edexcel

Pearson Edexcel Level 4 NVQ Diploma in Engineering Manufacture (QCF)

Pearson Edexcel Level 4 NVQ Extended Diploma in Engineering Manufacture (QCF)

Specification

NVQ/Competence-based qualification

First registration February 2014

Edexcel, BTEC and LCCI qualifications

Edexcel, BTEC and LCCI qualifications are awarded by Pearson, the UK's largest awarding body offering academic and vocational qualifications that are globally recognised and benchmarked. For further information, please visit our qualification websites at www.edexcel.com, www.btec.co.uk or www.lcci.org.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus

About Pearson

Pearson is the world's leading learning company, with 40,000 employees in more than 70 countries working to help people of all ages to make measurable progress in their lives through learning. We put the learner at the centre of everything we do, because wherever learning flourishes, so do people. Find out more about how we can help you and your learners at: www.pearson.com/uk

Please note: This document is a pathway within the Pearson Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering (QCF) and the Pearson Edexcel Level 3 NVQ Extended Diploma in Electrical and Electronic Engineering (QCF).

To view the whole specification you must download all 11 pathway documents.

References to third-party material made in this specification are made in good faith. We do not endorse, approve or accept responsibility for the content of materials, which may be subject to change, or any opinions expressed therein. (Material may include textbooks, journals, magazines and other publications and websites.)

All information in this specification is correct at time of publication.

ISBN 978 1 446 91164 8

Contents

Purpose of this specification

This specification sets out:

- the objectives of the qualifications
- any other qualifications that a learner must have completed before taking these qualifications
- any prior knowledge, skills or understanding which the learner is required to have before taking these qualifications
- the combination of units that a learner must have completed before the qualifications will be awarded and any pathways
- any other requirements that a learner must have satisfied before they will be assessed or before the qualifications will be awarded
- the knowledge, skills and understanding that will be assessed as part of the qualifications
- the method of any assessment and any associated requirements relating to it
- the criteria against which a learner's level of attainment will be measured (such as assessment criteria)
- assessment requirements and/or evidence requirements required as specified by the relevant Sector Skills Council/Standards Setting Body
- assessment requirements/strategy as published by the relevant Sector Skills Council/Standards Setting Body
- the Apprenticeship Framework in which the qualifications are included, where appropriate.

1 Introducing Pearson Edexcel NVQ/Competence-based qualifications

What are NVQ/Competence-based qualifications?

National Vocational Qualifications (NVQs) or Competence-based qualifications reflect the skills and knowledge needed to do a job effectively. They are work-based qualifications that give learners the opportunity to demonstrate their competence in the area of work or job role to which the qualification relates.

NVQs/Competence-based qualifications are outcomes-based with no fixed learning programme, allowing flexibility in their delivery to meet the individual learner's needs. The qualifications are based on the National Occupational Standards (NOS) for the sector, which define what employees, or potential employees, must be able to do and know, and how well they should undertake work tasks and work roles.

Most NVQ/Competence-based qualifications form the competence component of Apprenticeship Frameworks. They are suitable for those in employment or those who are studying at college and have a part-time job or access to a substantial work placement.

Most learners will work towards their qualification in the workplace or in settings that replicate the working environment as specified in the assessment requirements/strategy for the sector. Colleges, training centres and/or employers can offer these qualifications provided they have access to appropriate physical and human resources.

There are three sizes of NVQ/Competence-based qualification in the QCF:

- Award (1 to 12 credits)
- Certificate (13 to 36 credits)
- Diploma (37 credits and above).

Every unit and qualification in the QCF has a credit value.

The credit value of a unit specifies the number of credits that will be awarded to a learner who has met the learning outcomes of the unit.

The credit value of a unit is based on:

- one credit for those learning outcomes achievable in 10 hours of learning
- learning time – defined as the time taken by learners at the level of the unit, on average, to complete the learning outcomes of the unit to the standard determined by the assessment criteria.

2 Qualification summary and key information

Qualification title	Pearson Edexcel Level 4 NVQ Diploma in Engineering Manufacture (QCF)
QCF Qualification Number (QN)	601/2545/7
Qualification framework	Qualifications and Credit Framework (QCF)
Regulation start date	17/01/2014
Operational start date	01/02/2014
Approved age ranges	16-18 19+ Please note that sector-specific requirements or regulations may prevent learners of a particular age from embarking on this qualification. Please refer to the assessment requirements/strategy.
Credit value	80
Assessment	Portfolio of Evidence (internal assessment)
Guided learning hours	338-635
Grading information	The qualification and units are graded pass/fail.
Entry requirements	No prior knowledge, understanding, skills or qualifications are required before learners register for this qualification. However, centres must follow the Edexcel Access and Recruitment policy (see *Section 9, Access and Recruitment*) Centres must also follow the Pearson *Access and Recruitment* policy (see *Section 9*, *Access and Recruitment*)
Funding	For details on funding availability, please check the Learning Aim Reference Service (LARS), which replaces the Learning Aim Reference Application (LARA).

Qualification title	Pearson Edexcel Level 4 NVQ Extended Diploma in Engineering Manufacture (QCF)
QCF Qualification Number (QN)	601/2546/9
Qualification framework	Qualifications and Credit Framework (QCF)
Regulation start date	17/01/2014
Operational start date	01/02/2014
Approved age ranges	16-18 19+ Please note that sector-specific requirements or regulations may prevent learners of a particular age from embarking on this qualification. Please refer to the assessment requirements/strategy.
Credit value	107
Assessment	Portfolio of Evidence (internal assessment)
Guided learning hours	461-884
Grading information	The qualification and units are graded pass/fail.
Entry requirements	No prior knowledge, understanding, skills or qualifications are required before learners register for this qualification. However, centres must follow the Edexcel Access and Recruitment policy (see *Section 9, Access and Recruitment*) Centres must also follow the Pearson *Access and Recruitment* policy (see *Section 9*, *Access and Recruitment*)
Funding	For details on funding availability, please check the Learning Aim Reference Service (LARS), which replaces the Learning Aim Reference Application (LARA).

QCF Qualification Number and qualification title

Centres will need to use the QCF Qualification Number (QN) when they seek public funding for their learners. As well as a QN, each unit within a qualification has a QCF unit reference number (URN).

The qualification title, unit titles and QN will appear on each learner's final certificate. Centres should tell learners this when recruiting them and registering them with Pearson. There is more information about certification in our *UK Information Manual,* available on our website: www.edexcel.com

Qualification objectives

The Pearson Edexcel Level 4 NVQ Diploma in Engineering Manufacture (QCF) and the Pearson Edexcel Level 4 NVQ Extended Diploma in Engineering Manufacture (QCF) are for learners who work in, or who want to work in the engineering sector.

They give learners the opportunity to demonstrate occupational competence in the workplace to a level required in the engineering industry, have existing skills recognised and achieve a nationally-recognised Level 4 qualification.

Relationship with previous qualifications

These qualifications are a direct replacement for the Pearson Edexcel Level 4 NVQ Diploma in Engineering Leadership (QCF) and the Pearson Edexcel Level 4 NVQ Extended Diploma in Engineering Leadership (QCF), which have expired.

Apprenticeships

SEMTA, the Sector Skills Council for Engineering, includes the Pearson Edexcel Level 4 NVQ Diploma in Engineering Manufacture (QCF) and the Pearson Edexcel NVQ Level 4 Extended Diploma in Engineering Manufacture (QCF) as the competence component for the Higher Apprenticeship in Advanced Manufacture Engineering.

Progression opportunities through Pearson qualifications

Learners who have achieved the Pearson Edexcel Level 4 NVQ Diploma in Engineering Manufacture (QCF) and the Pearson Edexcel NVQ Level 4 Extended Diploma in Engineering Manufacture (QCF) can progress across the level and size of the engineering competence and knowledge qualifications and into other occupational areas such as team leading and management.

Industry support and recognition

These qualifications are supported by SEMTA.

Relationship with National Occupational Standards

These qualifications are based on the National Occupational Standards (NOS) in Engineering Maunfacture, which were set and designed by SEMTA.

3 Qualification structures

Pearson Edexcel Level 4 NVQ Diploma in Engineering Manufacture (QCF)

Learners must achieve a minimum of **80** credits through this pathway to be awarded this qualification.

Learners must achieve 5 credits from the **one** mandatory unit in Group A

AND

Learners must achieve a minimum of 75 credits from a minimum of **eleven** units from Group B1, Group B2 or Group B3.

INCLUDING

A minimum of 48 credits from **three** units from Group B1

And a minimum of 3 credits from **one** unit from **either** Group B2 or Group B3.

Please see Barred Combinations on pages 15 and 16 before choosing units from Group B1, Group B2 or Group B3

Centres should be aware that within the Level 4 qualification in this specification, learners will be required to meet the demands of unit(s) at level 5. Centres are advised to consider the support, guidance and opportunities they give to learners to meet the demands of the higher level unit(s) during delivery and assessment of the qualification.

Unit	Unit reference number	Group A – Mandatory units	Level	Credit	Guided learning hours
1	A/601/5013	Complying with Statutory Regulations and Organisational Safety Requirements	2	5	35

Unit	Unit reference number	Group B1 – Optional units	Level	Credit	Guided learning hours
2	J/505/0952	Identify and Define Areas of Engineering Research	4	16	56
3	L/505/0953	Develop a Research Methodology for Engineering	4	16	56
4	R/505/0954	Propose and Specify Engineering Research	4	16	56
5	L/505/0936	Undertake Engineering Research	4	16	56
6	Y/505/0955	Evaluate the Results of Engineering Research	4	16	56
7	F/505/0934	Identify Engineering Design Requirements of Clients	4	16	56
8	Y/505/0938	Establish an Engineering Design Brief	4	16	56
9	D/505/0956	Develop a Strategy for the Engineering Design Process	4	16	56
10	D/505/0939	Create Engineering Designs	4	16	56
11	R/505/0940	Evaluate Engineering Designs	4	16	56
12	Y/505/1006	Contribute to a Team Feasibility Review of a New Product Design	4	16	56
13	H/505/1008	Control the New Product Design Change Process	4	16	56
14	K/505/1009	Plan and Control New Product Design Benchmarking Activities	4	16	56
15	H/505/1011	Establish New Product Development and Introduction Brief	4	16	56
16	D/505/1010	Produce and Evaluate Conceptual Design Options for New Products	4	16	56
17	K/505/1012	Verify New Product Designs Using a Computer Model	4	16	56
18	L/505/1018	Verify New Product Designs Using a Physical Model	4	16	56
19	T/505/1045	Produce New Product Designs for Manufacture and Assembly	4	16	56
20	J/505/1048	Plan and Control New Product Manufacturing Process Benchmarking Activities	4	16	56
21	L/505/1049	Establish Manufacturing Process Design Brief for New Product Introduction	4	16	56

Unit	Unit reference number	Group B1 – Optional units	Level	Credit	Guided learning hours
22	F/505/1050	Develop a New Product Manufacturing Process Design Strategy	4	16	56
23	J/505/1051	Develop a New Product Manufacturing Process Flow and Floor Plan Layout	4	16	56
24	R/505/1053	Plan and Manage the Installation of the New Product Manufacturing Process	4	16	56
25	T/505/1059	Commission a New Product Manufacturing Process	4	16	56
26	A/505/0933	Solve Engineering or Manufacturing Problems	4	16	56
27	T/505/0963	Undertake Project Management Activities	4	16	56
28	Y/505/0941	Determine the Requirements for Engineering Activities	4	16	56
29	J/505/0935	Produce Engineering Specifications	4	16	56
30	D/505/0942	Specify Methods and Procedures to Achieve Engineering Requirements	4	16	56
31	H/505/0943	Schedule Engineering Activities	4	16	56
32	K/505/0944	Obtain Resources for the Implementation of Engineering Activities	4	16	56
33	M/505/0945	Implement Engineering Processes	4	16	56
34	T/505/0946	Monitor and Evaluate Engineering Processes	4	16	56
35	F/505/0951	Provide Technical Advice and Guidance on Engineering or Manufacturing Requirements	4	16	56
36	J/505/0949	Implement Quality Assurance Methods and Procedures	4	16	56
37	A/505/0950	Improve the Quality of Engineering Products or Processes	4	16	56
38	F/505/0948	Specify Risk Reduction Methods and Procedures	4	16	56
39	A/505/0947	Evaluate Engineering Risk Assessments	4	16	56
40	K/505/0961	Investigate Incidents Relating to Engineering Activities	4	16	56

Unit	Unit reference number	Group B1 – Optional units	Level	Credit	Guided learning hours
41	H/505/0957	Configure Engineering Products, Processes or Facilities	4	16	56
42	K/505/0958	Transfer Control of Engineering Products, Processes or Facilities	4	16	56
43	M/505/0959	Propose Decommissioning of Engineering Equipment, Processes or Facilities	4	16	56
44	H/505/0960	Plan and Decommission Engineering Equipment, Processes or Facilities	4	16	56
45	M/505/0962	Commission Engineering Products, Processes or Facilities	4	16	56
46	D/505/0987	Determine Welding and Related Technical Requirements to Achieve Objectives	4	16	56
47	H/505/0988	Plan Welding Production Resources and Activities	4	16	56
48	K/505/0989	Implement Welding Production Methods and Procedures	4	16	56
49	D/505/0990	Solve Welding Problems in Production	4	16	56
50	H/505/0991	Monitor Welding Activities in Production	4	16	56
51	K/505/0992	Inspect Welded Components or Structures for Visual Quality and Dimensional Accuracy	4	16	56
52	L/505/0967	Lead Welding and Fabrication Activities	4	16	56
53	R/505/0968	Lead Rail Welding Activities	4	16	56
54	A/505/0964	Lead Maintenance Activities	4	16	56
55	F/505/0965	Lead Mechanical Manufacturing or Inspection Activities	4	16	56
56	J/505/0966	Lead Installation or Commissioning Activities	4	16	56
57	Y/505/0969	Lead Electrical/Electronic Product Manufacturing or Testing Activities	4	16	56
58	L/505/0970	Carry Out the Testing and Calibration of Instrumentation Control Equipment and Circuits	4	16	56
59	R/505/0971	Carry Out Maintenance Activities on Mechanical Equipment	4	16	56

Unit	Unit reference number	Group B1 – Optional units	Level	Credit	Guided learning hours
60	Y/505/0972	Carry Out Maintenance Activities on Electrical Equipment	4	16	56
61	D/505/0973	Carry Out Maintenance Activities on Fluid Power Equipment	4	16	56
62	H/505/0974	Carry Out Maintenance Activities on Instrumentation and Control Equipment	4	16	56
63	K/505/0975	Carry Out Maintenance Activities on Mechanical Equipment Within an Engineered System	4	16	56
64	M/505/0976	Carry Out Maintenance Activities on Electrical Equipment Within an Engineered System	4	16	56
65	A/505/0978	Carry Out Maintenance Activities on Fluid Power Equipment Within an Engineered System	4	16	56
66	F/505/0979	Carry Out Maintenance Activities on Process Controller Equipment Within an Engineered System	4	16	56

