate, enter formulae at the relevant point within the worksheet • Use graphs which are representative of the information to be shown • Create a suitable database with appropriate alpha/numeric fields and search facilities • Use a font style and size of text in keeping with organisational codes and specific job requirements • Enter alpha and numeric data/text accurately into the correct location • Select and use appropriate text features (such as bold, italics, colour, underline) • Import and export information to and from other files or software packages • Correct routine errors or mistakes in operation • Edit documents, using appropriate techniques for the package being used (such as using sort, search and replace, spelling and grammar checks) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 Save and store files in appropriate locations, to include carrying out all of the following: <ul style="list-style-type: none"> • Create a group of folders or directories in which related files can be stored • Check that the file/document is correctly titled and referenced • Determine the size of the file/document, and check for sufficient space on the storage device for saving it • Save the file/document to an appropriate storage medium (such as hard drive, DVD, external storage device) • Where appropriate, create a separate backup copy and place it in safe storage • Produce a hard copy printout of the file/document 			
	1.11 Use computer software packages in compliance with one or more of the following: <ul style="list-style-type: none"> • Organisational guidelines • Statutory regulations and codes of practice • Computer software standards • BS and ISO standards 			
	1.12 Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve			
	1.13 Shut down the computer system to a safe condition on completion of the activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to use computer software packages to assist with engineering activities	2.1	Describe 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, also PAT test is in date			
		2.2	Describe the importance of good housekeeping arrangements (such as cleaning down work surfaces; storage devices, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition)			
		2.3	Describe the correct start-up and shutdown procedures to be used for the computer systems			
		2.4	Describe the methods and procedures used to minimise the chances of infecting a computer with a virus			
		2.5	Describe the implications if the computer they are using does become infected with a virus and who to contact if it does occur			
		2.6	Describe the identification of the correct software package from the menu or operating systems environment; the various techniques that are available to access and use the software (such as mouse, menu or tool bar, light pens, digitisers and tablets, printers or plotters, and scanners)			
		2.7	Describe the use of software manuals or help facilities and related documents to aid efficient operation of the relevant software system			
		2.8	Explain 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)			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		2.9 Describe the various software packages that are used within an engineering environment (such as word processing, databases, spreadsheets, graphic design and drawing packages, and electronic communication)			
		2.10 Describe the use of personal access codes, and logging on/off procedures that are required			
		2.11 Describe the various standard document formats that are used (such as letters, memoranda, facsimile, technical reports)			
		2.12 Explain how to create and set up a spreadsheet/worksheet, and how to determine and set out the required number of cells, rows, cell width			
		2.13 Explain how to create a database record, and how to determine and set out the required alpha/numeric fields of the correct size and type			
		2.14 Explain how to enter alpha/numeric and formulaic data, using keyboards, mouse and menu/tool bar facilities			
		2.15 Explain how to use highlighting/enhancement features and techniques			
		2.16 Explain how to edit documents using sort, search and edit facilities, spelling and grammar checks			
		2.17 Explain how to create tables, charts and graphs			
		2.18 Explain how to import and export files to and from other locations and other software packages			
		2.19 Explain how to save and store files/documents (such as determining document size; how to check that there is sufficient space to save the file in their chosen destination; saving and naming the file/document)			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		2.20 Describe the need to create backup copies, and to file them in a separate and safe location away from contamination and possible corruption			
		2.21 Explain how to produce hard copies of the documents that they have been working on			
		2.22 Explain when to act on their own initiative and when to seek help and advice from others			
		2.23 Describe the importance of leaving the work area and equipment in a safe condition on completion of the activities (such as correctly isolated, removing and disposing of waste)			

Learner name: _____

Date: _____

Learner signature: _____

Date: _____

Assessor signature: _____

Date: _____

Internal verifier signature: _____

Date: _____

(if sampled)

Unit 9: Conducting Business Improvement Activities

Unit reference number: H/504/6455

QCF level: 2

Credit value: 8

Guided learning hours: 41

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to conduct business improvement activities. It will prepare the learner 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.

Unit assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be found in Annexe A.

Additional assessment requirements have been published by Semta. Please refer to the Performing Engineering Operations NVQ assessment strategy in Annexe B.

Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Conduct business improvement activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			
		1.2	Apply and document a systematic plan, do, check, act (PDCA) approach to problems/improvement activities			
		1.3	Identify improvements within the operation or process for three of the following: <ul style="list-style-type: none"> • Reduced product cost • Improved safety • Improvement in delivery performance • Reduction in lead times • Resource utilisation • Improved quality • Improvements to working practices • Reduction in waste and/or energy usage • Improvement in customer satisfaction 			
		1.4	Apply the principles of workplace organisation to an operation or process using a 5S/5C audit and a 'red tag' exercise			
		1.5	Identify where information and/or resources are missing and where improvement can be made to increase the 5S/5C score			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	1.6	Apply the principle and processes of visual management to a operation or process using a variety of visual management techniques			
	1.7	Identify appropriate parts of the operation or process that will have visual controls			
	1.8	Identify key performance indicators that will be displayed in the work area			
	1.9	Determine and calculate both of the following: <ul style="list-style-type: none"> • Not right first time • Delivery schedule achievement Plus one more of the following: <ul style="list-style-type: none"> • Parts per operator hour (PPOH) • Value added per person (VAPP) • Cost breakdown in term of labour, material and overhead • Overall equipment effectiveness (OEE) • Stock turns • Floor space utilization (FSU) 			
	1.10	Produce or update a standard operating procedure (SOP) and visual controls for the operation or process			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		1.11 Produce/contribute to improvements in existing standard operating procedures for three of the following: <ul style="list-style-type: none"> • Customer service • Cleaning of equipment/work area • Maintenance of equipment • Health and safety practices • Process procedures • Manufacturing operations • Product quality • Staff development 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.12 Create and/or update visual controls that promote six of the following: <ul style="list-style-type: none"> • Producing shadow boards to standardise the storage and location of area equipment • Colour coding of equipment • Safety • Zero defects • Performance measures • Process control boards • Parts control system • Skills matrices • Process concerns or corrective actions • Work in progress locations and quantities (WIP) • Standard operating procedures • Workplace organisation • Problem resolution (such as Kaizen boards) • Autonomous maintenance worksheets 			
	1.13 Deal promptly and effectively with problems within their control and seek help and guidance from the relevant people when they have problems they cannot resolve			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.14 Record and present the records from business improvement activities to the appropriate people using: <ul style="list-style-type: none"> • Verbal report using visual aids such as flipcharts and white boards Plus one more method from the following: <ul style="list-style-type: none"> • Written or typed report • Specific company documentation • Computer based presentation 			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to conduct business improvement activities	2.1	Describe the health and safety requirements of the area in which they are carrying out the business improvement activities			
		2.2	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.3	Describe the implications of not taking account of legislation, regulations, standards and guidelines when conducting business improvement activities			
		2.4	Explain what is meant by business improvement, and how continuous improvement activities can benefit a company			
		2.5	Describe the application of the seven key measures of competitiveness (delivered right first time, delivery schedule achievement, people productivity, stock turns, overall equipment effectiveness, value added per person, floor space utilisation)			
		2.6	Explain how to obtain and interpret information on the engineering/manufacturing operation or process requirements (such as customer specifications and instructions, quality control requirements, product drawings/specification, methods and techniques to be used)			
		2.7	Describe the eight wastes (over-production, inventory, transport, over-processing, waiting time, operator motion, bad quality, failure to exploit human potential) and how to eliminate these forms of waste in a process or operation			
		2.8	Describe the steps in a 5S/5C audit and a 'red tag' exercise and how to carry them out			
		2.9	Explain how to score and audit the 5S/5C exercise			
		2.10	Explain how to arrange and label the necessary equipment for rapid identification and access			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.11 Explain how to use “root cause” problem solving analysis using the 5 Whys/How technique			
	2.12 Explain how to evaluate improvement ideas in order to select those that are to be pursued			
	2.13 Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
	2.14 Explain how to create standard operating procedures (SOPs) and correlate work activities into them			
	2.15 Describe the techniques required to communicate information using visual control systems (such as Kanban systems, card systems, colour coding, floor footprints, graphs, team boards, tool/equipment shadow boards)			
	2.16 Explain how information and equipment can be displayed for various work applications (IT systems)			
	2.17 Describe the extent of their own authority and whom they should report to, in the event of problems that they cannot resolve			

Learner name: _____

Date: _____

Learner signature: _____

Date: _____

Assessor signature: _____

Date: _____

Internal verifier signature: _____

Date: _____

(if sampled)

Unit 10: General Machining, Fitting and Assembly Applications

Unit reference number: K/504/6456

QCF level: 2

Credit value: 12

Guided learning hours: 55

Unit aim

This unit covers the skills and knowledge needed to prove the competences required for general machining, fitting and assembly applications. It will prepare the learner 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.

Unit assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be found in Annexe A.

Additional assessment requirements have been published by Semta. Please refer to the Performing Engineering Operations NVQ assessment strategy in Annexe B.

Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Carry out general machining, fitting and assembly applications	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Carry out all of the following during the machining, fitting and assembly activities: <ul style="list-style-type: none"> • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Ensure that all hand tools and equipment used are in a safe and serviceable condition (such as cables to hand tools and extension leads, file handles, hammer striking faces) • Ensure that all machine tools are correctly guarded at all times • Check that all measuring equipment is within calibration date • Return all tools and equipment to the correct location on completion of the fitting activities 			
		1.3	Determine what has to be done and how they are going to do it			
		1.4	Obtain the appropriate tools and equipment for the manufacturing operations			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		1.5 Mark out the components for the required operations, using appropriate tools and techniques to include all of the following: <ul style="list-style-type: none"> • Preparing/determining suitable datums from which to mark out (such as choosing a machine face or filing a flat face as a datum) • Applying a marking medium to enhance clarity of the marking out • Using an appropriate method of marking out (such as direct marking using instruments, use of templates or tracing/transfer methods) • Using a range of marking out equipment (such as rules, squares, scribes, Vernier instruments) • Marking out a range of features (such as datum/centre lines, square/rectangular profiles, circles/radial profiles, hole positions) 			
		1.6 Cut and shape the materials to the required specification, using appropriate tools and techniques			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 Cut and shape two different types of material from the following: <ul style="list-style-type: none"> • Low carbon/mild steel • High carbon steel • Cast iron • Stainless steel • Aluminium/aluminium alloys • Brass/brass alloys • Plastic/nylon/synthetic • Composite • Other specific material 			
	1.8 Use appropriate methods and techniques to assemble and secure the components in their correct positions			
	1.9 Use three of the following workholding devices: <ul style="list-style-type: none"> • Bench vice • Machine vice • Clamps (such as toolmaker's) • Three-jaw chuck • Four-jaw chuck • Collet chuck • Drive plate and centres 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 Use a range of hand fitting methods, to include all of the following: <ul style="list-style-type: none"> • Cutting out the rough profile using saws (such as hacksaw, band saw) • Cutting a screw thread (such as by tapping or dieing) • Filing flat and square • Filing a curved profile • Drilling holes 			
	1.11 Produce mechanical assemblies, using six of the following methods and techniques: <ul style="list-style-type: none"> • Assembling components having interference fits (such as by pressure, expansion or contraction) • Securing components using threaded fasteners (such as nuts, bolts, machine screws, cap screws) • Securing components using spring clips (such as external circlips, internal circlips, special clips) • Using locking and retaining devices (such as tab washers, locking nuts, wire locks, special purpose types) • Securing components using rivets (such as countersunk, roundhead, blind, special purpose types) • Applying sealing compounds or adhesives • Electrical bonding of components • Setting and adjusting components to give correct working parameters (such as shimming and packing) • Torque setting of nuts and bolts 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.12 Carry out turning operations to include all of the following: <ul style="list-style-type: none"> • Mounting the workpiece in an appropriate workholding device • Mounting cutting tools in tool holders to give the correct centre height • Selecting and setting appropriate feeds and speeds • Facing off • Producing parallel diameters • Producing stepped diameters • Producing tapered diameters • Centre drilling and drilling a hole • Reaming or boring a hole 			
	1.13 Carry out milling operations, to include all of the following: <ul style="list-style-type: none"> • Mounting the workpiece in an appropriate workholding device • Mounting cutting tools on appropriate arbors or direct to the machine spindle • Selecting and setting appropriate feeds and speeds • Producing flat and square faces • Producing parallel faces • Producing angular faces • Producing an enclosed slot • Producing an open ended slot 			
	1.14 Measure and check that all dimensional and geometrical aspects of the component are to the specification			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.15 Carry out the necessary checks for accuracy, to include all of the following: <ul style="list-style-type: none"> • Linear dimensions (such as lengths, depths) • Diameters (such as external, internal) • Flatness • Squareness • Angles • Profiles • Hole size and position • Thread size and fit • Surface finish 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.16 Use the following measuring equipment during the checking activities: <ul style="list-style-type: none"> • External micrometers • Vernier/digital/dial calliper • Surface finish equipment (such as comparison plates, machines) Plus four more of the following: <ul style="list-style-type: none"> • Rules • Squares • Protractors • Depth micrometers • Depth Verniers • Feeler gauges • Bore/hole gauges • Slip gauges • Radius/profile gauges • Thread gauges • Dial test indicators (DTI) • Coordinate measuring machine (CMM) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.17 Produce components within all of the following standards, as applicable to the process: <ul style="list-style-type: none"> • Components to be free from false tool cuts, burrs and sharp edges • Dimensional tolerance +/- 0.25mm or +/- 0.010" • Flatness and squareness 0.05mm per 25mm or 0.002" per inch • Angles within +/- 1 degree • Screw threads to BS Medium fit • Reamed holes within H8 • Surface finish 63µin or 1.6 µm 			
	1.18 Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve			
	1.19 Leave the work area in a safe and tidy condition on completion of the manufacturing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to carry out general machining, fitting and assembly applications	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the machining, fitting and assembly activities undertaken (such as wearing appropriate protective clothing and equipment (PPE), using machine guards, and of keeping the work area safe and tidy			
		2.2	Describe the hazards associated with the activities (such as use of power tools, trailing leads or hoses, damaged or badly maintained tools and equipment, using files with damaged or poor fitting handles, using machine tools), and how they can be minimised			
		2.3	Explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken			
		2.4	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.5	Explain how to prepare the materials in readiness for the marking out activities, in order to enhance clarity, accuracy and safety (such as visually checking for defects, cleaning the materials, removing burrs and sharp edges, applying a marking-out medium)			
		2.6	Explain how to select and establish a suitable datum; the importance of ensuring that marking out is undertaken from the selected datum, and the possible effects of working from a different datum			
		2.7	Describe the use of marking-out conventions when marking out the workpiece (such as datum lines, cutting guidelines, square and rectangular profiles, circular and radial profiles, angles, holes linearly positioned, boxed and on pitch circles)			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		2.8 Describe the various fitting activities to be carried out (such as how to file flat, square and curved surfaces and achieve a smooth surface finish; how to select saw blades for different materials, and how to set the saw blades for different operations; how to produce screw threads on workpieces using hand dies; how to determine the drill size for tapped holes, and the importance of using the taps in the correct sequence)			
		2.9 Explain how to prepare drilling machines for operations (such as adjustment of table height and position; mounting and securing drills, in chucks or Morse taper sockets; setting and adjusting spindle speeds; setting and adjusting guards/safety devices)			
		2.10 Describe the methods of holding the workpiece for the hand fitting, turning and milling activities (such as in a bench vice, machine vice, chuck, collets or clamped directly to the machine table)			
		2.11 Describe the assembly methods, techniques and procedures to be used; how the components are to be aligned, adjusted and positioned prior to securing them, and the tools and equipment that is used			
		2.12 Describe the various mechanical fastening devices that are used (such as nuts, bolts, machine screws, cap screws, clips, pins, locking and retaining devices)			
		2.13 Describe the various turning operations that can be performed (such as parallel, stepped and tapered external diameters, drilled, bored and reamed holes, internal and external screw threads, special profiles)			
		2.14 Describe the various milling operations that can be performed (such as flat, parallel, square and angled surfaces; open ended and enclosed slots, special forms, drilled and bored holes)			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		2.15 Explain how to mount and secure the cutting tools in the tool holding devices (such as front or rear tools posts; mounting cutters on long or stub arbors; mounting drills in chucks or by the use of Morse taper sockets; the need to ensure that the tool is sharp and secure)			
		2.16 Describe the techniques of taking trial cuts and checking dimensional accuracy; the application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy			
		2.17 Describe the factors that affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as type of material, size of material, operations being performed, workholding method/security of workpiece, condition of machine, finish and tolerance required)			
		2.18 Describe the application of cutting fluids and compounds with regard to a range of different materials, and why some materials do not require cutting fluids to be used			
		2.19 Explain how to check the workpiece and the measuring equipment that is used (such as rules, micrometers, Verniers, gauges and surface finish comparison equipment)			
		2.20 Describe the need to check that the measuring equipment is within current calibration dates, and that the instruments are correctly zeroed; measuring internal and external dimensions (such as lengths, diameters, depths, slots, hole positions, angles, profiles); measuring geometric features (such flatness, squareness, parallelism, concentricity, ovality); how to check surface finish (such as by using comparison blocks or instruments)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Explain when to act on their own initiative and when to seek help and advice from others			
		2.22	Describe the importance of leaving the work area and equipment in a safe and clean condition on completion of the machining and fitting activities (such as isolating machines, removing and returning cutting tools, cleaning the equipment, and removing and disposing of waste)			

Learner name: _____

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Assessor signature: _____

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Internal verifier signature: _____

Date: _____

(if sampled)

Unit 11: General Fabrication and Welding Applications

Unit reference number: M/504/6457

QCF level: 2

Credit value: 12

Guided learning hours: 55

Unit aim

This unit covers the skills and knowledge needed to prove the competences required for general fabrication and welding applications. It will prepare the learner 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.

Unit assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be found in Annexe A.

Additional assessment requirements have been published by Semta. Please refer to the Performing Engineering Operations NVQ assessment strategy in Annexe B.

Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Carry out general fabrication and welding applications	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Carry out all of the following during the fabrication and welding activities: <ul style="list-style-type: none"> Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations Ensure that all hand tools and equipment used are in a safe and serviceable condition including PAT tested (such as extension leads, powered hand tools and welding equipment cables, welding plant hoses, the striking faces of chisels and hammers, guillotines, shears and forming machines) Check that all measuring equipment to be used is within calibration date Return all tools and equipment to the correct location on completion of the fabrication activities 			
		1.3	Determine what has to be done and how they are going to do it			
		1.4	Obtain the appropriate tools and equipment for the fabrication and welding operations			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 Mark out the components for the required operations, using appropriate tools and techniques to include all of the following: <ul style="list-style-type: none"> • Preparing/determining suitable datums from which to mark out • Applying a marking medium to enhance clarity of the marking out (such as chalk, bluing or paint) • Using an appropriate method of marking out (such as direct marking using instruments, use of templates or tracing/transfer methods) • Using a range of marking-out equipment (such as rules/tapes, straight edge, squares, scribes, dividers or trammels, protractors, punch) • Marking out a range of features (such as datum/centre lines, square/rectangular profiles, circles/radial profiles, hole positions, cutting and bending detail) 			
	1.6 Cut and shape the materials to the required specification, using appropriate tools and techniques			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	1.7	Use two appropriate materials from the following: <ul style="list-style-type: none"> • Hot rolled mild steel • Cold rolled mild steel • Coated mild steel (such as primed, tinned, galvanised) • Stainless steel • Aluminium • Brass • Copper • Lead • Titanium 			
	1.8	Cut and form material to the marked-out shape, using six of the following hand tools: <ul style="list-style-type: none"> • Tin snips • Bench shears • Saws (such as hand, mechanical, band) • Hand power tools (such as drill, nibbling, saw) • Hammers/panel beating equipment • Stakes and formers • Trepanning • Files • Pneumatic tools • Free hand thermal cutting (such as gas or plasma) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 Cut and form material to the marked-out shape, using all of the following machine tools: <ul style="list-style-type: none"> • Guillotine • Pillar or bench drill • Bending machine (hand or powered) Plus two more from the following: <ul style="list-style-type: none"> • Press • Punch/cropping machine • Nibbling machine • Rolling machine (hand or powered) • Trepanning machine • Wheeling machine • Jenny/wiring machine • Swaging machine 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 Perform cutting and forming operations to produce four of the following shapes: <ul style="list-style-type: none"> • Straight cuts • Cut-ins (straight and curved) • Notches • External curved contours • Internal curved contours • Round holes • Square holes Plus four of the following: <ul style="list-style-type: none"> • Bends/upstands • Folds/safe edges • Tray/box sections • Wired edges • Swages • Curved panels • Cylindrical sections • Square-to-round trunking • Ribbed components 			
	1.11 Use the appropriate methods and techniques to assemble and secure the components in their correct positions			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.12 Assemble fabricated components, using four of the following methods: <ul style="list-style-type: none"> • Temporary tack welding • Soldering or brazing • Resistance spot welding • Riveting (such as hollow or solid) • Adhesive bonding • Mechanically fastened (such as bolts, screws) • Self securing joints (such as knocked up, paned down, swaged, joggled) 			
	1.13 Use manual welding and related equipment, to include one of the following welding processes: <ul style="list-style-type: none"> • Manual metal-arc (MMA) • MIG/MAG • TIG • Manual oxy/fuel gas welding 			
	1.14 Produce two of the following welded joints of at least 150mm long, with at least one stop and start included: <ul style="list-style-type: none"> • Fillet lap joints • Corner joints • Tee fillet joints • Butt joints 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.15 Produce fabricated components and assemblies which meet all of the following: <ul style="list-style-type: none"> • All dimensions are within +/- 3.0mm or +/- 0.125" • Finished components meet the required shape/geometry (such as squareness, straightness, angularity and being free from twists) • Completed components are free from excessive tooling marks, deformation, cracking, sharp edges, slivers or burrs • All components are correctly assembled, and have secure and firm joints • Welds are adequately fused and have a uniform profile, free from excessive undulations, with regular and even ripple formation • The weld surface is free from cracks and substantially free from porosity, shrinkage cavities and trapped slag 			
	1.16 Measure and check that all dimensional and geometrical aspects of the component are to the specification			
	1.17 Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve			
	1.18 Leave the work area in a safe and tidy condition on completion of the manufacturing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to carry out general fabrication and welding applications	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the fabrication and welding activities undertaken			
		2.2	Describe the personal protective clothing and equipment (PPE) to be worn when carrying out the fabrication and welding activities (such as leather gloves, eye protection, ear protection), and the importance of keeping the work area safe and tidy			
		2.3	Describe the hazards associated with carrying out fabrication and welding activities (such as handling sheet materials; using dangerous or badly maintained tools and equipment; operating guillotines and bending machines; using hand and bench shears; the electric arc; fumes and gases; spatter; hot slag and metal), and how they can be minimised			
		2.4	Explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken			
		2.5	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.6	Explain how to prepare the materials in readiness for the marking out activities, in order to enhance clarity, accuracy and safety (such as visually checking for defects, cleaning the materials, removing burrs and sharp edges, applying a marking-out medium)			
		2.7	Explain how to select and establish a suitable datum; the importance of ensuring that marking out is undertaken from the selected datum, and the possible effects of working from a different datum			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		2.8 Describe the use of marking-out conventions when marking out the workpiece (including datum lines, cutting guidelines, square and rectangular profiles, circular and radial profiles, angles, holes linearly positioned, boxed and on pitch circles)			
		2.9 Describe the tools and techniques available for cutting and shaping sheet materials (such as tin snips, bench shears, guillotines, portable power tools, bench drills, saws)			
		2.10 Describe the use and care of tools and equipment (including checks that must be made to ensure that the tools are fit for purpose and tested - such as sharp, undamaged, plugs and cables secure and free from damage, machine guards or safety devices operating correctly)			
		2.11 Describe the hand tools used in fabrication forming activities, and typical operations that they are used for (such as hammers, stakes, formers, sand bags)			
		2.12 Describe the various machine tool forming equipment that can be used to produce a range of shapes (such as bends, box sections, cylinders and curved sections, wired edges and swages)			
		2.13 Explain how to set up the various machines to produce the required forms (such as setting up of rolls; setting fingers on bending machines; setting forming tools for swaging)			
		2.14 Describe the characteristics of the various materials used, with regard to the bending and forming process			
		2.15 Explain how the materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.16 Describe the various methods of securing the assembled components (the range of mechanical fastening devices that are used (such as nuts and bolts, screws, special fasteners, resistance and tack welding methods and techniques, adhesive bonding of components and self-secured joints - such as knocked up, paned down, swaged and joggled)			
	2.17 Describe the preparations to be carried out on the components prior to assembling them			
	2.18 Explain how to set up and align the various components, and the tools and equipment to be used			
	2.19 Describe the methods of temporarily holding the joints together to aid the assembly activities (clamps, rivet clamps)			
	2.20 Describe the basic principles of fusion welding and the types of welded joints to be produced (such as lap joints, corner joints, tee joints and butt welds)			
	2.21 Describe the various welding techniques that can be used, and their typical applications (such as manual metal arc (MMA), MIG/MAG, TIG and manual oxy/fuel gas welding)			
	2.22 Describe the Types, selection and application of filler wires and welding electrodes			
	2.23 Describe the inspection techniques that can be applied to check that shape (including straightness) and dimensional accuracy are to specification and within acceptable limits			
	2.24 Describe the problems that can occur with the fabrication and welding activities (such as defects caused by incorrectly set or blunt shearing blades), and how these can be overcome			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.25	Explain when to act on their own initiative and when to seek help and advice from others			
		2.26	Describe the importance of leaving the work area and equipment in a safe and clean condition on completion of the fabrication and welding activities (such as isolating machines, cleaning the equipment, and removing and disposing of waste)			

Learner name: _____

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Assessor signature: _____

Date: _____

Internal verifier signature: _____

Date: _____

(if sampled)

Unit 12: General Electrical and Electronic Engineering Applications

Unit reference number: T/504/6458

QCF level: 2

Credit value: 12

Guided learning hours: 55

Unit aim

This unit covers the skills and knowledge needed to prove the competences required for general electrical and electronic engineering applications. It will prepare the learner 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.

Unit assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be found in Annexe A.

Additional assessment requirements have been published by Semta. Please refer to the Performing Engineering Operations NVQ assessment strategy in Annexe B.

Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Carry out general electrical and electronic engineering applications	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Carry out all of the following during the wiring and testing activities: <ul style="list-style-type: none"> • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Ensure the safe isolation of services during the wiring and testing activities • Follow job instructions, circuit and assembly drawings and test procedures at all times • Check that tools and test instruments to be used are within calibration date and are in a safe, tested and usable condition • Ensure that the components used are free from damage, dirt or other contamination • Prepare the electrical and electronic components for the assembly and wiring operations (such as pre-forming and cleaning pins) • Where appropriate, apply procedures and precautions to eliminate electrostatic discharge (ESD) hazards (such as the use of grounded wrist straps and mats) • Return all tools and equipment to the correct location on completion of the wiring and testing activities 			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Plan the electrical and electronic wiring and testing activities before they start them			
		1.4	Use appropriate sources to obtain the required specifications, circuit diagrams and test information			
		1.5	Obtain the correct tools and equipment for the wiring and testing operations, and check that they are in a safe and usable condition			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.6 Use two of the following test instruments during the wiring and testing activities:</p> <ul style="list-style-type: none"> • Low reading ohmmeter • Insulation resistance tester • Clamp meter • Voltage indicator <p>Plus three more of the following:</p> <ul style="list-style-type: none"> • multimeter • Oscilloscope • Logic probe/clip • Logic analyser • Pulse sequencing analyser • Counter-timers • Signature analysers • Protocol analyser • Signal generator • Signal tracer • Stabilised power supplies • Measuring bridges • Software diagnostic programs • Data communications test set • Bus exerciser/analyser 			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
	1.7	Mount and secure the electrical and electronic components safely and correctly, to meet specification requirements			
	1.8	Use three of the following types of cable when producing the electrical and electronic circuits: <ul style="list-style-type: none"> • Single core • Multi core • PVC twin and earth • Armoured • Coaxial • Ribbon cables • Fibre optics • Screened • Wiring loom/harness • Data/communication • Flexible (such as cotton or rubber covered) • Mineral insulated (such as FP 200) 			
	1.9	Install and terminate the cables to the appropriate connections on the components			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 Wire up three of the following electrical circuits/systems: <ul style="list-style-type: none"> • Domestic lighting circuits • Domestic power circuits • Motor control circuits • Instrumentation and control circuits • Vehicle heating or ventilating • Vehicle lighting • Vehicle starting and ignition • Emergency lighting systems • Air conditioning control circuits • Refrigeration control circuits • Heating/boiler control circuits • Aircraft lighting circuits • Alarm systems (such as fire, intruder, process control) • Electro-pneumatic or electro-hydraulic control circuits • Other control circuits (such as pumps, fans, blowers, extractors) • Power generation and control circuits • Avionic circuits and systems • Communication systems • Computer systems • Other specific electrical circuits 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.11 Apply wiring methods and techniques, to include all of the following: <ul style="list-style-type: none"> • Positioning and securing of equipment and components • Determining current rating and lengths of cables required • Stripping outer coating without damage to conductor insulation • Stripping cable conductor insulation/protection • Adding cable end fittings (such plugs, sockets multi-way connectors) • Making mechanical/screwed/clamped connections • Crimping (such as spade end, loops, tags and pins) • Soldering and de-soldering • Attaching suitable cable identification • Leaving sufficient slack for termination and movement • Secure wires and cables (such as glands, clips, plastic strapping, lacing, harnessing) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.12 Assemble electronic components to produce four of the following types of circuit: <ul style="list-style-type: none"> • Audio amplifiers • Signal converters • Signal generators • Counter-timers • Oscillators • Filters • Microprocessor-based applications (such as PIC chips) • Comparators • Power amplifiers • Motor control • Regulated power supplies • Logic function controls • Display circuits • Other specific circuit • Sensor/actuator circuit (such as linear, rotational, temperature, photo-optic, flow, level, pressure) • Digital circuit (such as process control, microprocessor, logic devices, display devices) • Signal processing circuit (such as frequency modulating/demodulating, amplifiers, filters) • Alarms and protection circuits • ADC and DAC hybrid circuits 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.13 Use appropriate test methods and equipment to check that the completed circuit is safe and meets all aspects of the specification			
	1.14 Carry out checks and adjustments, appropriate to the equipment and circuits being wired, to include three of the following: <ul style="list-style-type: none"> • Making visual checks (such as signs of damage, incorrect termination/orientation, solder bridges, dry joints, incorrect value components) • Movement checks (such as loose wires, fittings and connections, incorrectly seated devices/packages) • Testing that the equipment operates to the circuit specification • Carrying out fault finding techniques (such as half-split, input/output, unit substitution) Plus six more from the following: <ul style="list-style-type: none"> • Protective conductor resistance values • Insulation resistance • Continuity • Polarity • Power rating • Resistance • Capacitance • DC voltage/current levels • AC voltage/current levels • Logic states • Clock/timer switching 			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	1.14	...continued <ul style="list-style-type: none"> • Oscillations • Attenuation • Pulse width/rise time • Open/short circuit • Waveform analysis • Frequency values • Inductance • RCD disconnection time • Modulation/demodulation • Amplification • Signal noise/interference levels 			
	1.15	Produce electrical and electronic circuits which comply with one or more of the following standards: <ul style="list-style-type: none"> • BS 7671/IET wiring regulations • Other BS and/or ISO standards • Company standards and procedures 			
	1.16	Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve			
	1.17	Leave the work area in a safe and tidy condition on completion of the wiring and testing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to carry out general electrical and electronic engineering applications	2.1	Describe the specific safety practices and procedures that they need to observe when wiring and testing electrical and electronic circuits (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)			
		2.2	Describe the hazards associated with wiring and testing electrical and electronic circuits and equipment, and with the tools and equipment used (such as heat, toxic fumes, spilled/splashed chemicals/solder, static electricity, using sharp instruments for stripping cable insulation, connecting clips/probes into circuits), and how they can be minimised			
		2.3	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy			
		2.4	Explain what constitutes a hazardous voltage and how to recognise victims of electric shock			
		2.5	Explain how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)			
		2.6	Describe the interpretation of circuit diagrams, wiring diagrams, and other relevant specifications (including BS and ISO schematics, wiring regulations, symbols and terminology)			
		2.7	Describe the basic principles of operation of the equipment/circuits being produced, and the purpose of the individual modules/components used			
		2.8	Describe the different types of cabling and their application (such as multicore cables, single core cables, solid and multi-stranded cables, steel wire armoured (SWA), mineral insulated (MI), screened cables, data/communications cables, fibre-optics)			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
	2.9	Describe the application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units, relays, solenoids, transformers, sensors and actuators)			
	2.10	Describe the application and use of circuit protection equipment (such as fuses and other overload protection devices, trips, residual current device (RCD))			
	2.11	Describe the various types of circuit boards used (such as printed circuit boards, thin film, thick film and flexible film circuitry)			
	2.12	Explain how to recognise, read the values and identify polarity and any other orientation requirements for all electronic components being used in the assemblies (such as capacitors, diodes, transistors, integrated circuit chips, and other discrete through-hole or surface-mounted components)			
	2.13	Explain how to check that components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)			
	2.14	Describe the methods of mounting and securing electrical equipment/components to various surfaces (such as the use of nuts and bolts, screws and masonry fixing devices)			
	2.15	Describe the methods of laying in or drawing cables into conduit, trunking and traywork systems, and the need to ensure the cables are not twisted or plaited			
	2.16	Describe the techniques used to terminate electrical and electronic components and equipment (such as plugs and sockets; soldering; screwed, clamped and crimped connections, glands and sealed connectors)			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		2.17 Describe the use of BS7671/IET wiring regulations when selecting wires and cables, and when carrying out tests on circuits			
		2.18 Describe the methods of attaching markers/labels to components or cables to assist with identification (such as colour coding conductors, using coded tabs)			
		2.19 Describe the tools and equipment used in the wiring activities (including the use of cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools)			
		2.20 Explain how to check that tools and equipment are free from damage or defects, and are in a safe, calibrated, PAT tested and usable condition			
		2.21 Describe the importance of conducting inspections and checks before connecting to the supply (such as visual examination for loose or exposed conductors, excessive solder or solder spikes which may allow short circuits to occur, strain on terminations, insufficient slack cable at terminations, continuity and polarity checks, insulation checks)			
		2.22 Describe the care, handling and application of electrical and electronic test and measuring instruments (such as multimeter, insulation resistance tester, loop impedance test instruments, oscilloscopes, signal generators and logic probes)			
		2.23 Explain how to apply approved test procedures; the safe working practices and procedures required when carrying out the various tests, and the need to use suitably fused test probes and clips			
		2.24 Explain how to identify suitable test points within the circuit, and how to position the test instruments into the circuit so as to ensure the correct polarity and without damaging the circuit components			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		2.25 Explain how to set the instrument zero readings; obtaining instrument readings and comparing them with circuit parameters			
		2.26 Describe the problems that can occur with the wiring and testing operations, and how these can be overcome			
		2.27 Describe the fault-finding techniques to be used if the equipment fails to operate correctly			
		2.28 Explain when to act on their own initiative and when to seek help and advice from others			
		2.29 Describe the importance of leaving the work area and equipment in a safe and clean condition on completion of the wiring and testing activities (such as returning hand tools and test equipment to the designated location, cleaning the work area, and removing and disposing of waste)			

Learner name: _____

Date: _____

Learner signature: _____

Date: _____

Assessor signature: _____

Date: _____

Internal verifier signature: _____

Date: _____

(if sampled)

Unit 13: General Maintenance Engineering Applications

Unit reference number: A/504/6459

QCF level: 2

Credit value: 12

Guided learning hours: 55

Unit aim

This unit covers the skills and knowledge needed to prove the competences required for general maintenance engineering applications. It will prepare the learner 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.

Unit assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be found in Annexe A.

Additional assessment requirements have been published by Semta. Please refer to the Performing Engineering Operations NVQ assessment strategy in Annexe B.

Learning outcomes and assessment criteria

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Carry out general maintenance engineering applications	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Carry out all of the following during the maintenance activity: <ul style="list-style-type: none"> Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations Ensure the safe isolation of equipment (such as mechanical, electrical, gas, air or fluids), where appropriate Follow job instructions, maintenance drawings and procedures Check that the tools and test instruments are within calibration/test date, and are in a safe and usable condition Ensure that the system is kept free from foreign objects, dirt or other contamination Return all tools and equipment to the correct location on completion of the maintenance activities 			
		1.3	Plan the maintenance activities before they start them			
		1.4	Obtain all the information they need for the safe removal and replacement of the equipment components			
		1.5	Obtain and prepare the appropriate tools and equipment			
		1.6	Apply appropriate fault finding techniques, tools and aids to locate the faults			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.7 Use appropriate dismantling and re-assembly techniques to deal with three of the following technologies:</p> <p>Mechanical equipment:</p> <p>Carry out all of the following:</p> <ul style="list-style-type: none"> • Draining and replenishing fluids • Removing and refitting/replacing locking and retaining devices • Proof marking components to aid reassembly • Removing and refitting minor mechanical units/sub-assemblies (such as guards, cover plates, pulleys and belts) • Removing and refitting major mechanical components (such as shafts, gear mechanisms, bearings, clutches) • Replacing lifed items (such as filters, oils/lubricants) • Setting, aligning and adjusting replaced units <p>Electrical equipment:</p> <p>Carry out all of the following:</p> <ul style="list-style-type: none"> • Isolating the power supply • Disconnecting and reconnecting wires/cables • Removing and replacing minor electrical components (such as relays, sensing devices, limit switches) • Removing and replacing major electrical components (such as motors, switch/control gear) • Attaching cable end fittings (such as crimped and soldered) • Making de-energised checks before powering up 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.7 ...continued</p> <p>Fluid power equipment:</p> <p>Carry out all of the following:</p> <ul style="list-style-type: none"> • Chocking/supporting cylinders/rams/components • Releasing stored pressure • Removing and replacing hoses/pipes • Removing and replacing minor or lifted components (such as filters, gaskets, dust seals) • Removing and replacing major components (such as pumps, cylinders, valves, actuators) • Setting and adjusting replaced components • Making de-energised checks before re-pressurising the system <p>Programmable controller based equipment:</p> <p>Carry out all of the following:</p> <ul style="list-style-type: none"> • De-activating and resetting program controller • Disconnecting and reconnecting wires/cables • Removing and replacing input/output interfacing • Removing and replacing program logic peripherals • Checking and reviewing program format and content • Editing programs using the correct procedure (where appropriate) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 ...continued Process instrumentation: Carry out all of the following: <ul style="list-style-type: none"> • Isolating instruments/sensing devices • Disconnecting supply/signal connections • Removing and replacing instruments in the system • Replacing all 'lifer' items (such as seals, gaskets, dust covers) • Re-connecting instrumentation pipework and power supply • Checking that signal transmission is satisfactory Electronic equipment: Carry out all of the following: <ul style="list-style-type: none"> • Isolating equipment from the power supply • Dismantling/disconnecting equipment to the required level • Disconnecting and reconnecting wires and cables • Removing and replacing electronic units/circuit boards • Removing and replacing electronic components • Soldering and de-soldering • Making de-energised checks before powering up 			
	1.8 Use the appropriate methods and techniques to remove and replace the required components			
	1.9 Carry out tests on the maintained equipment, in accordance with the test schedule/defined test procedures			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 Carry out checks and tests to help diagnose problems, and confirm that the maintained equipment performs to specification, to include two of the following:</p> <ul style="list-style-type: none"> • Making visual checks (such as signs of leakage, damage, missing parts, overheating, wear/deterioration) • The use of fault finding techniques (such as six point, half-split, input/output, unit substitution) • The use of diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records) <p>Plus two more from the following:</p> <ul style="list-style-type: none"> • Mechanical checks (such as correct operation of moving parts, correct working clearance of parts, belt/chain tension, bearing loading, torque loading of fasteners) • Electrical checks (such as continuity, polarity, protective conductor resistance values, voltage levels, load current, inductance) • Electronic checks (such as resistance, capacitance, waveform, frequency values, amplification, signal noise/interference levels, logic states) • Process control checks (such as pressure, flow, level, temperature, weight, sequence/timing) • Controller checks (such as forcing contacts on and off, logic states, checking that fail safe devices and system emergency stops are operating correctly) 			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
		1.11 Maintain engineering equipment and systems, in compliance with one or more of the following: <ul style="list-style-type: none"> • Organisational guidelines and codes of practice • Equipment manufacturer's operation range • BS and/or ISO standards 			
		1.12 Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve			
		1.13 Leave the work area in a safe and tidy condition on completion of the maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to carry out general maintenance engineering applications	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the maintenance activities undertaken			
		2.2	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy			
		2.3	Describe the hazards associated with carrying out maintenance activities on engineering equipment and systems (such as handling oils, greases, stored energy/force, live electrical components, process controller interface, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them			
		2.4	Describe the system isolation procedures or permit-to-work procedure that applies			
		2.5	Explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process			
		2.6	Describe the procedure for obtaining drawings, job instructions, related specifications, replacement parts, materials and other consumables necessary for the maintenance activities			
		2.7	Explain how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards), in relation to work undertaken			
		2.8	Describe the basic principles of how the equipment functions, operation sequence, the working purpose of individual units/components and how they interact			
		2.9	Explain how to use the various diagnostic aids to help identify the location of the fault			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	2.10	Describe the various fault location techniques that can be used, and how they are applied (such as half-split, input-to-output, function testing, unit substitution, and equipment self-diagnostics)			
	2.11	Explain how to evaluate sensory information (sight, sound, smell, touch)			
	2.12	Explain how to use a range of fault diagnostic equipment to investigate the problem			
	2.13	Describe the methods and techniques used to dismantle and reassemble mechanical equipment (such as release of pressures/force; proof marking to aid reassembly; removing/replacing mechanical fasteners - nuts, bolts, clips and pins); removing components by extraction or pressing)			
	2.14	Describe the methods and techniques used to dismantle and reassemble electrical/electronic equipment (such as unplugging, soldering and de-soldering, removal and replacement of screwed, clamped and crimped connections)			
	2.15	Describe the methods and techniques used to dismantle and reassemble fluid power and process control instrumentation equipment (such as isolation of equipment; release of pressures/force; disconnecting and reconnecting pipes and hoses)			
	2.16	Describe the methods and procedures used to check programmable controllers (such as checking the program for errors against the required performance with regard to the sequence of operations and programmed instructions; using monitoring devices and test measurements to check inputs and outputs; using techniques such as 'force on - force off' to simulate process conditions; checking that fail safe devices and system emergency stops are operating correctly)			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
	2.17	Describe the methods of checking that components are fit for purpose; how to identify defects and wear characteristics; and the need to replace 'lifer' items			
	2.18	Describe the use of BS 7671/IET wiring and other regulations when selecting wires and cables, and when carrying out tests on systems			
	2.19	Explain how to check that tools and equipment are free from damage or defect, are in a safe and usable condition; are within calibration and test dates, and are configured correctly for the intended purpose			
	2.20	Describe the importance of making 'off-load' checks before running the equipment under power			
	2.21	Describe the importance of completing maintenance documentation and/or reports following the maintenance activity			
	2.22	Describe the problems that can occur during the maintenance activity, and how they can be overcome			
	2.23	Explain when to act on their own initiative and when to seek help and advice from others			
	2.24	Describe the importance of leaving the work area and equipment in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to the designated location, cleaning the work area, and removing and disposing of waste)			

Learner name: _____

Date: _____

Learner signature: _____

Date: _____

Assessor signature: _____

Date: _____

Internal verifier signature: _____

Date: _____

(if sampled)

12 Further information and useful publications

To get in touch with us visit our 'Contact us' pages:

- Edexcel: **www.edexcel.com/contactus**
- BTEC: **www.edexcel.com/btec/contactus**
- Pearson Work Based Learning and Colleges: **pearsonwbl.edexcel.com/pages**
- books, software and online resources for UK schools and colleges:
www.pearsonschoolsandfecolleges.co.uk/contactus

Key publications

- *Adjustments for candidates with disabilities and learning difficulties – Access and Arrangements and Reasonable Adjustments, General and Vocational qualifications* (Joint Council for Qualifications (JCQ))
- *Equality Policy* (Pearson)
- *Recognition of Prior Learning Policy and Process* (Pearson)
- *UK Information Manual* (Pearson)
- *UK Quality Vocational Assurance Handbook* (Pearson).

All of these publications are available on our website.

Further information and publications on the delivery and quality assurance of NVQ/Competence-based qualifications is available on our website, at www.pearsonwbl.edexcel.com/NVQ-competence-based.

Our publications catalogue lists all the material available to support our qualifications. To access the catalogue and order publications, please go to www.edexcel.com/resources/publications.

13 Professional development and training

Pearson supports UK and international customers with training related to our qualifications. This support is available through a choice of training options and sector events, or through customised training at your centre.

The support we offer focuses on a range of issues, including:

- planning for the delivery of a new programme
- planning for assessment
- building your team and teamwork skills
- developing learner-centred learning and teaching approaches
- building functional skills into your programme
- building in effective and efficient quality assurance systems.

For more information on training options and upcoming events, please visit our website, www.pearsonwbl.edexcel.com/training-events. You can request customised training by completing the enquiry form on our website and we will contact you to discuss your training needs.