Unit	Unit reference number	Group B2 – Optional units	Level	Credit	Guided learning hours
67	F/600/9682	Build, Support and Manage a Team	4	4	20
68	R/600/9587	Develop, Maintain and Review Personal Networks	4	4	25
69	L/600/9622	Review Risk Management Processes in Own Area of Responsibility	4	3	20
70	T/600/9601	Provide Leadership and Direction for Own Area of Responsibility	4	5	30
71	H/600/9609	Ensure Compliance with Legal, Regulatory, Ethical and Social Requirements	4	5	25
72	M/600/9659	Implement Change in Own Area of Responsibility	4	6	25
73	D/600/9690	Support Individuals to Develop and Take Responsibility for their Performance	4	4	20
74	H/600/9691	Know how to Follow Disciplinary Procedures	4	4	20
75	K/600/9692	Managing Grievance Procedures	4	3	10
76	M/600/9693	Support the Management of Redundancies in Own Area of Responsibility	4	3	15
77	K/600/9661	Develop Working Relationships with Colleagues and Stakeholders	4	4	20
78	M/600/9676	Support Learning and Development Within Own Area of Responsibility	4	5	25
79	F/600/9679	Address Performance Problems Affecting Team Members	4	3	20
80	H/600/9738	Manage a Tendering Process	4	4	20
81	L/600/9703	Develop and Implement a Risk Assessment Plan in Own Area of Responsibility	4	6	20
82	K/600/9711	Manage Physical Resources	4	3	25
83	M/600/9712	Manage the Environmental Impact of Work Activities	4	5	10
84	Y/600/9798	Prepare for and Support Quality Audits	4	4	20
85	K/600/9790	Develop and Implement Marketing Plans	4	6	25
86	M/600/9791	Analyse the Market in which your Organisation Operates	4	5	25

Unit	Unit reference number	Group B2 – Optional units	Level	Credit	Guided learning hours
87	Y/600/9588	Develop and Evaluate Operational Plans for Own Area of Responsibility	5	6	25
88	A/600/9793	Manage the Achievement of Customer Satisfaction	4	5	25
89	H/600/9674	Plan, Allocate and Monitor Work in Own Area of Responsibility	4	5	25
90	T/601/2580	Manage Budgets	4	5	29
91	J/601/2552	Agree a Budget	3	4	25
92	H/601/2560	Make Decisions in a Business Environment	4	4	24
93	K/601/2561	Negotiate in a Business Environment	4	7	40
94	F/601/2565	Prepare Specifications for Contracts	4	5	30

Unit	Unit reference number	Group B3 – Optional units	Level	Credit	Guided learning hours
95	F/600/5406	Leading Workplace Organisation Activities	4	10	25
96	M/600/5420	Leading Continuous Improvement (Kaizen) Activities	4	14	32
97	M/600/5434	Leading the Development of Visual Management Systems	4	9	25
98	K/600/5447	Leading the Creation of Flexible Production and Manpower Systems	4	7	25
99	M/600/5563	Leading Value Stream Mapping (VSM) Activities	4	13	32
100	J/600/5665	Leading Statistical Process Control (SPC) Activities	4	8	25
101	A/600/5713	Leading Value Management (Value Engineering and Value Analysis) Activities	4	11	32
102	L/600/5733	Leading Failure Modes and Effects Analysis (FMEA) Activities	4	9	25
103	R/600/5748	Leading Measurement Systems Analysis (MSA) Activities	4	9	25
104	L/600/5862	Carrying Out Design of Experiments (DOE)	4	9	25
105	K/600/5867	Leading Mistake/Error Proofing (POKA YOKE) Activities	4	9	25
106	J/600/5875	Applying Quality Function Deployment (QFD)	4	9	25
107	F/600/5888	Leading the Creation of Standard Operating Procedures (SOP)	4	8	25
108	D/600/5896	Leading the Application of Six Sigma Methodology to a Project	4	14	32
109	T/600/5905	Leading the Carrying Out of Six Sigma Process Mapping	4	14	32
110	T/600/5919	Leading the Application of Basic Statistical Analysis	4	10	25
111	Y/600/5931	Leading the Application of Six Sigma Metrics to a Project	4	9	25
112	R/600/5944	Leading the Production of a Characteristic Selection Matrix	4	9	25
113	L/600/5957	Leading the Carrying Out of Capability Studies	4	14	32

Barred combinations

Learners may select only **ONE** of the following		
Unit 90	T/601/2580	Manage Budgets
Unit 91	J/601/2552	Agree a Budget

If **Unit 8 (Establish an Engineering Design Brief - Y/505/0938)** is chosen, learners **may not** select any of the following units		
Unit 15	H/505/1011	Establish New Product Development and Introduction Brief
Unit 21	L/505/1049	Establish Manufacturing Process Design Brief for New Product Introduction

If **Unit 26 (Solve Engineering or Manufacturing Problems - A/505/0933)** is chosen, learners **may not** select any of the following units		
Unit 49	D/505/0990	Solve Welding Problems in Production

If **Unit 28 (Determine the Requirements for Engineering Activities - Y/505/0941)** is chosen, learners **may not** select any of the following units		
Unit 46	D/505/0987	Determine Welding and Related Technical Requirements to Achieve Objectives

If **Unit 33 (Implement Engineering Processes - M/505/0945)** is chosen, learners **may not** select any of the following units		
Unit 48	K/505/0989	Implement Welding Production Methods and Procedures

If **Unit 34 (Monitor and Evaluate Engineering Processes - T/505/0946)** is chosen, learners **may not** select any of the following units		
Unit 50	H/505/0991	Monitor Welding Activities in Production

If **Unit 37 (Improve the Quality of Engineering Products or Processes - A/505/0950)** is chosen, learners **may not** select any of the following units		
Unit 95	F/600/5406	Leading Workplace Organisation Activities
Unit 113	L/600/5957	Leading the Carrying Out of Capability Studies

If **Unit 54 (Lead Maintenace Activities - A/505/0964)** is chosen, learners **may not** select any of the following units		
Unit 58	L/505/0970	Carry Out the Testing and Calibration of Instrumentation Control Equipment and Circuits
Unit 66	F/505/0979	Carry Out Maintenance Activities on Process Controller Equipment Within an Engineered System

If **Unit 56 (Lead Installation or Commissioing Activities - J/505/0966)** is chosen, learners **may not** select any of the following units		
Unit 24	R/505/1053	Plan and Manage the Installation of the New Product Manufacturing Process
Unit 25	T/505/1059	Commission a New Product Manufacturing Process

Pearson Edexcel Level 4 NVQ Extended Diploma in Engineering Manufacture (QCF)

Learners must achieve a minimum of **107** credits through this pathway to be awarded this qualification.

Learners must achieve 5 credits from the **one** mandatory unit in Group A

AND

Learners must achieve a minimum of 75 credits from a minimum of **eleven** units from Group B1, Group B2 or Group B3.

INCLUDING

A minimum of 48 credits from **three** units from Group B1

And a minimum of 3 credits from **one** unit from **either** Group B2 or Group B3.

AND EITHER

Learners must achieve a minimum of 27 credits from **three** units in Group C

OR

Learners must achieve a minimum of 11 credits from **one** unit in Group D1, a minimum of 16 credits from **two** units in Group D2 and a minimum of 24 credits from **two** units in Group D3.

Please see Barred Combinations on pages 30, 31, 32 and 33 before choosing units from Group B1, Group B2, Group B3, Group C or Group D1

Centres should be aware that within the Level 4 qualification in this specification, learners will be required to meet the demands of unit(s) at level 5. Centres are advised to consider the support, guidance and opportunities they give to learners to meet the demands of the higher level unit(s) during delivery and assessment of the qualification.

Unit	Unit reference number	Group A – Mandatory units	Level	Credit	Guided learning hours
1	A/601/5013	Complying with Statutory Regulations and Organisational Safety Requirements	2	5	35

Unit	Unit reference number	Group B1 – Optional units	Level	Credit	Guided learning hours
2	J/505/0952	Identify and Define Areas of Engineering Research	4	16	56
3	L/505/0953	Develop a Research Methodology for Engineering	4	16	56
4	R/505/0954	Propose and Specify Engineering Research	4	16	56
5	L/505/0936	Undertake Engineering Research	4	16	56
6	Y/505/0955	Evaluate the Results of Engineering Research	4	16	56
7	F/505/0934	Identify Engineering Design Requirements of Clients	4	16	56
8	Y/505/0938	Establish an Engineering Design Brief	4	16	56
9	D/505/0956	Develop a Strategy for the Engineering Design Process	4	16	56
10	D/505/0939	Create Engineering Designs	4	16	56
11	R/505/0940	Evaluate Engineering Designs	4	16	56
12	Y/505/1006	Contribute to a Team Feasibility Review of a New Product Design	4	16	56
13	H/505/1008	Control the New Product Design Change Process	4	16	56
14	K/505/1009	Plan and Control New Product Design Benchmarking Activities	4	16	56
15	H/505/1011	Establish New Product Development and Introduction Brief	4	16	56
16	D/505/1010	Produce and Evaluate Conceptual Design Options for New Products	4	16	56
17	K/505/1012	Verify New Product Designs Using a Computer Model	4	16	56
18	L/505/1018	Verify New Product Designs Using a Physical Model	4	16	56
19	T/505/1045	Produce New Product Designs for Manufacture and Assembly	4	16	56
20	J/505/1048	Plan and Control New Product Manufacturing Process Benchmarking Activities	4	16	56
21	L/505/1049	Establish Manufacturing Process Design Brief for New Product Introduction	4	16	56

Unit	Unit reference number	Group B1 – Optional units	Level	Credit	Guided learning hours
22	F/505/1050	Develop a New Product Manufacturing Process Design Strategy	4	16	56
23	J/505/1051	Develop a New Product Manufacturing Process Flow and Floor Plan Layout	4	16	56
24	R/505/1053	Plan and Manage the Installation of the New Product Manufacturing Process	4	16	56
25	T/505/1059	Commission a New Product Manufacturing Process	4	16	56
26	A/505/0933	Solve Engineering or Manufacturing Problems	4	16	56
27	T/505/0963	Undertake Project Management Activities	4	16	56
28	Y/505/0941	Determine the Requirements for Engineering Activities	4	16	56
29	J/505/0935	Produce Engineering Specifications	4	16	56
30	D/505/0942	Specify Methods and Procedures to Achieve Engineering Requirements	4	16	56
31	H/505/0943	Schedule Engineering Activities	4	16	56
32	K/505/0944	Obtain Resources for the Implementation of Engineering Activities	4	16	56
33	M/505/0945	Implement Engineering Processes	4	16	56
34	T/505/0946	Monitor and Evaluate Engineering Processes	4	16	56
35	F/505/0951	Provide Technical Advice and Guidance on Engineering or Manufacturing Requirements	4	16	56
36	J/505/0949	Implement Quality Assurance Methods and Procedures	4	16	56
37	A/505/0950	Improve the Quality of Engineering Products or Processes	4	16	56
38	F/505/0948	Specify Risk Reduction Methods and Procedures	4	16	56
39	A/505/0947	Evaluate Engineering Risk Assessments	4	16	56
40	K/505/0961	Investigate Incidents Relating to Engineering Activities	4	16	56

Unit	Unit reference number	Group B1 – Optional units	Level	Credit	Guided learning hours
41	H/505/0957	Configure Engineering Products, Processes or Facilities	4	16	56
42	K/505/0958	Transfer Control of Engineering Products, Processes or Facilities	4	16	56
43	M/505/0959	Propose Decommissioning of Engineering Equipment, Processes or Facilities	4	16	56
44	H/505/0960	Plan and Decommission Engineering Equipment, Processes or Facilities	4	16	56
45	M/505/0962	Commission Engineering Products, Processes or Facilities	4	16	56
46	D/505/0987	Determine Welding and Related Technical Requirements to Achieve Objectives	4	16	56
47	H/505/0988	Plan Welding Production Resources and Activities	4	16	56
48	K/505/0989	Implement Welding Production Methods and Procedures	4	16	56
49	D/505/0990	Solve Welding Problems in Production	4	16	56
50	H/505/0991	Monitor Welding Activities in Production	4	16	56
51	K/505/0992	Inspect Welded Components or Structures for Visual Quality and Dimensional Accuracy	4	16	56
52	L/505/0967	Lead Welding and Fabrication Activities	4	16	56
53	R/505/0968	Lead Rail Welding Activities	4	16	56
54	A/505/0964	Lead Maintenance Activities	4	16	56
55	F/505/0965	Lead Mechanical Manufacturing or Inspection Activities	4	16	56
56	J/505/0966	Lead Installation or Commissioning Activities	4	16	56
57	Y/505/0969	Lead Electrical/Electronic Product Manufacturing or Testing Activities	4	16	56
58	L/505/0970	Carry Out the Testing and Calibration of Instrumentation Control Equipment and Circuits	4	16	56
59	R/505/0971	Carry Out Maintenance Activities on Mechanical Equipment	4	16	56

Unit	Unit reference number	Group B1 – Optional units	Level	Credit	Guided learning hours
60	Y/505/0972	Carry Out Maintenance Activities on Electrical Equipment	4	16	56
61	D/505/0973	Carry Out Maintenance Activities on Fluid Power Equipment	4	16	56
62	H/505/0974	Carry Out Maintenance Activities on Instrumentation and Control Equipment	4	16	56
63	K/505/0975	Carry Out Maintenance Activities on Mechanical Equipment Within an Engineered System	4	16	56
64	M/505/0976	Carry Out Maintenance Activities on Electrical Equipment Within an Engineered System	4	16	56
65	A/505/0978	Carry Out Maintenance Activities on Fluid Power Equipment Within an Engineered System	4	16	56
66	F/505/0979	Carry Out Maintenance Activities on Process Controller Equipment Within an Engineered System	4	16	56

Unit	Unit reference number	Group B2 – Optional units	Level	Credit	Guided learning hours
67	F/600/9682	Build, Support and Manage a Team	4	4	20
68	R/600/9587	Develop, Maintain and Review Personal Networks	4	4	25
69	L/600/9622	Review Risk Management Processes in Own Area of Responsibility	4	3	20
70	T/600/9601	Provide Leadership and Direction for Own Area of Responsibility	4	5	30
71	H/600/9609	Ensure Compliance with Legal, Regulatory, Ethical and Social Requirements	4	5	25
72	M/600/9659	Implement Change in Own Area of Responsibility	4	6	25
73	D/600/9690	Support Individuals to Develop and Take Responsibility for their Performance	4	4	20
74	H/600/9691	Know how to Follow Disciplinary Procedures	4	4	20
75	K/600/9692	Managing Grievance Procedures	4	3	10
76	M/600/9693	Support the Management of Redundancies in Own Area of Responsibility	4	3	15
77	K/600/9661	Develop Working Relationships with Colleagues and Stakeholders	4	4	20
78	M/600/9676	Support Learning and Development Within Own Area of Responsibility	4	5	25
79	F/600/9679	Address Performance Problems Affecting Team Members	4	3	20
80	H/600/9738	Manage a Tendering Process	4	4	20
81	L/600/9703	Develop and Implement a Risk Assessment Plan in Own Area of Responsibility	4	6	20
82	K/600/9711	Manage Physical Resources	4	3	25
83	M/600/9712	Manage the Environmental Impact of Work Activities	4	5	10
84	Y/600/9798	Prepare for and Support Quality Audits	4	4	20
85	K/600/9790	Develop and Implement Marketing Plans	4	6	25
86	M/600/9791	Analyse the Market in which your Organisation Operates	4	5	25

Unit	Unit reference number	Group B2 – Optional units	Level	Credit	Guided learning hours
87	Y/600/9588	Develop and Evaluate Operational Plans for Own Area of Responsibility	5	6	25
88	A/600/9793	Manage the Achievement of Customer Satisfaction	4	5	25
89	H/600/9674	Plan, Allocate and Monitor Work in Own Area of Responsibility	4	5	25
90	T/601/2580	Manage Budgets	4	5	29
91	J/601/2552	Agree a Budget	3	4	25
92	H/601/2560	Make Decisions in a Business Environment	4	4	24
93	K/601/2561	Negotiate in a Business Environment	4	7	40
94	F/601/2565	Prepare Specifications for Contracts	4	5	30

Unit	Unit reference number	Group B3 – Optional units	Level	Credit	Guided learning hours
95	F/600/5406	Leading Workplace Organisation Activities	4	10	25
96	M/600/5420	Leading Continuous Improvement (Kaizen) Activities	4	14	32
97	M/600/5434	Leading the Development of Visual Management Systems	4	9	25
98	K/600/5447	Leading the Creation of Flexible Production and Manpower Systems	4	7	25
99	M/600/5563	Leading Value Stream Mapping (VSM) Activities	4	13	32
100	J/600/5665	Leading Statistical Process Control (SPC) Activities	4	8	25
101	A/600/5713	Leading Value Management (Value Engineering and Value Analysis) Activities	4	11	32
102	L/600/5733	Leading Failure Modes and Effects Analysis (FMEA) Activities	4	9	25
103	R/600/5748	Leading Measurement Systems Analysis (MSA) Activities	4	9	25
104	L/600/5862	Carrying Out Design of Experiments (DOE)	4	9	25
105	K/600/5867	Leading Mistake/Error Proofing (POKA YOKE) Activities	4	9	25
106	J/600/5875	Applying Quality Function Deployment (QFD)	4	9	25
107	F/600/5888	Leading the Creation of Standard Operating Procedures (SOP)	4	8	25
108	D/600/5896	Leading the Application of Six Sigma Methodology to a Project	4	14	32
109	T/600/5905	Leading the Carrying Out of Six Sigma Process Mapping	4	14	32
110	T/600/5919	Leading the Application of Basic Statistical Analysis	4	10	25
111	Y/600/5931	Leading the Application of Six Sigma Metrics to a Project	4	9	25
112	R/600/5944	Leading the Production of a Characteristic Selection Matrix	4	9	25
113	L/600/5957	Leading the Carrying Out of Capability Studies	4	14	32

Unit	Unit reference number	Group C – Optional units	Level	Credit	Guided learning hours
114	F/504/6348	Producing Mechanical Engineering Drawings Using a CAD System	2	11	61
115	J/504/6349	Producing Components Using Hand Fitting Techniques	2	14	64
116	F/504/6351	Producing Mechanical Assemblies	2	15	68
117	L/504/6353	Forming and Assembling Pipework Systems	2	14	64
118	R/504/6354	Carrying Out Aircraft Detail Fitting Activities	2	14	64
119	L/504/6367	Installing Aircraft Mechanical Fasteners	2	11	61
120	L/504/6370	Producing Aircraft Detail Assemblies	2	14	64
121	Y/504/6372	Preparing and Using Lathes for Turning Operations	2	15	68
122	K/504/6375	Preparing and Using Milling Machines	2	15	68
123	T/504/6377	Preparing and Using Grinding Machines	2	15	68
124	F/504/6379	Preparing and Proving CNC Machine Tool Programs	2	14	64
125	F/504/6382	Preparing and Using CNC Turning Machines	2	14	64
126	L/504/6384	Preparing and Using CNC Milling Machines	2	14	64
127	D/504/6387	Preparing and Using CNC Machining Centres	2	14	64
128	D/504/6390	Preparing and Using Industrial Robots	2	14	64
129	T/504/6394	Maintaining Mechanical Devices and Equipment	2	14	64
130	J/504/6397	Assembling and Testing Fluid Power Systems	2	14	64
131	F/504/6401	Maintaining Fluid Power Equipment	2	14	64
132	J/504/6402	Producing Sheet Metal Components and Assemblies	2	14	64
133	L/504/6403	Producing Platework Components and Assemblies	2	14	64
134	R/504/6404	Cutting and Shaping Materials Using Thermal Cutting Equipment	2	14	64

Unit	Unit reference number	Group C – Optional units	Level	Credit	Guided learning hours
135	Y/504/6405	Preparing and Proving CNC Fabrication Machine Tool Programs	2	14	64
136	D/504/6406	Preparing and Using CNC Fabrication Machinery	2	14	64
137	K/504/6408	Preparing and Using Manual Metal Arc Welding Equipment	2	15	68
138	M/504/6409	Preparing and Using Manual TIG or Plasma-Arc Welding Equipment	2	15	68
139	H/504/6410	Preparing and Using Semi-Automatic MIG, MAG and Flux Cored Arc Welding Equipment	2	15	68
140	Y/504/6419	Preparing and Using Manual Oxy/Fuel Gas Welding Equipment	2	14	64
141	L/504/6420	Preparing and Using Manual Flame Brazing and Braze Welding Equipment	2	11	61
142	R/504/6421	Producing Electrical or Electronic Engineering Drawings Using a CAD System	2	11	61
143	Y/504/6422	Wiring and Testing Electrical Equipment and Circuits	2	14	64
144	D/504/6423	Forming and Assembling Electrical Cable Enclosure and Support Systems	2	13	65
145	H/504/6424	Assembling, Wiring and Testing Electrical Panels/Components Mounted in Enclosures	2	14	64
146	K/504/6425	Assembling and Testing Electronic Circuits	2	14	64
147	M/504/6426	Maintaining Electrical Equipment/Systems	2	15	68
148	T/504/6427	Maintaining Electronic Equipment/Systems	2	15	68
149	A/504/6428	Maintaining and Testing Process Instrumentation and Control Devices	2	15	68
150	F/504/6429	Wiring and Testing Programmable Controller Based Systems	2	15	68
151	T/504/6430	Using Wood for Pattern, Modelmaking and Other Engineering Applications	2	15	68

Unit	Unit reference number	Group C – Optional units	Level	Credit	Guided learning hours
152	A/504/6431	Assembling Pattern, Model and Engineering Woodwork Components	2	14	64
153	F/504/6432	Producing Composite Mouldings Using Wet Lay-Up Techniques	2	14	64
154	L/504/6434	Producing Composite Mouldings Using Pre-Preg Techniques	2	14	64
155	R/504/6435	Producing Composite Mouldings Using Resin Flow Infusion Techniques	2	14	64
156	Y/504/6436	Producing Composite Assemblies	2	14	64
157	D/504/6437	Producing Components by Rapid Prototyping Techniques	2	11	61
158	H/504/6438	Producing and Preparing Sand Moulds and Cores for Casting	2	14	64
159	K/504/6439	Producing and Preparing Molten Materials for Casting	2	14	64
160	D/504/6440	Producing Cast Components by Manual Means	2	13	65
161	H/504/6441	Fettling, Finishing and Checking Cast Components	2	11	61
162	M/504/6443	Finishing Surfaces by Applying Coatings or Coverings	2	9	41
163	T/504/6444	Finishing Surfaces by Applying Treatments	2	9	41
164	A/504/6445	Carrying Out Heat Treatment of Engineering Materials	2	9	41
165	F/504/6446	Carrying Out Hand Forging of Engineering Materials	2	9	41
166	J/504/6447	Stripping and Rebuilding Motorsport Vehicles (Pre-Competition)	2	14	64
167	L/504/6448	Inspecting a Motorsport Vehicle During a Competition	2	14	64
168	R/504/6449	Diagnosing and Rectifying Faults on Motorsport Vehicle Systems During Competition	2	15	68
169	J/504/6450	Carrying Out Maintenance Activities on Motorsport Vehicle Electrical Equipment	2	15	68
170	L/504/6451	Stripping and Rebuilding Motorsport Engines (Pre-Competition)	2	14	64

Unit	Unit reference number	Group C – Optional units	Level	Credit	Guided learning hours
171	R/504/6452	Producing CAD Models/Drawings Using a CAD System	2	11	61
175	K/504/6456	General Machining, Fitting and Assembly Applications	2	12	55
176	M/504/6457	General Fabrication and Welding Applications	2	12	55
177	T/504/6458	General Electrical and Electronic Engineering Applications	2	12	55
178	A/504/6459	General Maintenance Engineering Applications	2	12	55
179	L/503/4056	Joining Public Service Vehicle Components by Mechanical Processes	2	11	61
180	R/503/4057	Assembling Structural Sub Assemblies to Produce a Public Service Vehicle	2	14	64
181	Y/503/4058	Fitting Sub Assemblies and Components to Public Service Vehicles	2	14	64
182	R/503/7198	Preparing and Manoeuvring Armoured Fighting Vehicles AFVs for Maintenance and Transportation	2	14	64
183	J/504/3404	Producing Composite Mouldings Using Resin Film Infusion Techniques	2	14	64

Unit	Unit reference number	Group D1 – Optional units	Level	Credit	Guided learning hours
114	F/504/6348	Producing Mechanical Engineering Drawings Using a CAD System	2	11	61
142	R/504/6421	Producing Electrical or Electronic Engineering Drawings Using a CAD System	2	11	61
171	R/504/6452	Producing CAD Models/Drawings Using a CAD System	2	11	61

Unit	Unit reference number	Group D2 – Optional units	Level	Credit	Guided learning hours
172	Y/504/6453	Producing Engineering Project Plans	2	8	37
173	D/504/6454	Using Computer Software Packages to Assist with Engineering Activities	2	8	37
174	H/504/6455	Conducting Business Improvement Activities	2	8	41

Unit	Unit reference number	Group D3 – Optional units	Level	Credit	Guided learning hours
175	K/504/6456	General Machining, Fitting and Assembly Applications	2	12	55
176	M/504/6457	General Fabrication and Welding Applications	2	12	55
177	T/504/6458	General Electrical and Electronic Engineering Applications	2	12	55
178	A/504/6459	General Maintenance Engineering Applications	2	12	55

Barred combinations

Learners may select only **ONE** of the following		
Unit 90	T/601/2580	Manage Budgets
Unit 91	J/601/2552	Agree a Budget

If **Unit 8 (Establish an Engineering Design Brief - Y/505/0938)** is chosen, learners **may not** select any of the following units		
Unit 15	H/505/1011	Establish New Product Development and Introduction Brief
Unit 21	L/505/1049	Establish Manufacturing Process Design Brief for New Product Introduction

If **Unit 26 (Solve Engineering or Manufacturing Problems - A/505/0933)** is chosen, learners **may not** select any of the following units		
Unit 49	D/505/0990	Solve Welding Problems in Production

If **Unit 28 (Determine the Requirements for Engineering Activities - Y/505/0941)** is chosen, learners **may not** select any of the following units		
Unit 46	D/505/0987	Determine Welding and Related Technical Requirements to Achieve Objectives

If **Unit 33 (Implement Engineering Processes - M/505/0945)** is chosen, learners **may not** select any of the following units		
Unit 48	K/505/0989	Implement Welding Production Methods and Procedures

If **Unit 34 (Monitor and Evaluate Engineering Processes - T/505/0946)** is chosen, learners **may not** select any of the following units		
Unit 50	H/505/0991	Monitor Welding Activities in Production

If **Unit 37 (Improve the Quality of Engineering Products or Processes - A/505/0950)** is chosen, learners **may not** select any of the following units		
Unit 95	F/600/5406	Leading Workplace Organisation Activities
Unit 113	L/600/5957	Leading the Carrying Out of Capability Studies

If **Unit 54 (Lead Maintenace Activities - A/505/0964)** is chosen, learners **may not** select any of the following units		
Unit 58	L/505/0970	Carry Out the Testing and Calibration of Instrumentation Control Equipment and Circuits
Unit 66	F/505/0979	Carry Out Maintenance Activities on Process Controller Equipment Within an Engineered System

If **Unit 56 (Lead Installation or Commissioing Activities - J/505/0966)** is chosen, learners **may not** select any of the following units		
Unit 24	R/505/1053	Plan and Manage the Installation of the New Product Manufacturing Process
Unit 25	T/505/1059	Commission a New Product Manufacturing Process

Learners may select only **ONE** of the following		
Unit 114	F/504/6348	Producing Mechanical Engineering Drawings Using a CAD System
Unit 142	R/504/6421	Producing Electrical or Electronic Engineering Drawings Using a CAD System
Unit 171	R/504/6452	Producing CAD Models/Drawings Using a CAD System

If **Unit 175 (General Machining, Fitting and Assembly Applications - K/504/6456)** is chosen, learners **may not** select any of the following units		
Unit 115	J/504/6349	Producing Components Using Hand Fitting Techniques
Unit 116	F/504/6351	Producing Mechanical Assemblies
Unit 118	R/504/6354	Carrying Out Aircraft Detail Fitting Activities
Unit 121	Y/504/6372	Preparing and Using Lathes for Turning Operations
Unit 122	K/504/6375	Preparing and Using Milling Machines
Unit 125	F/504/6382	Preparing and Using CNC Turning Machines
Unit 126	L/504/6384	Preparing and Using CNC Milling Machines
Unit 127	D/504/6387	Preparing and Using CNC Machining Centres

If **Unit 176 (General Fabrication and Welding Applications - M/504/6457)** is chosen, learners **may not** select any of the following units		
Unit 120	L/504/6370	Producing Aircraft Detail Assemblies
Unit 132	J/504/6402	Producing Sheet Metal Components and Assemblies
Unit 133	L/504/6403	Producing Platework Components and Assemblies
Unit 135	Y/504/6405	Preparing and Proving CNC Fabrication Machine Tool Programs
Unit 136	D/504/6406	Preparing and Using CNC Fabrication Machinery
Unit 137	K/504/6408	Preparing and Using Manual Metal Arc Welding Equipment
Unit 138	M/504/6409	Preparing and Using Manual TIG or Plasma-Arc Welding Equipment
Unit 139	H/504/6410	Preparing and Using Semi-Automatic MIG, MAG and Flux Cored Arc Welding Equipment
Unit 140	Y/504/6419	Preparing and Using Manual Oxy/Fuel Gas Welding Equipment
Unit 144	D/504/6423	Forming and Assembling Electrical Cable Enclosure and Support Systems

If **Unit 177 (General Electrical and Electronic Engineering Applications - T/504/6458)** is chosen, learners **may not** select any of the following units		
Unit 143	Y/504/6422	Wiring and Testing Electrical Equipment and Circuits
Unit 145	H/504/6424	Assembling, Wiring and Testing Electrical Panels/Components Mounted in Enclosures
Unit 146	K/504/6425	Assembling and Testing Electronic Circuits
Unit 150	F/504/6429	Wiring and Testing Programmable Controller Based Systems

If **Unit 178 (General Maintenance Engineering Applications - A/504/6459)** is chosen, learners **may not** select any of the following units		
Unit 129	T/504/6394	Maintaining Mechanical Devices and Equipment
Unit 131	F/504/6401	Maintaining Fluid Power Equipment
Unit 147	M/504/6426	Maintaining Electrical Equipment/Systems
Unit 148	T/504/6427	Maintaining Electronic Equipment/Systems
Unit 149	A/504/6428	Maintaining and Testing Process Instrumentation and Control Devices
Unit 150	F/504/6429	Wiring and Testing Programmable Controller Based Systems
Unit 168	R/504/6449	Diagnosing and Rectifying Faults on Motorsport Vehicle Systems During Competition
Unit 169	J/504/6450	Carrying Out Maintenance Activities on Motorsport Vehicle Electrical Equipment

4 Assessment

These qualifications are assessed through an externally verified Portfolio of Evidence that consists of evidence gathered during the course of the learner's work.