Support services

Face-to-face support: our team of Regional Quality Managers, based around the country, are responsible for providing quality assurance support and guidance to anyone managing and delivering NVOs/Competence-based qualifications. The Regional Quality Managers can support you at all stages of the standard verification process as well as in finding resolutions of actions and recommendations as required. A UK map showing the Regional Quality Managers' contact details can be found at www.btec.co.uk/support.

Online support: find the answers to your questions by browsing over 100 FAQs on our website or by submitting a query using our Work Based Learning Ask the Expert Service. You can search the database of commonly asked questions relating to all aspects of our qualifications in the work-based learning market. If you are unable to find the information you need, send us your query and our qualification or administrative experts will get back to you. The Ask the Expert service is available at www.pearsonwbl.edexcel.com/Our-support.

Online forum

Pearson Work Based Learning Communities is an online forum where employers, further education colleges and workplace training providers are able to seek advice and clarification about any aspect of our qualifications and services, as well as share knowledge and information with others. The forums are sector specific and cover Business Administration, Customer Service, Health and Social Care, Hospitality and Catering and Retail. The online forum is available at www.pearsonwbl.edexcel.com/Our-support.

14 Contact us

We have a dedicated Account Support team, based throughout the UK, to give you more personalised support and advice. To contact your Account Specialist you can use any of the following methods:

Email: wblcustomerservices@pearson.com

Telephone: 0844 576 0045

If you are new to Pearson and would like to become an approved centre, please contact us at:

Email: wbl@pearson.com

Telephone: 0844 576 0045

Complaints and feedback

We are working hard to provide you with excellent service. However, if any element of our service falls below your expectations, we want to understand why, so that we can prevent it from happening again. We will do all that we can to put things right.

If you would like to register a complaint with us, please email wblcomplaints@pearson.com.

We will formally acknowledge your complaint within two working days of receipt and provide a full response within seven working days.

Annexe A: Assessment requirements/strategy: Common Requirements for NVQs in the QCF

Background to NVQs

The Review of Vocational Qualifications in England and Wales (RVQ) Working Group report in April 1986 recommended the introduction of NVQ's to address weaknesses in the then current systems of vocational qualifications. Amongst the weaknesses it identified were:

- no clear, readily understandable pattern of provision as well as considerable overlap, duplication and gaps in that provision
- many barriers to accessing vocational qualifications and inadequate arrangements for progression and transfer of credit
- assessment methods biased towards testing of knowledge rather than skill or competence
- insufficient recognition of learning gained outside formal education and training
- limited take-up of vocational qualifications.

The Review also recommended that:

'the Government should establish a National Council for Vocational Qualifications (NCVQ).'

The purpose of the National Council for Vocational Qualifications was to establish National Vocational Qualifications. The concept of a standard of competence was fundamental to NVQs and the report further recommended that:

'The NCVQ should establish a clear focus for national action to secure specification of standards of competence.... by effective and appropriate industry bodies'.

The National Council for Vocational Qualifications (NCVQ) was established in the autumn of 1986. NCVQ's NVQ Criteria and Guidance from 1995 states that.

'At the heart of an NVQ is the concept of occupational competence; the ability to perform to the standards required in employment across a range of circumstances and to meet changing demands. NVQs are first and foremost about what people can do. They go beyond technical skills to include planning, problem solving, dealing with unexpected occurrences, working with other people and applying the knowledge and understanding that underpins overall competence'.

This is the context in which this regulatory framework is developed to operate in addition to the General provisions of Regulatory arrangements for the Qualifications and Credit Framework 2008. The NVQ is not a general qualification, it is a particular type that operates in a specific context – the workplace – and relies upon specific provisions and requirements unique to a competency based qualification.

In 1993 NCVQ developed and published the Awarding Bodies Common Accord.

'The Common Accord was draftedin order to set out assessment and verification processes which would offer the necessary quality in relation to all NVQ awards. It emphasises the coherence of the NVQ framework to make it easier for users of NVQs to understand the system and seeks to improve the cost effectiveness and credibility of NVQs'.

The Common Accord was intended to be applied flexibly within its main principles, but subsequently, following the establishment of the Qualifications and Curriculum Authority with formal regulatory powers, it was adapted to become the mandatory NVQ Code of practice. This document reflects the principles articulated in the Code of Practice while seeking to capture the intent of the QCF for a more flexible qualifications framework and at the same time responding to the UK CES requirement for “a new, lighter touch and fit for purpose Code of Practice”¹.

Purpose of this document

At a meeting chaired by Ofqual on the 5th May 2009, called as a component of the ongoing discussions into the place of NVQs in the QCF, that organisation placed responsibility with the community of SSCs and SSBs to develop the required guidance to underpin the NVQ brand in the QCF. Ofqual indicated that they were not prepared to sanction formal regulation at this stage in the development of the QCF, with such decisions left until a review of operations of the framework to take place at a later time.

In conjunction with this development is the obvious necessity to gain agreement from all parties to use this document as the basis for requirements of qualifications using the term NVQ in the title, in the QCF.

Additional requirements

1. Qualification titles (links to QCF clauses 1.18 to 1.21)

- 1.1. Each qualification title submitted for accreditation in the QCF that purports to be of the type NVQ must be presented in a standard format that identifies clearly that it is an NVQ.
- 1.2. Any qualification submitted for accreditation with NVQ in the title must apply the title defined by the relevant SSC/B.

2. Relationship with NOS

- 2.1. Qualifications using the title NVQ are based upon National Occupational Standards (NOS). For any qualification purporting to be of the type NVQ the following standards must apply:
 - (a) There must be a direct relationship between NOS and all Units in the qualification.
 - (b) They must be based entirely and only on NOS developed by SSCs/SSBs.
 - (c) They must attest to competence in an occupational role (where competence is defined as the ability to apply knowledge, understanding, practical and thinking skills to be effective in work: these skills will usually include problem-solving, being flexible to meet changing demands and the ability to work with or alongside others).
 - (d) They should be made up of units that are shared.

3. Rules of combination (links to clauses 1.23 to 1.27)

- 3.1. Any qualification purporting to be an NVQ must conform to the following guidelines:
 - (a) Rules of combination must be that determined by SSC/Bs.
 - (b) Qualifications of the type NVQ covered by this requirement:
 - i. must consist of entirely competence based units that conform to the requirements of clause 2.1.
 - ii. must be based upon units recognised in the QCF.
 - (c) No organisation is permitted to submit a qualification under a different title that has the same units and rules of combination as an NVQ.

4. Assessment and quality assurance (links to clauses 5.5 to 5.10)

- 4.1. NVQs are a type of qualification that reflects the unique needs of the workplace. Over the period of their use the principles, practices and requirements surrounding the assessment and quality assurance have evolved to reflect a range of varying needs. The principles outlined in this document seek to reduce any perceived burden attached to this process and to remove any inappropriate requirements from the process.
- 4.2. Additionally Awarding Organisations are encouraged to make use of naturally occurring quality assurance and monitoring systems where they exist in workplace assessment environments.
- 4.3. Assessment methodologies of qualifications using the title NVO must implement the assessment strategies developed in partnership by the relevant SSC/Bs and Awarding Organisations. This document will be published separately and will include requirements for assessment and verification of SVQs. The specified assessment strategies must enable the qualification to attest to competence in the workplace typically they will incorporate the following requirements:
 - (a) Application of the specified skills, knowledge and understanding to standards required in the workplace.
 - (b) Specification of the type and amount of evidence to be collected for the purpose of assessing competence.
 - (c) Identification of any aspects of the assessment of NOS that may be/need to be simulated.
 - (d) Clarification of the extent to which simulated working conditions may be used in assessment and of any required characteristics of the simulations including definitions of what might constitute realistic working environments.
 - (e) Specification of the occupational expertise of assessors and verifiers.
- 4.4. Units used in qualifications with the title NVQ may reference the requirements of Assessment Strategies in the QCF Unit specification without requiring full duplication.

5. Assessor Requirements (links to QCF clause 5.2)

5.1. The principles of assessment for qualifications using the title NVQ reflect the unique nature of a workplace competency based qualification where the accumulation of evidence towards recognition requires both a formative and summative elements and dictates the need for the application of methods suited to the individual, environment and competency being assessed. It is the application of knowledge and skills that is then assessed in the workplace that makes NVQs unique - in other qualifications the application is implied rather than visible and required. It is expected that the assessment of qualifications will be underpinned by arrangements that reflect the principles outlined below:

- (a) Assessment must be carried out by competent persons who hold, or are working towards a suitable qualification. By default this is the Assessor units A1 and/or A2 (and by implication legacy D32/33 unit) but may be an appropriate equivalent as defined in the assessment strategy for that qualification or family of qualifications.
- (b) Assessors must have sufficient and relevant technical/occupational competence in the Unit, at or above the level of the Unit being assessed
- (c) All Assessors are expected to be fully conversant with the Unit(s) against which the assessments and verification are to be undertaken.
- (d) Unqualified Assessors must have a plan to achieve the relevant assessor qualification as defined in the Assessment Strategy within the timeframe specified.