To achieve a pass for the full qualification, the learner must achieve all the required units in the stated qualification structure. Each unit has specified learning outcomes and assessment criteria. To pass each unit the learner must:

- achieve **all** the specified learning outcomes
- satisfy **all** the assessment criteria by providing sufficient and valid evidence for each criterion
- prove that the evidence is their own.

The learner must have an assessment record that identifies the assessment criteria that have been met, and it should be cross-referenced to the evidence provided. The assessment record should include details of the type of evidence and the date of assessment. The unit specification or suitable centre documentation can be used to form an assessment record.

It is important that the evidence provided to meet the assessment criteria of the unit and learning outcomes is:

Valid	relevant to the standards for which competence is claimed
Authentic	produced by the learner
Current	sufficiently recent to create confidence that the same skill, understanding or knowledge persist at the time of the claim
Reliable	indicates that the learner can consistently perform at this level
Sufficient	fully meets the requirements of the standards.

Learners can provide evidence of occupational competence from:

- **current practice** where evidence is generated from a current job role
- a **programme of development** where evidence comes from assessment opportunities built into a learning programme, whether at or away from the workplace. The evidence provided must meet the requirements of the Sector Skills Council's assessment requirements/strategy.
- the **Recognition of Prior Learning (RPL)** where a learner can demonstrate that they can meet the assessment criteria within a unit through knowledge, understanding or skills they already possess without undertaking a course of development. They must submit sufficient, reliable, authentic and valid evidence for assessment. Evidence submitted based on RPL should provide confidence that the same level of skill/understanding/knowledge exists at the time of claim as existed at the time the evidence was produced. RPL is acceptable for accrediting a unit, several units, or a whole qualification.

  Further guidance is available in the policy document *Recognition of Prior Learning Policy and Process*, available on the Edexcel website.
- a **combination** of these.

Assessment requirements/strategy

The assessment requirements/strategy for these qualifications have been included in *Annexe A*. It sets out the overarching assessment principles and the framework for assessing the qualifications to ensure that they remain valid and reliable. They have been developed by SEMTA in partnership with employers, training providers, awarding organisations and the regulatory authorities.

The Management Standards Centre assessment requirements/strategy has been included in *Annexe C*. Both the Management Standards Centre and SEMTA assessment requirement/strategy should be applied to Units 67–89.

The Skills Council for Administration assessment requirements/strategy has been included in *Annexe D*. Both the Skills Council for Administration and SEMTA assessment requirement/strategy should be applied to Units 90–94.

Types of evidence

To achieve a unit, the learner must gather evidence that shows that they have met the required standard specified in the assessment criteria as well as the requirements of the SEMTA assessment requirements/strategy. As stated in the assessment requirements/strategy, the evidence for these qualifications can take a variety of forms as indicated below:

- direct observation of the learner's performance by their assessor (O)
- outcomes from oral or written questioning (Q&A)
- products of the learner's work (P)
- personal statements and/or reflective accounts (RA)
- outcomes from simulation (S)
- professional discussion (PD)
- assignment, project/case studies (A)
- authentic statements/witness testimony (WT)
- expert witness testimony (EWT)
- evidence of Recognition of Prior Learning (RPL).

Learners can use the abbreviations for cross-referencing purposes in their portfolios.

Learners can also use one piece of evidence to prove their knowledge, skills and understanding across different assessment criteria and/or across different units. It is not necessary for learners to have each assessment criterion assessed separately. They should be encouraged to reference evidence to the relevant assessment criteria. Evidence must be available to the assessor, internal verifier and Pearson standards verifier.

Any specific evidence requirements for individual units are stated in the unit introduction for the units in *Section 11*.

There is further guidance about assessment on our website. Please see *Section 12* for details.

Assessment of knowledge

The units within these qualifications include of knowledge-based learning outcomes and assessment criteria. The evidence provided to meet these learning outcomes and assessment criteria must be in line with the SEMTA assessment strategy/requirements. Any specific assessment requirements are stated in the unit introduction for the units in *Section 11*.

Centres need to look closely at the verbs used for each assessment criterion in the units when devising the assessment to ensure that learners can provide evidence with sufficient breadth and depth to meet the requirements. Any assignment brief should indicate clearly, which assessment criteria are being targeted.

Centres are encouraged to give learners realistic scenarios and to maximise the use of practical activities in delivery and assessment. To avoid over-assessment, centres are encouraged to link delivery and assessment across the knowledge-based learning outcomes.

Credit transfer

Credit transfer describes the process of using a credit or credits awarded in the context of a different qualification or awarded by a different awarding organisation towards the achievement requirements of another qualification. All awarding organisations recognise the credits awarded by all other awarding organisations that operate within the QCF.

If learners achieve credits with other awarding organisations, they do not need to retake any assessment for the same units. The centre must keep evidence of unit achievement.

5 Centre resource requirements

As part of the approval process, centres must make sure that the resource requirements below are in place before offering the qualifications.

- Centres must have the appropriate physical resources to support both the delivery and assessment of the qualifications. For example, a workplace in line with industry standards, or a Realistic Working Environment (RWE), where permitted, as specified in the assessment requirements/strategy for the sector, equipment, IT, learning materials, teaching rooms.
- Where permitted, RWE must offer the same conditions as the normal day-to-day working environment, with a similar range of demands, pressures and requirements for cost-effective working.
- Centres must meet any specific human and physical resource requirements outlined in the assessment requirements/strategy in *Annexe B, Annexe C, Annexe D, Annexe E and Annexe F*. Staff assessing learners must meet the occupational competence requirements within the overarching assessment requirements/strategy for the sector.
- There must be systems in place to ensure the continuing professional development for staff delivering the qualifications.
- Centres must have appropriate health and safety policies, procedures and practices in place for the delivery of the qualifications.
- Centres must deliver the qualifications in accordance with current equality legislation. For further details on Pearson's commitment to the Equality Act 2010, please see *Section 9 Access and recruitment* and *Section 10 Access to qualifications for learners with disabilities or specific needs*. For full details on the Equality Act 2010, please go to www.legislation.gov.uk

6 Centre recognition and approval

Centre recognition

Centres that have not previously offered Pearson Edexcel accredited vocational qualifications need to apply for and be granted centre recognition and approval as part of the process for approval to offer individual qualifications.

Existing centres will be given 'automatic approval' for a new qualification if they are already approved for a qualification that is being replaced by a new qualification and the conditions for automatic approval are met.

Guidance on seeking approval to deliver Pearson Edexcel vocational qualifications is available at www.pearsonwbl.edexcel.com/qualifications-approval.

Approvals agreement

All centres are required to enter into an approval agreement, which is a formal commitment by the head or principal of a centre, to meet all the requirements of the specification and any associated codes, Conditions or regulations. Pearson will act to protect the integrity of the awarding of qualifications. If centres do not comply with the agreement, this could result in the suspension of certification or withdrawal of approval.

7 Quality assurance of centres

Quality assurance is at the heart of vocational qualifications. Centres will internally assess NVQs/Competence-based qualifications using internal quality assurance procedures to ensure standardisation of assessment across all learners. Pearson uses external quality assurance procedures to check that all centres are working to national standards. It gives us the opportunity to identify and provide support, if needed, to safeguard certification. It also allows us to recognise and support good practice.

For the qualifications in this specification, the Pearson quality assurance model is as described below.

Centres offering Pearson Edexcel NVQs/Competence-based qualifications will usually receive two standards verification visits per year (a total of two days per year). The exact frequency and duration of standards verifier visits must reflect the centre's performance, taking account of the number:

- of assessment sites
- and throughput of learners
- and turnover of assessors
- and turnover of internal verifiers.

For centres offering a full Pearson BTEC Apprenticeship (i.e. all elements of the Apprenticeship are delivered with Pearson through registration of learners on a Pearson BTEC Apprenticeship framework) a single standards verifier will be allocated to verify all elements of the Pearson BTEC Apprenticeship programme. If a centre is also offering stand-alone NVQs/Competence-based qualifications in the same sector as a full Pearson BTEC Apprenticeship, the same standards verifier will be allocated.

In order for certification to be released, confirmation is required that the National Occupational Standards (NOS) for assessment, verification and for the specific occupational sector are being consistently met.

Centres are required to declare their commitment to ensuring quality and to providing appropriate opportunities for learners that lead to valid and accurate assessment outcomes.

For further details, please go to the *UK Vocational Quality Assurance Handbook* (updated annually) and the *Edexcel NVQs, SVQs and competence-based qualifications – Delivery Requirements and Quality Assurance Guidance* on our website, at www.pearsonwbl.edexcel.com/NVQ-competence-based.

8 Programme delivery

Centres are free to offer the qualifications using any mode of delivery (for example full-time, part-time, evening only, distance learning,) that meets learners' needs. However, centres must make sure that learners have access to the resources identified in the specification and to the sector specialists delivering and assessing the units. Centres must have due regard to Pearson's policies that may apply to different modes of delivery.

Those planning the programme should aim to address the occupational nature of the qualification by:

- engaging with learners, initially, through planned induction, and subsequently through the involvement of learners in planning for assessment opportunities
- using naturally occurring workplace activities and products to present evidence for assessment against the requirements of the qualification
- developing a holistic approach to assessment by matching evidence to different assessment criteria, learning outcomes and units, as appropriate, thereby reducing the assessment burden on learners and assessors
- taking advantage of suitable digital methods to capture evidence.

9 Access and recruitment

Pearson's policy regarding access to its qualifications is that:

- they should be available to everyone who is capable of reaching the required standards
- they should be free from any barriers that restrict access and progression
- there should be equal opportunities for all wishing to access the qualifications.

Centres must ensure that their learner recruitment process is conducted with integrity. This includes ensuring that applicants have appropriate information and advice about the qualification to ensure that it will meet their needs.

Centres should review applicants' prior qualifications and/or experience, considering whether this profile shows that they have the potential to achieve the qualification.

For learners with disabilities and specific needs, this review will need to take account of the support available to them during the delivery and assessment of the qualification. The review must take account of the information and guidance in *Section 10 Access to qualifications for learners with disabilities or specific needs*.

10 Access to qualifications for learners with disabilities or specific needs

Equality and fairness are central to our work. Pearson's Equality Policy requires that all learners should have equal opportunity to access our qualifications and assessments and that our qualifications are awarded in a way that is fair to every learner.

We are committed to making sure that:

- learners with a protected characteristic (as defined by the Equality Act 2010) are not, when they are undertaking one of our qualifications, disadvantaged in comparison to learners who do not share that characteristic
- all learners achieve the recognition they deserve from undertaking a qualification and that this achievement can be compared fairly to the achievement of their peers.

Learners taking a qualification can be assessed in British sign language or Irish sign language where it is permitted for the purpose of reasonable adjustments.

Further information on access arrangements can be found in the Joint Council for Qualifications (JCQ) document *Access Arrangements, Reasonable Adjustments and Special Consideration for General and Vocational qualifications.*

Details on how to make adjustments for learners with protected characteristics are given in the document *Pearson Supplementary Guidance for Reasonable Adjustment and Special Consideration in Vocational Internally Assessed Units.*

Both documents are on our website at: www.edexcel.com/policies

11 Unit format

Each unit has the following sections.

Unit title

The unit title is on the QCF and this form of words will appear on the learner's Notification of Performance (NOP).

Unit reference number

Each unit is assigned a unit reference number that appears with the unit title on the Register of Regulated Qualifications.

QCF level

All units and qualifications within the QCF have a level assigned to them. There are nine levels of achievement, from Entry to level 8. The QCF Level Descriptors inform the allocation of the level.

Credit value

All units have a credit value. When a learner achieves a unit, they gain the specified number of credits. The minimum credit value is 1 and credits can be awarded in whole numbers only.

Guided learning hours

Guided learning hours are the times when a tutor, trainer or facilitator is present to give specific guidance towards the learning aim for a programme. This definition includes workplace guidance to support the development of practical job-related skills, tutorials and supervised study in, for example, open learning centres and learning workshops. It also includes the time spent by staff assessing learners' achievements, for example in the assessment of competence for NVQs/Competence qualifications.

Unit aim

This gives a summary of what the unit aims to do.

Unit assessment requirements/evidence requirements

The SSC/B set the assessment/evidence requirements. Learners must provide evidence according to each of the requirements stated in this section.

Learning outcomes

The learning outcomes of a unit set out what a learner knows, understands or is able to do as the result of a process of learning.

Assessment criteria

The assessment criteria specify the standard required by the learner to achieve the learning outcome.

Unit 1: Complying with Statutory Regulations and Organisational Safety Requirements

Unit reference number: A/601/5013

QCF level: 2

Credit value: 5

Guided learning hours: 35

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to comply with the statutory regulations and organisational safety requirements. 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 Engineering 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	Comply with statutory regulations and organisational safety requirements	1.1	Comply with their duties and obligations as defined in the Health and Safety at Work Act			
		1.2	Demonstrate their understanding of their duties and obligations to health and safety by: • Applying in principle their duties and responsibilities as an individual under the Health and Safety at Work Act • Identifying, within their organisation, appropriate sources of information and guidance on health and safety issues, such as: - eye protection and personal protective equipment (PPE) - COSHH regulations - risk assessments • Identifying the warning signs and labels of the main groups of hazardous or dangerous substances • Complying with the appropriate statutory regulations at all times			
		1.3	Present themselves in the workplace suitably prepared for the activities to be undertaken			
		1.4	Follow organisational accident and emergency procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Comply with emergency requirements, to include: • Identifying the appropriate qualified first aiders and the location of first aid facilities • Identifying the procedures to be followed in the event of injury to themselves or others • Following organisational procedures in the event of fire and the evacuation of premises • Identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions of equipment			
		1.6	Recognise and control hazards in the workplace			
		1.7	Identify the hazards and risks that are associated with the following: • Their working environment • The equipment that they use • Materials and substances (where appropriate) that they use • Working practices that do not follow laid-down procedures			
		1.8	Use correct manual lifting and carrying techniques			
		1.9	Demonstrate one of the following methods of manual lifting and carrying: • Lifting alone • With assistance of others • With mechanical assistance			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Apply safe working practices and procedures to include: • Maintaining a tidy workplace, with exits and gangways free from obstruction • Using equipment safely and only for the purpose intended • Observing organisational safety rules, signs and hazard warnings • Taking measures to protect others from any harm resulting from the work that they are carrying out			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to comply with statutory regulations and organisational safety requirements	2.1	Describe the roles and responsibilities of themselves and others under the Health and Safety at Work Act, and other current legislation (such as The Management of Health and Safety at Work Regulations, Workplace Health and Safety and Welfare Regulations, Personal Protective Equipment at Work Regulations, Manual Handling Operations Regulations, Provision and Use of Work Equipment Regulations, Display Screen at Work Regulations, Reporting of Injuries, Diseases and Dangerous Occurrences Regulations)			
		2.2	Describe the specific regulations and safe working practices and procedures that apply to their work activities			
		2.3	Describe the warning signs for the seven main groups of hazardous substances defined by Classification, Packaging and Labelling of Dangerous Substances Regulations			
		2.4	Explain how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed			
		2.5	Explain what constitutes a hazard in the workplace (such as moving parts of machinery, electricity, slippery and uneven surfaces, poorly placed equipment, dust and fumes, handling and transporting, contaminants and irritants, material ejection, fire, working at height, environment, pressure/stored energy systems, volatile, flammable or toxic materials, unshielded processes, working in confined spaces)			
		2.6	Describe their responsibilities for identifying and dealing with hazards and reducing risks in the workplace			
		2.7	Describe the risks associated with their working environment (such as the tools, materials and equipment that they use, spillages of oil, chemicals and other substances, not reporting accidental breakages of tools or equipment and not following laid-down working practices and procedures)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.8	Describe the processes and procedures that are used to identify and rate the level of risk (such as safety inspections, the use of hazard checklists, carrying out risk assessments, COSHH assessments)			
		2.9	Describe the first aid facilities that exist within their work area and within the organisation in general; the procedures to be followed in the case of accidents involving injury			
		2.10	Explain what constitute dangerous occurrences and hazardous malfunctions, and why these must be reported even if no-one is injured			
		2.11	Describe the procedures for sounding the emergency alarms, evacuation procedures and escape routes to be used, and the need to report their presence at the appropriate assembly point			
		2.12	Describe the organisational policy with regard to fire fighting procedures; the common causes of fire and what they can do to help prevent them			
		2.13	Describe the protective clothing and equipment that is available for their areas of activity			
		2.14	Explain how to safely lift and carry loads, and the manual and mechanical aids available			
		2.15	Explain how to prepare and maintain safe working areas; the standards and procedures to ensure good housekeeping			
		2.16	Describe the importance of safe storage of tools, equipment, materials and products			
		2.17	Describe the extent of their own authority, and to whom they should report 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 2: Identify and Define Areas of Engineering Research

Unit reference number: J/505/0952

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to identify and define areas of engineering research. 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 Engineering 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	Identify and define areas of engineering research	1.1	Carry out all of the following activities in identifying and defining areas of research: • Choose area/s to be researched, based on a current problem or need • Take account of any previous research or relevant existing materials • Review the availability of expertise for the research being considered • Evaluate the potential for practical exploitation of the research • Evaluate the potential for payback on predicted costs of the research			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Identify the rationale for research to be undertaken, using two of the following potential problem areas: • Design requirement/limitation • Product function • Material problem • Customer concerns • Manufacturing methods and procedures • Technological advance • Organisational procedures • New design methods and/or techniques • Product aesthetics • Other (to be specified)			
		1.3	Identify engineering problems and issues, together with their implications for the organisation			
		1.4	Obtain accurate information on any relevant completed or current research			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Review and consider information obtained from four of the following sources: • Company data • The internet • Engineering associations or institutions • Company procedures • Other organisations • Technical data (such as journals, research, papers) • Statistical data • Regulatory/legal requirements • Libraries • Other sources			
		1.6	Assess the contribution of the research that has been undertaken			
		1.7	Identify any gaps in the research that might require further action			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Identify and define areas of research, taking into account three of the following: • British, European or International standards, directives or codes of practice • Health, safety and environmental requirements • Equipment manufactures operating specification/range • Organisational guidelines and procedures • Recognised compliance agency/body standards, directives or codes of practice • Other (to be specified)			
		1.9	Define clearly the research problem and provide a rationale for undertaking the research			
		1.10	Identify clearly any risks, benefits, and constraints associated with undertaking the research			
		1.11	Consider the benefits and constraints of four of the following when developing areas of research: • Spin-off products • Organisational capability • Availability of time • Commercial implications • Cost of resources • Changes in technology • Prestige • Personnel capabilities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Consult with colleagues on the feasibility and desirability of the research			
		1.13	Review the outcomes of the identification process, to include all of the following: • Assessment of the potential contribution of the research to the organisation, client and research team • Identification of any potential spin-offs • Identification of any related areas requiring research			
		1.14	Record and communicate areas of research to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to identify and define areas of engineering research	2.1	Explain where to obtain information on problems and issues which could impact on engineering			
		2.2	Explain the potential engineering problems and issues that could require research			
		2.3	Explain how to access relevant information for the research			
		2.4	Explain how to obtain technical data through information technology			
		2.5	Explain how to interpret and evaluate the results of research that has been carried out			
		2.6	Explain the importance of clearly defining the research problem			
		2.7	Explain who needs to be informed about the research problem and its progress			
		2.8	Explain other people who could benefit from the research			
		2.9	Explain how to communicate research information to the appropriate audience			
		2.10	Explain whom to consult on the feasibility and desirability of the research			
		2.11	Explain how to gain approval for the research activity			
		2.12	Explain the typical risks, benefits and constraints associated with undertaking the research, and how to evaluate their impact on the organisation			
		2.13	Explain the extent of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 3: Develop a Research Methodology for Engineering

Unit reference number: L/505/0953

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to develop a research methodology for engineering. 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 Engineering 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	Develop a research methodology for engineering	1.1	Confirm the aims and objectives of the research and identify any critical factors			
		1.2	Obtain and confirm the aims and objectives of the research, from within one of the following areas: • Designs • Organisational requirements • Materials • Technology • Other specific area			
		1.3	Identify all the relevant factors that have an impact on the research methodology			
		1.4	Assess any potential constraints on the research and develop contingency plans to overcome them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Identify any critical factors and constraints that could affect the research, including three of the following: • Cultural acceptability of the activity • Organisational capability • Prestige • Personnel capabilities • Commercial implications • External contracts • Timescales • Technology requirements • Environmental • Costs • Availability of resources/facilities • Safety			
		1.6	Establish the benefits and opportunities of collaborating with others			
		1.7	Select the research methods that can effectively achieve the aims and objectives			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Select appropriate research methods, to include four of the following: • Tests (such as destruction, emission, audio/sound frequency, life expectancy, durability, vibration analysis, simulation) • Observation • Qualitative data analysis • Environmental study • Quantitative data analysis • Statistical analysis and sampling • Interview • Design of experiments (DoE) • Case study • Survey • Other specific methods			
		1.9	Prioritise and schedule the research activities that are necessary			
		1.10	Prioritise and schedule all of the following into the research methodology: • Time • Documentation • Personnel • Benchmarks • Finance • Outcomes • Equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Calculate the resources and time scales required to implement the methodology			
		1.12	Calculate the resources necessary to implement the research, considering all of the following: • Personnel • Hardware and/or software • Equipment • Location/site facilities • Monitoring equipment/system • Contracts • Finances			
		1.13	Ensure that the methodology complies with three the following: • Organisational guidelines and procedures • Recognised compliance agency/body's standards, directives or codes of practice • Equipment manufacturer's operating specification/range • Customer standards and requirements • Health, safety and environmental requirements. • British, European or International standards or directives			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Evaluate the outcome of their actions, and prepare detailed plans of the methodology, to include all of the following: • Aims and objectives of the research • Research method(s) • Research prioritised schedule • Resources required and timescales • Details of contingency plans for overcoming potential constraints • Assessment of the benefits and opportunities of collaborating with others • Any factors that have an impact on the research methodology			
		1.15	Produce detailed plans of the research and record them in the appropriate information systems			
		1.16	Record and communicate the research methodology to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to develop a research methodology for engineering	2.1	Explain how to obtain and confirm the aims and objectives of the research			
		2.2	Explain the different types of area in which research can be undertaken by their organisation			
		2.3	Explain the types of factors that could have a critical effect on the methodology			
		2.4	Explain the types of constraint that could affect the research			
		2.5	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.6	Explain the regulations, directives and guidelines that could affect the research			
		2.7	Explain the regulations, directives and guidelines that could affect the research			
		2.8	Explain the advantages and disadvantages of collaborating with other organisations and people			
		2.9	Explain the various research methods that could be used, and where to obtain any specialist knowledge or expertise necessary for their application			
		2.10	Explain the statistical analysis techniques used on processes or data			
		2.11	Explain how to decide which are the most effective research methods			
		2.12	Explain how to determine the timescales required for the research			
		2.13	Explain how to prioritise and schedule research activities			
		2.14	Explain how to present research plans			
		2.15	Explain how to obtain information on resources			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.16	Explain how to assess the resources that are necessary			
		2.17	Explain how to assess the availability of resources			
		2.18	Explain the appropriate format for presenting the research methodology			
		2.19	Explain the company information systems for recording information			
		2.20	Explain the importance of using the company information systems			
		2.21	Explain the extent of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 4: Propose and Specify Engineering Research

Unit reference number:	**R/505/0954**
QCF level:	**4**
Credit value:	**16**
Guided learning hours:	**56**

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to propose and specify engineering research. 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 Engineering 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	Propose and specify engineering research	1.1	Comply with organisational procedures for approving research into engineering products or processes			
		1.2	Take into account three of the following when preparing the research proposal: • British, European or International standards, directives or codes of practice • Recognised compliance agency/body standards, directives or codes of practice • Organisational guidelines and procedures • Equipment manufactures operating specification/range • Customer standards and requirements • Health, safety and environmental requirements • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Ensure that the proposed research conforms to company procedures, and covers all of the following: • Aims and objectives or the research • Research methodology • Prioritised schedule • Resources required and timescales • Benefits and risks • Any factors that have an impact on the research methodology			
		1.4	Present clearly the aims and objectives of the research			
		1.5	Present clearly the methodology required to undertake the research			
		1.6	Record and communicate research proposals to the appropriate people, using: • A verbal report Plus one from the following: • Demonstration • Computer generated report • Computer-based presentation • Simulation or display • Other appropriate media			
		1.7	Specify the resources and timescales required to achieve the research			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Specify the timescales required, together with the necessary resources, including four of the following: • Materials • Facilities • Personnel • Hardware and/or software • Equipment • Location/site facilities • Monitoring equipment/systems • Contracts • Finances			
		1.9	Identify the overall benefits and risks of the research			
		1.10	Identify the sources of funding that might be available			
		1.11	Respond positively to any issues relating to the research proposal			
		1.12	Monitor the progress of the proposal and obtain the results of any decision			
		1.13	Monitor the progress of the research proposal, using one of the following: • Company procedure for research proposals • Informal discussion • Computer tracking			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to propose and specify engineering research	2.1	Explain the specific health, safety and environmental issues that relate to the proposed areas of research			
		2.2	Explain the types of engineering product, process or activity that may require research			
		2.3	Explain where to obtain information for the research from within the organisation			
		2.4	Explain the company policies and procedures that should be considered when preparing a research proposal			
		2.5	Explain the approval mechanisms for research proposals			
		2.6	Explain how to present research proposals, and the most appropriate method to use			
		2.7	Explain the types of information and the level of detail that should be included in research proposals			
		2.8	Explain the types of issue that can emerge during the assessment of research proposals			
		2.9	Explain how to identify potential benefits and risks of the research			
		2.10	Explain the importance of responding to the concerns of others			
		2.11	Explain the amount of time to allow for research proposals to be approved			
		2.12	Explain how to monitor the progress of research proposals			
		2.13	Explain how to obtain information on resources			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain the resources that are necessary			
		2.15	Explain how to assess the availability and suitability of resources			
		2.16	Explain the extent of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 5: Undertake Engineering Research

Unit reference number:	**L/505/0936**
QCF level:	**4**
Credit value:	**16**
Guided learning hours:	**56**