6. Verifier Requirements (links to QCF clause 5.2)

- 6.1. The principles of verification for qualifications using the title NVQ reflect the unique nature of a workplace based qualification. The verification process has been established to replicate the equivalent quality assurance (QA) functions that operate in academic qualifications, undertaken by examiners and moderators. It is expected that the awarding of qualifications will be underpinned by QA appropriate to workplace based delivery. At a minimum this should reflect the principles outlined below:
- (a) Internal verification must be carried out by competent persons who hold, or are working towards a suitable qualification. By default this is the Internal Verifier unit V1 (and by implication legacy D34 unit) but may be an appropriate equivalent as defined in the assessment strategy for that qualification or family of qualifications (qualifications outlined in 5.1 are also highly recommended).
 - (b) IVs must have sufficient and relevant technical/occupational familiarity in the Unit(s) being verified.
 - (c) External verification must be carried out by competent persons who hold, or are working towards a suitable qualification. By default this would be the External Verifier unit V2 (and by implication legacy D35 units) but may be an appropriate equivalent as defined in the assessment strategy for that qualification or family of qualifications (meeting the requirements outlines in clause 5.1 are also highly recommended). EV's are members of an Awarding Organisations staff or agents, who must have no connections with the Centre that would risk a loss of objectivity.
 - (d) EVs must have sufficient and relevant technical/occupational understanding in the Unit(s) being verified.
 - (e) All IVs and EVs are expected to:
 - i. be fully conversant with the standards and units against which the assessments and verification are to be undertaken.
 - ii. have an appropriate level of understanding of Awarding Organisation systems.
 - (f) Unqualified Verifiers must have a plan to achieve the relevant verifier qualifications as defined in the Assessment Strategy within the timeframe specified.
- 6.2. Where the provisions of clause 4.2 are implemented, audit programmes undertaken should seek to ensure that the QA and monitoring intent of clause 6.1 and associated referenced documents is achieved in naturally occurring systems.

7. Assessment Environment

- 7.1. Evidence should be obtained from the real working environment. However, in certain circumstances, simulation of work activities may be acceptable. Where this is considered necessary, assessors must be confident that the environment replicates the workplace to such an extent that competencies gained will be fully transferable to the workplace. In this case assessors must clearly identify those aspects of the workplace that are critical to performance, and make sure that they have been simulated satisfactorily and in accordance with the requirements of clause 4.3.
- 7.2. Units that may not be assessed by simulation will be defined in the assessment strategy for the qualification or family of qualifications. Where simulation is involved, assessors must obtain agreement with their IV and EV before assessing candidates.
- 7.3. There must be an appropriate evidential audit trail of assessment activity that reflects the qualification being assessed. Where appropriate, guidance will be provided in the assessment strategy for the qualifications or family of qualifications.

8. Awarding Organisations

8.1. Awarding Organisations must put in place a risk management methodology for qualifications using the title NVQ. This methodology should contain as a minimum the following features:

- Risk profiles.
- Risk banding characteristics.
- Risk assessment methodologies for each risk band.
- Risk avoidance strategies and activities.
- Risk mitigation activities.
- Performance management and monitoring programme.
- Sanctions provisions.

It is expected that these arrangements will reflect the risk characteristics and mitigation requirements of sectors, families of qualifications and individual qualifications outlined in the applicable Sector Qualifications Strategies and Assessment Strategies for the sector.

8.2. As outlined in clause 4.2 where naturally occurring quality and monitoring systems can be used to achieve the intent and outcomes of these QA arrangements every effort should be made to incorporate these systems, where this supports a suitably rigorous implementation and encourages integration into organisation culture and practices.

8.3. External monitoring of centres may be undertaken either through external verifier visits to centres or suitably constituted high level audit processes designed to ensure the integrity and effectiveness of naturally occurring QA and monitoring systems.

8.4. External monitoring of centres must include systems to ensure there is no conflict of interest.

8.5. The frequency of external monitoring activities should reflect an appropriate risk management methodology for a qualification of the type NVQ. The exact frequency, duration and character of these activities will reflect the centre's performance, taking account of:

- Risk profile of the centre type.
- Risk characteristics of the centre.
- Risk banding of the centre.
- Performance management and monitoring requirements.
- Risk mitigation characteristics.

Annexe B: Assessment requirements/strategy: Performing Engineering Operations (PEO)

Introduction

[Semta], the Sector Skills Council for the Science Engineering Manufacturing Technologies Sector, has produced this QCF Unit Assessment Strategy to:

- assist Assessors, Internal Verifiers and External Verifiers
- encourage and promote consistent assessment of QCF PEO NVQ units
- promote cost effective assessment plans

This document also provides definitions for:

- the scope of activities and the characteristics of typical learners undertaking QCF PEO NVQ units at level 1 and/or 2
- the qualifications and experience required for Assessors and Verifiers
- the assessment environment and notes on replicating the working environment.
- access to units

and requirements relating to:

- carrying out assessments
- performance evidence
- assessing knowledge and understanding

The importance and value in which employers and learners place on undertaking QCF PEO NVQ units will provide a key measure of [Semta's] success with this unit assessment strategy. Another key success factor will be [Semta's] partnership with the relevant Awarding Organisations and relevant SSC Academies.

Learners undertaking PEO Level 1 and/or 2 QCF NVQ Units

The PEO Level 1 and Level 2 units have been designed to cover those learners who are either:

- acquiring engineering competencies in a realistic, sheltered and controlled environment such as schools, colleges, training providers, company training centres, HM Prison Services and the MOD training workshops to enable a safe progression into the workplace/employment.
- employed but require additional engineering competencies as part of an existing job role or to enable career progression.

Assessor Requirements to Demonstrate Effective Assessment Practice

Assessment must be carried out by competent Assessors that as a minimum must hold the QCF Level 3 Award in Assessing Competence in the Work Environment. Current and operational Assessors that hold units D32 and/or D33 or A1 and/or A2 as appropriate to the assessment being carried out, will not be required to achieve the QCF Level 3 Award as they are still appropriate for the assessment requirements set out in this Unit Assessment Strategy. However, they will be expected to regularly review their skills, knowledge and understanding and where applicable undertake continuing professional development to ensure that they are carrying out workplace assessment to the most up to date National Occupational Standards (NOS)

Assessor Technical Requirements

Assessors must be able to demonstrate that they have verifiable, relevant and sufficient technical competence to evaluate and judge performance and knowledge evidence requirements as set out in the relevant QCF unit learning outcomes and associated assessment criteria.

This will be demonstrated either by holding a relevant technical qualification or by proven industrial experience of the technical areas to be assessed. The assessor's competence must, at the very least, be at the same level as that required of the learner(s) in the units being assessed.

Assessors must also be:

Fully conversant with the Awarding Organisation's assessment recording documentation used for the QCF NVQ units against which the assessments and verification are to be carried out, other relevant documentation and system and procedures to support the QA process.

Verifier Requirements (internal and external)

Internal quality assurance (Internal Verification) must be carried out by competent Verifiers that as a minimum must hold the QCF Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practices. Current and operational Internal Verifiers that hold internal verification units V1 or D34 will not be required to achieve the QCF Level 4 Award as they are still appropriate for the verification requirements set out in this Unit Assessment Strategy. Verifiers must be familiar with, and preferably hold, either the nationally recognised Assessor units D32 and/or D33 or A1 and/or A2 or the QCF Level 3 Award in Assessing Competence in the Work Environment

External quality assurance (External Verification) must be carried out by competent External Verifiers that as a minimum must hold the QCF Level 4 Award in the External Quality Assurance of Assessment Processes and Practices. Current and operational External Verifiers that hold external verification units V2 or D35 will not be required to achieve the QCF Level 4 Award as they are still appropriate for the verification requirements set out in this Unit Assessment Strategy. Verifiers must be familiar with, and preferably hold, either the nationally recognised Assessor units D32 and/or D33 or A1 and/or A2 or the QCF Level 3 Award in Assessing Competence in the Work Environment

External and Internal Verifiers will be expected to regularly review their skills, knowledge and understanding and where applicable undertake continuing professional development to ensure that they are carrying out workplace Quality Assurance (verification) of Assessment Processes and Practices to the most up to date National Occupational Standards (NOS)

Verifiers, both Internal and External, will also be expected to be fully conversant with the terminology used in the QCF NVO units against which the assessments and verification are to be carried out, the appropriate Regulatory Body's systems and procedures and the relevant Awarding Organisation's documentation, systems and procedures within which the assessment and verification is taking place.

Specific technical requirements for internal and external verifiers

Internal and external Verifiers for the PEO units must be able to demonstrate that have verifiable, sufficient and relevant industrial experience, and must have a working knowledge of the processes, techniques and procedures that are used in the engineering industry.

The tables on the following page show the recommended levels of technical competence for assessors, internal verifiers, and external verifiers.

Note: These levels of technical competence were derived by a project carried out by members of the Awarding Organisation Forum on the continuous professional development (CPD) of assessors and verifiers.