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to undertake engineering research. 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 Engineering 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	Undertake engineering research	1.1	Apply the research methods into the engineering products or processes according to established research principles			
		1.2	Carry out all of the following activities whilst undertaking the engineering research: • Obtain the aims and objectives from the research proposal • Ensure that all facilities and resources are available • Carry out and monitor the research activities • Record the results of the research, using the appropriate formats • Resolve or recommend appropriate actions to problems, as they occur • Disseminate information on the research activities to the appropriate people			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out the research, taking into account all of the following: • Aims and objectives • Potential benefits and risks • Methodology • Design constraints • Resource requirements • Schedule • Budget available • Legislative considerations • Risk analysis • Timescales			
		1.4	Implement the research using the necessary resources, including three of the following: • Materials • Manpower • Equipment • Monitoring equipment/system • Finances • Facilities • Hardware and/or software • Location/site facilities • Contracts			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Ensure that the correct amount of accurate data is collected as specified in the research methodology			
		1.6	Ensure that the research results are recorded and collated accurately in the appropriate formats			
		1.7	Ensure that the research results are analysed using valid methods			
		1.8	Monitor and record the research process, using two of the following methods: • Audio and/or video recording • Sampling • Manual data collection • Comparative analysis • Observation • Computer-aided data collection • Mechanical or electronic sensing			
		1.9	Monitor the progress of the research against plans and budgets			
		1.10	Identify any problems with the research as soon as practicable and determine the appropriate actions to take			
		1.11	Disseminate relevant information on the research to the appropriate people according to agreed procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Record and communicate details of the research to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer-based presentation • Computer generated report • Specific company form • Other appropriate media			
		1.13	Ensure that the research methodology complies with three of the following: • Organisational guidelines and codes of practice • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards • Customer standards and requirements • British, European or International standards or directives			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to undertake engineering research	2.1	Explain the specific health and safety issues that relate to the areas being researched			
		2.2	Explain how to obtain the research proposal from company systems/records			
		2.3	Explain the research methods that should be used			
		2.4	Explain how to select the most appropriate research method			
		2.5	Explain how to monitor and record the results of the research			
		2.6	Explain the amount and types of data that should be collected for different types of research			
		2.7	Explain the formats that should be used for recording data			
		2.8	Explain the methods available for analysing the results of the research			
		2.9	Explain how to select the most appropriate method(s) for analysing the research data			
		2.10	Explain how to obtain details of the plans and budgets available for the research			
		2.11	Explain how to obtain the resources specified in the research proposal			
		2.12	Explain the types of problem that could occur during the research			
		2.13	Explain the actions that should be taken to deal with different types of problem			
		2.14	Explain who requires information on the research, and the procedures for informing them			
		2.15	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 6: Evaluate the Results of Engineering Research

Unit reference number: Y/505/0955

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to evaluate the results of engineering research. 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 Engineering 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	Evaluate the results of engineering research	1.1	Plan the most appropriate way for evaluating the research			
		1.2	Carry out all of the following activities when evaluating research results: • Establish the evaluation criteria as the basis for the evaluation • Plan the most appropriate evaluation process • Collect information from appropriate sources for inclusion in the evaluation process • Implement the evaluation • Present the results of the evaluation, together with their recommendations			
		1.3	Establish clear and precise criteria for evaluating the success of the research			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Establish the criteria for evaluation of the research methodology, to include two of the following: • Test results (such as life expectancy, strength, durability, emission values, audio/sound frequency, statistical results) • Performance • Quality • Costs • Safety • Effects • Environmental/sustainability • Dimensional outcomes • Process outcomes			
		1.5	Obtain accurate information on the research from all valid sources			
		1.6	Obtain the results of the research process using two of the following: • Audio or video recording • Observation • Sampling • Computer-aided data collection • Manual data collection • Mechanical or electronic sensing • Comparative analysis			
		1.7	Verify the research results by using the most appropriate methods			
		1.8	Assess the research against the evaluation criteria			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Evaluate the results of the research, using all of the following: • Verification of the results • Assessment against the evaluation criteria • Records of strengths and weaknesses of the research • Assessment of the impact of the research on the activities of the organisation • Any deviations from health, safety and environmental requirements			
		1.10	Highlight the strengths and weaknesses of the research			
		1.11	Identify the impact of the research results on the activities of the organisation			
		1.12	Record and communicate the results of the evaluation to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer-based presentation • Computer generated report • Specific company document • Other appropriate media			
		1.13	Present the results of the evaluation to the appropriate people according to agreed procedures			
		1.14	Recommend future action that could be taken as a result of the evaluation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to evaluate the results of engineering research	2.1	Explain how to obtain the results of the research from the company information systems			
		2.2	Explain the methods that are available for evaluating research			
		2.3	Explain the types of research undertaken by their organisation			
		2.4	Explain the evaluation criteria that could be used for different types of research			
		2.5	Explain the methods that could be used for obtaining information on the research			
		2.6	Explain the sources of information that can be used in the research			
		2.7	Explain who should be involved in the evaluation process			
		2.8	Explain the methods that could be used for assessing and verifying different types of result			
		2.9	Explain the type of impact that the evaluation could have on the organisation			
		2.10	Explain the regulations, directives and guidelines which could impact on the results of the evaluation, and where to obtain information on them			
		2.11	Explain who requires information on evaluations, and the procedures for informing them			
		2.12	Explain the types of recommendation that could emerge from evaluations			
		2.13	Explain how to present recommendations			
		2.14	Explain the extent of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 7: Identify Engineering Design Requirements of Clients

Unit reference number: F/505/0934

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to identify engineering design requirements of clients. 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 Engineering 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	Identify engineering design requirements of clients	1.1	Establish who is the client for the engineering products or processes			
		1.2	Establish the client from one of the following: • External – existing client • External – potential client • Internal – existing organisational requirement • Internal – new organisational opportunity			
		1.3	Obtain accurate information on the requirements of the client			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Agree with the client a product or process to be designed, from one of the following areas or activities: • Research • Design • Production • Installation • Manufacturing • Maintenance • Engineering operations • Commissioning • Configuration • Decommissioning			
		1.5	Confirm the client's objectives for the engineering products or processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Obtain accurate information to establish the design objectives, including six of the following: • Function • Life cycle • Technologies • Performance/capability • Monitoring/servicing/maintenance frequency • Aesthetics • Materials • Resources • Delivery schedule • Usability • Interfacing • Environmental/sustainability • Branding • Safety • On going support • Budget • Volume • Timing • Other (specify)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Ensure that engineering design requirements comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards directives or codes of practice • Customer standards and requirements • British, European or International standards or directives			
		1.8	Identify any unique or specific features that need particular consideration			
		1.9	Determine the feasibility of achieving the client's requirements			
		1.10	Confirm the requirements and other relevant issues with the client			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Brief the client to contain six of the following: • Confirmation of objectives • Draft design concepts • Supporting calculations and data • High level functionality • Feasibility of achieving requirements • Description of proposed implementation (including any special features) • Detail of specific issues for customer consideration (such as product safety, health and safety, impending regulation changes, emerging technologies) • Project review process • Product life cycle requirements • Client on going support			
		1.12	Record all relevant information in the appropriate information systems for future use			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Record and communicate requirements to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to identify engineering design requirements of clients	2.1	Explain the health, safety and environmental issues relating to the design of engineering products and processes			
		2.2	Explain how to obtain and interpret legislative and regulatory documentation			
		2.3	Explain the clients that they normally work with and how they fit into the supply chain			
		2.4	Explain how to obtain information from a client, and how to assess whether it is accurate			
		2.5	Explain whom they should deal with in the client's organisation			
		2.6	Explain the procedures for contacting the client's organisation			
		2.7	Explain the types of information required for establishing design requirements			
		2.8	Explain the extent and limit of their own organisation's capabilities for producing various designs			
		2.9	Explain the types of design feature that should be considered unique or specific, and why it is important to give these particular consideration			
		2.10	Explain the factors that affect the feasibility of achieving a client's requirements			
		2.11	Explain how to assess the feasibility of achieving the client's requirements			
		2.12	Explain how to prepare a brief confirming the requirements of the client, and why it is important to do so			
		2.13	Explain the various ways of presenting the brief to the client, and the importance of selecting the most appropriate method of presentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain the organisational process or procedure for recording the design requirements			
		2.15	Explain the importance of using company information systems for recording design requirements			
		2.16	Explain the extent of their own responsibility, and their level of authority when dealing with clients			
		2.17	Explain whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 8: Establish an Engineering Design Brief

Unit reference number: Y/505/0938

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to establish an engineering design brief. 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 Engineering 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	Establish an engineering design brief	1.1	Obtain the correct details of the specification for the engineering product or process			
		1.2	Carry out all of the following activities to establish the design brief: • Identify with the client the reasons or application for the design, and establish any constraints which may affect it • Review the critical operational/functional requirements and quality criteria of the design • Clarify with relevant people any aspects of the design that are ambiguous • Produce the proposed design brief, and discuss any changes needed to suit the operational/functional requirements with the relevant people • Ensure that the design brief meets relevant regulations, directives and guidelines • Record the design brief in the appropriate information system and communicate it to the relevant people			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Obtain the design requirements from one of the following types of client: • External – existing client • External – potential client • Internal – existing organisational requirement • Internal – new organisational opportunity			
		1.4	Establish information for the development of the design brief from two of the following sources: • Existing designs • Research • Tests or trials • Client • Suppliers • General or specialised media • Specialists/experts • Engineering department • User groups			
		1.5	Identify clearly any design constraints			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Establish the design brief constraints, considering four of the following: • Customer acceptability • Delivery schedule • Capacity • Capability • Departmental • Available technologies • Legal • International/national standards or directives • Copyright • Environmental/sustainability • Logistical • Financial • Safety • Commercial/branding			
		1.7	Incorporate all necessary details into the design brief			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Incorporate specifications for three of the following in the design brief: • Manufacturing requirements • Aesthetics • Characteristics • Fit, form or function • Materials • Performance/capability • Costs • Life cycles • Monitoring/servicing/maintenance requirements • Timescales • Inspection/testing • Technology • Components/systems			
		1.9	Produce a design brief that effectively encapsulates the requirements of the client			
		1.10	Ensure that the design brief complies with all relevant regulations, directives and guidelines			
		1.11	Clarify and agree the design brief with the client			
		1.12	Confirm that all participants in the design process are aware of the design brief			
		1.13	Record the design brief in the appropriate information systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Record and communicate design briefs to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			
		1.15	Ensure that the design briefs comply with three of the following: • Organisational guidelines and codes of practice • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards • Customer standards and requirements • British, European or International standards or directives			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to establish an engineering design brief	2.1	Explain the specific health, safety and environmental requirements that apply to the product or process to be designed			
		2.2	Explain how to obtain details of the specification of the product or process to be designed			
		2.3	Explain the types of design constraint that should be considered			
		2.4	Explain the different types of design brief that could be required			
		2.5	Explain the types of information and level of detail that should be included in a design brief			
		2.6	Explain the regulations, directives and guidelines that are relevant			
		2.7	Explain how to obtain information on regulations, directives and guidelines			
		2.8	Explain when a client should be consulted on a design brief			
		2.9	Explain who should be informed and consulted on the various aspects of a design brief			
		2.10	Explain the company systems for recording design information			
		2.11	Explain the importance of using the company information systems			
		2.12	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 9: Develop a Strategy for the Engineering Design Process

Unit reference number: D/505/0956

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to develop a strategy for the engineering design brief. 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 Engineering 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	Develop a strategy for the engineering design process	1.1	Carry out all of the following activities in developing a design strategy: • Establish a means of storing the design documentation and version control (configuration management) • Identify the activities that make up the design process • Establish the responsibility for each activity • Identify the resources required • Identify potential critical problems and generate effective contingency plans accordingly • Communicate information to the appropriate people, and to the quality management system • Develop a schedule for the design process • Ensure that the strategy takes into account regulations, directives and guidelines • Agree the schedule with the appropriate people			
		1.2	Identify the design activities that need to be undertaken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Establish the activities that will make up the design process, to include all of the following: • Confirmation of requirements • Production and review of detailed design/s • Review of reference materials • Development of models (such as software, physical) • Production and review of high level design/s • Obtaining final approval			
		1.4	Establish the responsibilities for developing specific aspects of the design process			
		1.5	Agree procedures for disseminating information on the designs			
		1.6	Establish the procedures to be used during the design process, for all of the following: • Disseminating information • Change management • Obtaining resources • Configuration management • Reviewing design/s • Resource procurement			
		1.7	Identify any potentially critical problems and establish effective contingency plans			
		1.8	Identify and obtain the resources necessary to undertake the design process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Develop strategies that include three of the following resources: • Equipment • Personnel • Facilities • Customer • Finance • Materials • Software/hardware			
		1.10	Prioritise and schedule the effective completion of the design process to achieve any deadlines			
		1.11	Ensure that the design process complies with all relevant regulations, directives and guidelines			
		1.12	Develop strategies that comply with three of the following: • Organisational guidelines and procedures • Recognised compliance agency/body's standards, directives or codes of practice • Equipment manufacturer's operating specification/range • Customer standards and requirements • British, European or International standards or directives • Health, safety and environmental requirements			
		1.13	Agree an effective strategy for the design process with all relevant people			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Record and communicate strategies to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer-based presentation • Computer generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to develop a strategy for the engineering design process	2.1	Explain the organisational procedures and information systems for storing design data and configuration management			
		2.2	Explain the organisational activities required for the design process			
		2.3	Explain the importance of establishing and recording responsibilities			
		2.4	Explain who should have responsibility for developing different parts of a design			
		2.5	Explain the various procedures that can be used in the design process			
		2.6	Explain the factors that should be taken into account for disseminating information			
		2.7	Explain the types of problem that could occur during the design process			
		2.8	Explain why it is important to have contingency plans			
		2.9	Explain what should be included in contingency plans			
		2.10	Explain how to prioritise and schedule design activities			
		2.11	Explain how to obtain information on resources			
		2.12	Explain how to determine what resources are necessary			
		2.13	Explain how to determine the availability of resources			
		2.14	Explain the regulations, directives and guidelines that are relevant			
		2.15	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.16	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 10: Create Engineering Designs

Unit reference number:	**D/505/0939**
QCF level:	**4**
Credit value:	**16**
Guided learning hours:	**56**

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to create engineering designs. 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 Engineering 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	Create engineering designs	1.1	Create designs that meet the client's requirements as specified in the design brief for the engineering product or process			
		1.2	Carry out all of the following activities when creating the designs: • Obtain and review existing information with reference to the specified design requirements • Prepare outline ideas for the designs, and agree them with interested parties • Carry out the design process, utilising the appropriate technology • Document all facets of the design activity • Communicate the outcomes of the design process to the appropriate people • Deliver the designs in the appropriate format • Ensure that the design cannot be changed or amended without authorisation			
		1.3	Apply approved engineering concepts, processes, principles to achieve the design brief			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Carry out the design process, taking into account all of the following: • Client requirements • Design brief • Design constraints • Legal/copyright considerations • Legislative requirements			
		1.5	Use three of the following to obtain the necessary data to produce the required design: • Drawing brief/request • Specifications • Change order/modification request • Regulations • Manuals • Sample/prototype/model • Calculations • Previous drawings/designs • Sketches • Test/trial data • Modelling data • Standards reference documents • Notes from meetings/discussions • Other (to be specified)			
		1.6	Create a suitable range of designs for the client to consider			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Create designs which take into consideration twelve of the following: • Function • Financial constraints • Manufacturing or installation requirements • Installation or commissioning requirements • Building redundancy into the design • Aesthetics • Performance/capability • Reliability • Life cycle of product, system or process • Compatibility • Maintenance and repair • Characteristics • Appropriate materials • Corporate branding • Technology • Product features • Availability of resources			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	...continued • Components to be used • Any interface requirements • Future client support • Timescales • Diversity/alternatives • Safety • Environmental/sustainability factors • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Produce designs which include ten of the following: • Straight lines • Symbols and abbreviations • Hidden detail • Hatching or shading • Dimensions • Curved/contour lines • Sectional detail • Surface detail/profiles • Insertion of standard components(such as mechanical,electrical, electronic or fluid power) • Angled lines • Circles or ellipses • Parts lists • Technical data and information • Tolerances • Test points • Connection or termination points • Component coding • Routing details • System interface			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	...continued • Component, equipment, system or site layout • Fault diagrams/trees • Component type, rating or specification • Other (to be specified)			
		1.9	Obtain suitable advice and guidance to assist in the design work			
		1.10	Present the designs in suitable formats and with sufficient information to allow the client to assess them			
		1.11	Identify any variations from the design brief and provide a suitable rationale for them			
		1.12	Ensure that engineering designs comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards, directives or codes of practice • Customer standards and requirements • British, European or International standards or directives			
		1.13	Ensure that the designs are protected in line with organisational procedures			
		1.14	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
		1.15	Communicate details of the engineering designs to the appropriate people, using: • A verbal report Plus one from the following: • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to create engineering designs	2.1	Explain 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	Explain the methods and procedures used to minimise the chances of infecting a computer with a virus			
		2.3	Explain the implications if the computer they are using does become infected with a virus and who to contact if it does occur			
		2.4	Explain the relevant sources and methods for obtaining any required technical information relevant to the design being produced			
		2.5	Explain how to identify of the correct design software/package and the factors that must be considered			
		2.6	Explain the regulations, standards, directives and codes of practice that are relevant, and any implications they have on the design			
		2.7	Explain how to obtain information on regulations, standards directives and codes of practice			
		2.8	Explain the national, international and organisational standards and conventions that are used for the design			
		2.9	Explain the underlying engineering or manufacturing principles and concepts required to produce fit for purpose designs			
		2.10	Explain the functionality of the design including any interrelationships required with other components/products/systems or technologies			
		2.11	Explain how and where to obtain the design brief/specification			
		2.12	Explain the different types of design brief that could be required			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain how to address any necessary variations from the design brief			
		2.14	Explain the types and level of detail that should be included in a design			
		2.15	Explain the methods for achieving different types of design			
		2.16	Explain the design formats that are most suitable to meet the client's needs			
		2.17	Explain the number of different designs that are necessary to provide a client with options			
		2.18	Explain the sources of advice and guidance on designs			
		2.19	Explain how to present designs to the client			
		2.20	Explain the potential risks to a design, and how can it be protected			
		2.21	Explain the need for effective document and data control and the implications if these are not applied			
		2.22	Explain the need to create backup copies, and to file tem in a separate and safe location			
		2.23	Explain the procedures used for making changes or amendments to the design			
		2.24	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 11: Evaluate Engineering Designs

Unit reference number: R/505/0940

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to evaluate engineering designs. 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 Engineering 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	Evaluate engineering designs	1.1	Plan the most appropriate way for evaluating the design of the engineering product or process			
		1.2	Establish clear and precise criteria for evaluating the designs			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Establish the criteria for evaluating the design, considering twelve of the following: • Function • Financial constraints • Manufacturing or installation requirements • Installation or commissioning requirements • Building redundancy into the design • Appropriate materials • Technology • Aesthetics • Performance/capability • Reliability • Life cycle of product, system or process • Servicing, maintenance or repair • Product features • Availability of resources • Characteristics • Corporate branding • Components or systems to be used • Functional requirements • Any interface requirements • Future client support • Timescales			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	...continued • Diversity/alternatives • Safety • Environmental and sustainability factors • Other (to be specified)			
		1.4	Obtain accurate information on the designs from all valid sources			
		1.5	Obtain information to assist the evaluation, from the design brief to include two of the following: • The design options created • Design presentations • Any previous modelling/mock ups or simulations • Design documentation • Suppliers • Consultant/research data • Equipment manufacturers • General or specialised media • Technical specialists • Colleagues • Operational staff/users • The client/customer			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Carry out all of the following activities when evaluating the design: • Plan the most appropriate way to evaluate the design • Obtain clear criteria on which to base the evaluation • Obtain the necessary information from the appropriate sources • Evaluate the design against the established criteria, using appropriate evaluation methods • Make recommendations on various design options, and communicate the results of the evaluation to the appropriate people			
		1.7	Evaluate engineering designs, using: • Analysis of the design documentation Plus one of the following: • Simulation • Small-scale production • Pilot trial/test • Model/mock m up • Prototype assessment • Software simulation/modelling • Consultation/market research			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Evaluate all of the following in engineering designs: • Performance against design criteria • How effectively they meet the design brief • Advantages/disadvantages • Options for improvement • Conformity with organisational/ industry standards, directives or codes of practice • Conformity with relevant health, safety and environmental standards			
		1.9	Verify the designs by using the most appropriate methods			
		1.10	Assess the designs against the evaluation criteria			
		1.11	Highlight the strengths and weaknesses of the designs			
		1.12	Identify the designs that are the most effective at meeting the client's requirements			
		1.13	Present the results of the evaluation to the appropriate people according to agreed procedures			
		1.14	Present the results of the evaluation, and their recommendations, to two of the following: • The design team • The client • Colleagues • Other stakeholders			
		1.15	Recommend options for the designs			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to evaluate engineering designs	2.1	Explain the various methods that are used for evaluating designs			
		2.2	Explain how to select the most appropriate evaluation method			
		2.3	Explain the evaluation criteria that could be used for different types of design			
		2.4	Explain how to obtain the different types of design information			
		2.5	Explain where to obtain the design information			
		2.6	Explain who should be involved in the evaluation process			
		2.7	Explain how to determine what additional resources may be required for the evaluation process			
		2.8	Explain how to obtain additional resources			
		2.9	Explain the methods that could be used for verifying different types of result			
		2.10	Explain the type of impact the evaluation could have on the organisation			
		2.11	Explain who requires information on evaluations, and the procedures for informing them			
		2.12	Explain the types of recommendation that could emerge from evaluations			
		2.13	Explain how to present recommendations, and the various ways in which this can be achieved			
		2.14	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 12: Contribute to a Team Feasibility Review of a New Product Design

Unit reference number: Y/505/1006

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to contribute to a team feasibility review of a new product design. 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 Engineering 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	Contribute to a team feasibility review of a new product design	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Carry out all of the following activities in the product feasibility review: • Identify important characteristics of the design • Provide technical evaluation and recommended strategies • Identify potential strengths, weakness and opportunities for the new product, in the context of their area of responsibility • Communicate information to the appropriate people and to the quality management system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Establish the criteria and procedures for feasibility review of the design, including six of the following: • Functionality • performance/specification • Aesthetics • Materials • Cost • regulatory requirements • Weight • Recycling • Manufacturability • Durability • Interfacing • Safety			
		1.4	Evaluate the team review meeting agenda and identify actions			
		1.5	Prepare data and information for the team review of the new product			
		1.6	Evaluate the design specification in the context of their area of responsibility			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Carry out the product review activity, to include all of the following: • Establish comparisons between the new product and existing products/processes • Review comparison data and information systems • Identify new technologies that are being included in the new product • Identify effective methods and techniques for meeting the design requirements • Generate ideas for improved product performance			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Contribute technical advice and recommendations to the review process, on two of the following: • Machining • Welding • Assembling • Casting • Forming • Wiring • Testing/inspection • Packaging • Coating/covering • Electrical components • Electronic components • Fabrication • Joining • Pressing • Storing • Logistics/movement • Processing operations • Moulding • Laying up • Bonding/gluing • Heat treatment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	...continued • Integrated technologies • Computer hardware/software • New technologies • Other (specify)			
		1.9	Make recommendations as to where improvements/changes can be made to the design/product			
		1.10	Record the results of the feasibility exercise, according to agreed procedures			
		1.11	Record and communicate the results of the review exercise to the appropriate people using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			
		1.12	Execute and communicate agreed actions, following the feasibility exercise, in the agreed timescales			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to contribute to a team feasibility review of a new product design	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations/directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the organisational procedures and information systems for storing product review data			
		2.4	Explain the organisational activities required for the NPDI team's product review process			
		2.5	Explain the importance of establishing and recording responsibilities for new product review and analysis process			
		2.6	Explain who should have responsibility for the different parts of the review process			
		2.7	Explain the various procedures that can be used in the product review process			
		2.8	Explain the principles and techniques used in a structured new product review			
		2.9	Explain the factors to be taken into account for disseminating information before and after a review process			
		2.10	Explain the types of problem that could occur during the team review process			
		2.11	Explain the methods and techniques used to evaluate new products			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.12	Explain how to use decision making and creativity techniques (such as brainstorming) to generate ideas for improvement			
		2.13	Explain how to prioritise and rank improvement ideas			
		2.14	Explain why it is important to have new product review exercises			
		2.15	Explain what should be included in plans for team reviews of new products			
		2.16	Explain how to prioritise and schedule review activities			
		2.17	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 13: Control the New Product Design Change Process

Unit reference number: H/505/1008

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to control the new product design change process. 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 Engineering 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	Control the new product design change process	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Obtain correct and accurate details about the design change needed			
		1.3	Establish why the change is necessary, using the appropriate supporting data and information			
		1.4	Establish the need for the design change from two of the following sources: • Existing designs • Research • Tests or trials • Client • Suppliers • Manufacturing and/or assembly department • Specialists/experts • Engineering department • Quality assurance department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Establish design change requirements, and analyse data for six of the following criteria: • Functionality • Performance • Aesthetics • Materials • Delivery • Regulatory requirements • Weight • Recycling • Manufacturability • Durability • Interfacing • Environmental impact			
		1.6	Use a structured approach to implementing the design change			
		1.7	Produce the conceptual design options for manufacture and/or assembly			
		1.8	Identify the designs that most effectively meet the change requirements			
		1.9	Justify change against all of the following criteria: • Quality • Cost • Delivery			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Evaluate design change options, using three of the following: • Strengths, weaknesses, opportunities and threats (SWOT) analysis • Force field analysis • Critical success factor/process matrix • Process failure mode and effects analysis (PFMEA) • Weighted selection • Tree diagram • Attribute analysis • Fishbone diagram • Relationship diagram • Paired comparison • Mind map • Technology/state-of-the-art analysis • Other (specify)			
		1.11	Ensure that the build plan complies with relevant regulations, directives, standards and guidelines, from one of the following: • International • National • Manufacturer specific • Company policy and procedures • Industry specific • Statutory bodies			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Generate the appropriate documentation to implement the change			
		1.13	Establish and implement the appropriate validation process, and obtain sign-off from the relevant people for the change			
		1.14	Record and communicate the results of the change process to the appropriate people using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			
		1.15	Record and communicate the design change, using the appropriate information system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to control the new product design change process	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations, directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the specific health and safety requirements that apply to the design being changed			
		2.4	Explain how to obtain details of the specification of the design being changed			
		2.5	Explain the types of design change options that should be considered			
		2.6	Explain the different types of design change that could be required			
		2.7	Explain the types of information and level of detail that should be included in a design change document			
		2.8	Explain how to use a systematic approach to design change			
		2.9	Explain how to analyse the design change data and information			
		2.10	Explain the regulations and guidelines that are relevant			
		2.11	Explain how to obtain information on regulations and guidelines			
		2.12	Explain when a client should be consulted on a design change			
		2.13	Explain who should be informed and consulted on the various aspects of a design change			
		2.14	Explain the company systems for recording design change information			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Explain the importance of using the company information systems			
		2.16	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 14: Plan and Control New Product Design Benchmarking Activities

Unit reference number: K/505/1009

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to plan and control new product design benchmarking 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 Engineering 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	Plan and control new product design benchmarking activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Obtain all customer requirements and the design specification for the new product			
		1.3	Develop a benchmarking strategy for the new product/design			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Establish the criteria and procedures for benchmarking the design, including all of the following: • Functionality • Performance/specification • Aesthetics • Materials • Cost • Regulatory requirements • Weight • Recycling/sustainability • Manufacturability • Obtaining parts • Literature reviews • Customer needs • Methods and techniques • Durability • Interfacing • Safety			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Implement the benchmarking activity, using appropriate methods and techniques to include all of the following: • Establish the existing key competitor designs for the new product • Establish benchmarking criteria from customer requirements and design specification • Obtain all available information on the competitor designs, and assess them against the benchmarking criteria • Identify gaps in current product performance • Establish current state of the art for each identified benchmarking criteria • Identify the designs that are the most effective at meeting the customer's requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Collect and analyse the data gained from the benchmarking activity, using approved techniques to include three of the following: • Strengths, weaknesses, opportunities and threats (SWOT) analysis • Force field analysis • Critical success factor/process matrix • Design failure mode and effects analysis • Weighted selection • Tree diagram • Attribute analysis • Fishbone diagram • Relationship diagram • Paired comparison • Mind map • Technology/state-of-the-art analysis • Other (specify)			
		1.7	Make recommendations as to where improvements can be made to the design/product			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Communicate the results of the benchmarking exercise and record it in the relevant company information systems by a : • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			
		1.9	Present and record the results of the benchmarking exercise to the appropriate people, according to agreed procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to plan and control new product design benchmarking activities	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations/directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the organisational procedures and information systems for storing benchmarking data			
		2.4	Explain the organisational activities required for the benchmarking process			
		2.5	Explain the importance of establishing and recording responsibilities for benchmarking data collection			
		2.6	Explain who should have responsibility for developing different parts of the benchmarking process			
		2.7	Explain the various procedures that can be used in the benchmarking process			
		2.8	Explain the principles and techniques used in structured product comparison			
		2.9	Explain the factors that should be taken into account for disseminating information			
		2.10	Explain the types of problem that could occur during the benchmarking process			
		2.11	Explain the methods and techniques used to evaluate competitor products			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.12	Explain how to group critical success factors into categories (such as using fishbone diagrams or tree diagrams)			
		2.13	Explain how to identify gaps in current product performance			
		2.14	Explain what constitutes value adding and non-value adding activities			
		2.15	Explain how to identify what a customer requires from a product			
		2.16	Explain how to complete a risk assessment for using alternative new/state-of-the-art technology			
		2.17	Explain how to use decision making and creativity techniques (such as brainstorming) to generate ideas for improvement			
		2.18	Explain how to prioritise and rank improvement ideas			
		2.19	Explain why it is important to have benchmarking exercises			
		2.20	Explain what should be included in benchmarking plans			
		2.21	Explain how to prioritise and schedule benchmarking activities			
		2.22	Explain how to obtain information on key competitor products			
		2.23	Explain how to determine what resources are necessary for the benchmarking exercise (such as competitor products)			
		2.24	Explain the regulations and guidelines that are relevant			
		2.25	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.26	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 15: Establish New Product Development and Introduction Brief