Technical Requirements for Assessors and Verifiers

Position	Prime activity requirements	Support activity requirements	Technical requirements (see notes)
Assessor	Assessment Skills	IV Systems	Technical <i>competence</i> in the areas covered by the QCF units being assessed
Internal Verifier	Verification Skills	Assessment Knowledge	Technical <i>understanding</i> of the areas covered by the QCF units being verified
External Verifier	Verification skills	Assessment Understanding	Technical <i>awareness</i> of the areas covered by the units being verified

Notes

1. Technical *competence* is defined here as a combination of practical skills, knowledge, and the ability to apply both of these, in familiar and new situations, within a real working environment.
2. Technical *understanding* is defined here as having a good understanding of the technical activities being assessed, together with knowledge of relevant Health & Safety implications and requirements of the assessments.
3. Technical *awareness* is defined here as a general overview of the subject area, sufficient to ensure that assessment and evidence are reliable, and that relevant Health and Safety requirements have been complied with.
4. The competence required by the assessor, internal verifier and external verifier, in the occupational area being assessed, is likely to exist at three levels as indicated by the shaded zones in the following table.

Technical Competence required by:	An ability to <i>discuss</i> the general principles of the competences being assessed	An ability to <i>describe</i> the practical aspects of the competence being assessed	An ability to <i>demonstrate</i> the practical competences being assessed
Assessor			
Internal Verifier			
External Verifier			

Assessment Environment

The PEO Level 1 and 2 units are intended to have a wide application throughout the engineering sector. It is necessary therefore to have a flexible approach to the environment in which the units are delivered and assessed.

There will be learners who have been working in an industry for some time and wish to acquire a broad range of basic competencies as part of an existing job role or to enable career progression. The PEO units will satisfy that need. Where this is the case assessment should take place within the learner's normal workplace/environment.

However, there is much to be gained by acquiring the basic engineering competencies whilst working in a sheltered environment. This is due to an ongoing emphasis on safety critical work activities and the need to ensure flexibility of assessment opportunities to both maintain and enhance the provision of competent personnel within the industry. This assessment method will allow a minimum safe level of skills, knowledge and understanding to be achieved and demonstrated by the learner prior to being exposed to the hazards of the industrial environment, thus minimizing the risk of injury to themselves and other employees.

It is recognised that not all learners who wish to achieve PEO QCF NVQ units would require this form of assessment. Only those who are judged to be potentially at risk would need to provide evidence of a minimum level of skills, knowledge and understanding to enter the industrial environment.

Examples of this are:

- Where the hazardous nature of the engineering occupations mean that the learner requires close supervision whilst they provide evidence of competence involving safety critical activities.
- For reasons of age, people entering an industrial training environment are gradually introduced to the “world of work”, this helps them mature and grow in confidence as well as providing evidence of their engineering competence.
- Learners with special assessment requirements benefit from the close supervision offered by this type of environment whilst providing evidence of competence.
- Adult learners new to the industry or to a specific skill area can provide evidence without fear of making mistakes which could prove to be dangerous and/or expensive.
- Where equipment to be used or worked on by approved, licensed or competent people (such as the aircraft industry) learners can only provide the necessary evidence that they have achieved a level of skills, knowledge and understanding in-order that they may prepare themselves for future employment.
- Penal institutions where learners wish to provide evidence of a vocational achievement in-order that they may prepare themselves for future employment.

For the above reasons the assessment of a learners competence in a sheltered environment is acceptable for this qualification, where the environment replicates that expected in industry. Where applicable, the machinery, tools, materials, equipment and resources used must be representative of industry standards and there must be sufficient equipment/resources available for each learner to demonstrate their competence individually. Workpieces or work outcomes assessed must be the learners own work and should be actual work examples that combine the skills, techniques required by the QCF units so that achievement will properly reflect the learners competence as specified in the unit assessment criteria

Assessors must therefore ensure that the competency is fully transferable to the workplace. Other aspects that should be considered could include:

- environmental conditions such as lighting conditions, noise levels and the presence of hazards
- pressure of work such as time constraints and repetitive activities
- producing actual workpieces or work outcomes and the consequence of making mistakes and the effect this has on customer, supplier and departmental relationships.

Access to Assessment

There are no entry requirements required for the PEO units unless this is a legal requirement of the process or the environment. Assessment is open to any learner who has the potential to reach the assessment requirements set out in the relevant units.

Aids or appliances, which are designed to alleviate disability, may be used during assessment, providing they do not compromise the standard required.

Carrying Out Assessments

The PEO units were specifically developed to cover a wide range of activities. The evidence produced for the units will, therefore, depend on the learners choice of "bulleted items" listed in the unit assessment criteria.

Where the assessment criteria gives a choice of bulleted items (for example 'any three from five'), assessors should note that learners do not need to provide evidence of the other items to complete the unit (in this example above, two items) particularly where these additional items may relate to other activities or methods that are not part of the learners normal workplace activity or area of expertise.

Performance Evidence Requirements

Performance evidence must be the main form of evidence gathered. In order to demonstrate consistent competent performance for a unit, a minimum of three different examples of performance of the unit activity will be required. Items of performance evidence often contain features that apply to more than one unit, and can be used as evidence in any unit where they are suitable.

Performance evidence must be:

- products of the learners' work, such as items that have been produced or worked on, plans, charts, reports, standard operating procedures, documents produced as part of a work activity, records or photographs of the completed activity

together with:

- evidence of the way the learners carried out the activities, such as witness testimonies, assessor observations or authenticated learner reports of the activity undertaken.

Competent performance is more than just carrying out a series of individual set tasks. Many of the units contain statements that require the learner to provide evidence that proves they are capable of combining various features and techniques. Where this is the case, separate fragments of evidence would not provide this combination of features and techniques and, therefore, will not be acceptable as demonstrating competent performance.

If there is any doubt as to what constitutes suitable evidence the internal/external verifier should be consulted.

Example:

Unit 11: Preparing and Using Lathes for Turning Operations Level 2

Unit specific additional assessment requirements:

In order to prove their ability to combine different turning operations, at least one of the machined components produced must be of a significant nature, and must have a minimum of six of the features listed in assessment criteria 1.11.

Assessing Knowledge and Understanding

Knowledge and understanding are key components of competent performance, but it is unlikely that performance evidence alone will provide enough evidence in this area. Where the learners knowledge and understanding (and the handling of contingency situations) is not apparent from performance evidence, it must be assessed by other means and be supported by suitable evidence.

Knowledge and understanding can be demonstrated in a number of different ways. Semta expects oral questioning and practical demonstrations to be used, as these are considered the most appropriate for these units. Assessors should ask enough questions to make sure that the learner has an appropriate level of knowledge and understanding, as required by the unit. Awarding Organisations may choose other methods, which must be supported by a suitable rationale

Evidence of knowledge and understanding will **not** be required for those bulleted items in the assessment criteria that have not been selected by the learner.

The achievement of the specific knowledge and understanding requirements of the units cannot simply be inferred by the results of tests or assignments from other units, qualifications or training programmes. Where evidence is submitted from these sources, the assessor must, as with any assessment, make sure the evidence is valid, reliable, authentic, directly attributable to the learner, and meets the full knowledge and understanding requirements of the unit.

Where oral questioning is used the assessor must retain a record of the questions asked, together with the learner's answers.

Awarding Organisations may choose other methods, which must be supported by a suitable rationale.

Witness testimony

Where 'observation is used to obtain performance evidence, this must be carried out against the unit assessment criteria. Best practice would require that such observation is carried out by a qualified Assessor. If this is not practicable, then alternative sources of evidence may be used.

For example, the observation may be carried out against the assessment criteria by someone else that is in close contact with the learner. This could be a team leader, supervisor, mentor or line manager who may be regarded as a suitable witness to the learner's competency. However, the witness must be technically competent in the process or skills that they are providing testimony for, to at least the same level of expertise as that required of the learner. It will be the responsibility of the assessor to make sure that any witness testimonies accepted as evidence of the learner's competency are reliable, auditable and technically valid.

Notes:

It is recognised that some Awarding Organisations provide supplementary guidance and documentation to centres to support the quality of assessment and verification practice of occupational competence units

Quality Control of Assessment**General**

There are two major points where an Awarding Organisation interacts with the Centre in relation to the External Quality Control of Assessment and these are:

- Approval - when a Centre take on new qualifications/units, the Awarding Organisation, normally through an External Verifier (EV) ensures that the Centre is suitably equipped and prepared to deliver the new units/qualification
- Monitoring - throughout the ongoing delivery of the qualification/units the Awarding Organisation, through EV monitoring and other mechanisms must maintain the quality and consistency of assessment of the units/qualification

Approval

In granting Approval, the Awarding Organisation, normally through its External Verifiers (EV)

Must ensure that the prospective Centre:

- Meets the requirements of the Qualification Regulator
- Has sufficient and appropriate physical and staff resources
- Meets relevant health and safety and/or equality and access requirements
- Has a robust plan for the delivery of the qualification/units

The Awarding Organisation may visit the Centre to view evidence or may undertake this via other means.

The Awarding Organisation must have a clear rationale for the method(s) deployed

Monitoring

The Awarding Organisation, through EV monitoring and other mechanisms must ensure:

- that a strategy is developed and deployed for the ongoing Awarding Organisation monitoring of the Centre. This strategy must be based on an active risk assessment of the Centre. In particular the strategy must identify the learner's, assessors and Internal Verifier sampling strategy to be deployed and the rationale behind this
- that the Centre's internal quality assurance processes are effective in learner's assessment
- that sanctions are applied to a Centre where necessary and that corrective actions are taken by the Centre and monitored by the Awarding Organisation/EV
- that reviews of Awarding Organisation's external auditing arrangements are undertaken

September 2014

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