Unit reference number: H/505/1011

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to establish a new product development and introduction brief. 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 Engineering 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	Establish new product development and introduction brief	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Carry out all of the following activities to establish the NPDI brief: • Identify with the client the reasons or application for the new product design, and establish any constraints which may affect it • Review the critical operational/functional requirements and quality criteria of the NPDI • Clarify with relevant people any aspects of the design that are ambiguous • Produce the proposed NPDI brief, and discuss any changes needed to suit the operational/functional requirements with the relevant people • Ensure that the NPDI brief meets relevant regulations and guidelines • Agree the NPDI brief with the client for the design • Record the NPDI brief in the appropriate information system, and communicate it to the relevant people			
		1.3	Establish who is the client for the new product development and introduction (NPDI) brief			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Obtain accurate information on the NPDI requirements of the client to include one of the following: • External – existing client • External – potential client • Internal – existing organisational requirement • Internal – new organisational opportunity			
		1.5	Establish information for the development of the NPDI brief from two of the following sources: • Existing designs • Research • Tests or trials • Client • Suppliers • General or specialist media • Specialists/experts • Engineering department • User groups			
		1.6	Identify any unique or specific features that need particular consideration			
		1.7	Determine the feasibility of achieving the client's requirements			
		1.8	Identify clearly any design constraints			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Establish the NPDI brief constraints, considering four of the following: • Customer acceptability • Time availability • Cost of resources • Capacity • Copyright • Departmental • Legal • International/national standards • Environmental • Logistical • Safety • Commercial/prestige			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Obtain accurate information to establish NPDI objectives and specifications for six of the following: • Aesthetics • Quality characteristics • Function • Performance • Resources • Delivery schedule • Usability • Materials • Performance • Cost • Interfacing • Technology • Components • Durability			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Prepare a NPDI brief for the client containing all of the following: • Confirmation of objectives • High level functionality • Feasibility of achieving requirements • Description of proposed implementation (including any special features) • Detail of specific issues for consideration (such as product safety, health and safety, impending regulation changes, emerging technology) • NPDI project review process			
		1.12	Incorporate all necessary details into the design brief			
		1.13	Produce a NPDI brief that effectively encapsulates the requirements of the client			
		1.14	Ensure that the NPDI brief complies with all relevant regulations and guidelines to include one of the following: • International • National • Manufacturer specific • Company policy and procedures • Industry specific • Statutory bodies			
		1.15	Clarify and agree the NPDI brief with the client			
		1.16	Confirm that all participants in the design process are aware of the NPDI brief			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Record the NPDI brief in the appropriate information systems and communicate it to appropriate people using: • Verbal reports Plus one of the following methods: • Electronic mail • Computer-based presentation • Computer-based report • Specific company form			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to establish new product development and introduction brief	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations, directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain how to obtain details of the specification of the product or process to be designed			
		2.4	Explain the types of design constraints that should be considered			
		2.5	Explain the different types of existing design brief that could be required			
		2.6	Explain the types of information and level of detail that should be included in a NPDI brief			
		2.7	Explain when a client should be consulted on a NPDI brief			
		2.8	Explain who should be informed and consulted on the various aspects of a NPDI brief			
		2.9	Explain how to obtain and interpret legislation and regulatory documentation			
		2.10	Explain the clients that they normally work with, and how they fit into the supply chain			
		2.11	Explain how to obtain information from a client, and how to assess whether it is accurate			
		2.12	Explain whom they should deal with in a client's organisation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain the procedures for contacting the client's organisation			
		2.14	Explain the types of information that is necessary for establishing NPDI requirements			
		2.15	Explain the organisational procedures and information systems for storing NPDI data			
		2.16	Explain the various technologies to be used in the NPDI concepts			
		2.17	Explain the equipment and methods used to produce the NPDI concepts			
		2.18	Explain the extent and limit of their own organisation's capabilities for producing various new product designs			
		2.19	Explain the types of design feature that should be considered unique, and why it is important to give these particular consideration			
		2.20	Explain the factors that should be taken into account for disseminating NPDI information			
		2.21	Explain the types of problem that could occur during the design concept process			
		2.22	Explain the methods and techniques used to evaluate design concepts			
		2.23	Explain why it is important to have or generate a range of design concepts			
		2.24	Explain the hazards associated with the various technologies			
		2.25	Explain how to conduct a risk assessment of the various design concepts, and identify associated contingency plans to minimise their effect			
		2.26	Explain how to determine what resources are necessary for the design concept exercise			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.27	Explain how to assess the feasibility of achieving the client's requirements			
		2.28	Explain how to present a NPDI brief to the client, and the importance of selecting the most appropriate method of presentation			
		2.29	Explain how to obtain and interpret relevant information on regulations and guidelines			
		2.30	Explain the organisational process or procedure for recording new product design requirements, and the importance of using this			
		2.31	Explain the extent of their own responsibility and their level of authority when dealing with clients			
		2.32	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 16: Produce and Evaluate Conceptual Design Options for New Products

Unit reference number: D/505/1010

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce and evaluate conceptual design options for new products. 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 Engineering 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 and evaluate conceptual design options for new products	1.1	Work safely at all times, complying with health and safety and other relevant regulations/directives and guidelines			
		1.2	Carry out all of the following activities in producing and evaluating conceptual designs: • Produce the conceptual design options • Identify the criteria to be used to evaluate each of the conceptual designs • Evaluate each conceptual design against the established criteria • Identify the designs that are most effective at meeting the customer's requirements • Identify any risks, and produce a contingency strategy for minimising them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Evaluate design such as concepts for two of the following: • Materials (metals, chemicals, plastics, ceramics, composites) • Electrical components • Software programs • Electronic components • Mechanical components • Integrated technologies • Fabricated/welded • Other (specify)			
		1.4	Apply a systematic approach to the evaluation process			
		1.5	Obtain all customer requirements and the design specification for the new product			
		1.6	Establish all the technologies to be considered as part of the design			
		1.7	Produce conceptual designs using each of the identified technologies			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Identify the criteria to be used to evaluate each of the conceptual designs from the customer requirements, and evaluate using at least one of the following: • Strengths, weaknesses, opportunities and threats (SWOT) analysis • Force field analysis • Critical success factor/process matrix • Design failure mode & effects analysis (DFMEA) • Weighted selection • Tree diagram • Attribute analysis • Fishbone diagram • Relationship diagram • Paired comparison • Mind map • Technology/state-of-the-art analysis • Other (specify)			
		1.9	Evaluate each conceptual design against the established criteria, and identify the designs that are most effective at meeting the customer's requirements			
		1.10	Compare results and design performance from similar design exercises, and identify any lessons learned			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Identify any perceived risks, and produce a contingency strategy for minimising them to include all of the following: • Embedded technology • Innovative technology • Security of supply • Lack of performance • Environmental constraints • Interfacing components/technologies • Hazardous processes • Hazardous material • Hazardous emissions • Other specific			
		1.12	Record and present the results of the evaluation to the appropriate people, according to agreed procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to produce and evaluate conceptual design options for new products	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations, directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify manage and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the organisational procedures and information systems for storing conceptual design data			
		2.4	Explain the various technologies to be used in the design concepts			
		2.5	Explain how to apply and use a systematic approach to the evaluation process			
		2.6	Explain the equipment and methods used to produce the design concepts			
		2.7	Explain the factors that should be taken into account for disseminating information			
		2.8	Explain the types of problem that could occur during the design concept process			
		2.9	Explain the methods and techniques used to evaluate design concepts			
		2.10	Explain why it is important to generate a range of design concepts			
		2.11	Explain how to conduct a risk assessment of the various design concepts, and identify associated contingency plans to minimise their effect			
		2.12	Explain how to determine what resources are necessary for the design concept exercise			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain the hazards associated with the various technologies			
		2.14	Explain how to obtain and interpret relevant information on regulations, directives and guidelines			
		2.15	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 17: Verify New Product Designs Using a Computer Model

Unit reference number: K/505/1012

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to verify new product designs using a computer model. 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 Engineering 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	Verify new product designs using a computer model	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Carry out all of the following activities in verifying designs with computer models: • Obtain the documentation and drawings containing design data for the computer model • Plan the methods to be used in constructing and evaluating the design using the computer model • Develop the computer model for the design in the appropriate format and software • Evaluate results from the computer model against the design data, using established procedures			
		1.3	Establish a method for creation of the computer model, using at least one of the following: • 3D surface modelling for CAM system • 3D graphical motion/ function modelling			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Establish design concepts and mechanism for collecting data from the model, for at least four of the following characteristics: • Geometry • Aesthetics • Materials • Weight • Durability • Interfacing • Performance • Assembly/manufacturability • Other (specify)			
		1.5	Determine and obtain the appropriate resources, including three of the following: • Equipment • Facilities • Finance • Plant • Components • Materials • People • Services • Other specific			
		1.6	Obtain the design data to be verified with the computer model			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Use the appropriate equipment hardware and software to create the computer model, in the appropriate format			
		1.8	Establish the plan to evaluate the computer model against requirements, including three of the following: • Timing plan • Identification of authorisation channels • Environmental requirements • Configuring process • Preparation of the model • Preparation of the process • Testing and/or trials • Handover process			
		1.9	Establish key criteria for verification of the design performance			
		1.10	Run the computer model and evaluate results and design performance against the criteria			
		1.11	Monitor the modelling and verification process to ensure that it meets the design characteristics, and that all of the following are achieved: • Correct implementation of the agreed plan • Effective use of resources • Identification and solving of any problems that occur			
		1.12	Identify any potential risks from the computer modelling exercise			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Ensure that the modelling and evaluation process complies with relevant regulations, directives and guidelines, including one of the following: • International • National • Manufacturing specific • Company policy and procedures • Industry specific • Statutory bodies			
		1.14	Record the outcomes of the evaluation process in the appropriate company information system, and communicate the outcomes to the relevant people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			
		1.15	Present the results of the verification exercise to the appropriate people, according to agreed procedures			
		1.16	Record all relevant information in the appropriate information systems for future use, according to agreed procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to verify new product designs using a computer model	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations, directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the specific safety precautions to be taken when working with computer systems (to include such things as safety guidance relating to the use of visual display unit (VDU) equipment and workstation 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)			
		2.4	Explain the 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)			
		2.5	Explain the basic set-up and operation of the modelling system, and the peripheral devices that are used (such as mouse, light pen, digitiser and tablet, printer or plotter, and scanner)			
		2.6	Explain the correct start-up and shutdown procedures to be used for the computer system			
		2.7	Explain how to access the specific computer modelling software to be used, and the use of software manuals and related documents to aid efficient operation of the relevant drawing system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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)			
		2.9	Explain the national, international and organisational standards and conventions that are used for the models			
		2.10	Explain how to set up computer model templates parameters (such as layers of drawings, scale, size, colour set-up, line types, dimensioning system and text styles)			
		2.11	Explain the application and use of computer modelling tools (such as for straight lines, curves and circles; how to create hatching and shading on drawings; producing layers of drawings)			
		2.12	Explain how to access, recognise and use a wide range of standard components and symbol libraries from the CAD equipment			
		2.13	Explain the applications of different 3D modelling programmes (such as surface, solid and wire frame)			
		2.14	Explain the display views that can be used on 3D models (such as view co-ordinate geometry and object co-ordinate geometry)			
		2.15	Explain the application and use of drawing tools for surface or solid modelling; how to modify drawings using surface/solid modelling tools or Boolean operators; how to add dimensions and text to model drawings			
		2.16	Explain the need for document control (such as ensuring that completed drawings are approved, labelled and stored on a suitable storage medium, the need to create backup copies of computer files and to file them in a separate and safe location away from electromagnetic sources, filing and storing hard copies for use in production)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Explain the procedures for drawing change notes, trial changes, up-issuing of drawings, modifications, and miscellaneous amendments to drawings			
		2.18	Explain the sources and methods for obtaining the required technical information relevant to the model being produced (such as limits and fits, contraction allowances, bearing selection, surface finish)			
		2.19	Explain the various technologies to be used in the verification of designs using computers			
		2.20	Explain the equipment and methods used to produce computer models			
		2.21	Explain the factors that should be taken into account for disseminating information			
		2.22	Explain the types of problem that could occur during the design modelling process			
		2.23	Explain the methods and techniques used to verify designs using computer models			
		2.24	Explain why it is important to have models to verify designs			
		2.25	Explain how to conduct a risk assessment of the various designs, and identify associated contingency plans to minimise their effect			
		2.26	Explain how to determine what resources are necessary for the design modelling exercise			
		2.27	Explain the regulations, directives and guidelines that are relevant			
		2.28	Explain the methods and procedures used to minimise the chances of infecting a computer with a virus			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.29	Explain the implications if the computer they are using does become infected with a virus and who to contact if it does occur			
		2.30	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.31	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 18: Verify New Product Designs Using a Physical Model

Unit reference number: L/505/1018

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to verify new product designs using a physical model. 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 Engineering 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	Verify new product designs using a physical model	1.1	Obtain the design data against which the physical model is to be verified			
		1.2	Carry out all of the following activities in preparation for verifying the conceptual designs: • Obtain all relevant design documentation for the physical model (such as design drawings, specifications, customer brief/requirements) • Determine the resources required to produce the physical model (such as modelling method, materials required, people with the required skills, access to specialised equipment such as wind tunnels) • Plan the methods to be used in constructing and evaluating the physical model • Establish key criteria for verification of the physical model against the design data • Establish methods of collecting the required design data from the physical model • Determine how the results of the verification exercise will be recorded in company systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Consider the various ways of producing the physical model and establish the most appropriate method to include one of the following: • Rapid prototyping • Soft tool • Handmade • Machined • Formed • Fabricated • Other specific process			
		1.4	Determine and obtain the appropriate resources, including three of the following: • Equipment • Facilities • Finance • Plant • Components • Materials • People • Services • Other (specify)			
		1.5	Identify any potential design limits and constraints from the physical modelling exercise			
		1.6	Arrange construction of the physical model			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Monitor the modelling process, to ensure that it meets the design characteristic and that all of the following are achieved: • Correct implementation of the agreed plan • Effective use of resources • The model produced accurately reflects the design data • Identification and solving of any problems that occur			
		1.8	Collect design data from the physical model using the appropriate equipment, materials and people to include four of the following: • Geometry • Aesthetics • Materials • Weight • Durability • Interfacing • Performance • Assembly/manufacturability • Aerodynamics • Safety • Other (specify)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Establish a plan to evaluate the physical model against requirements, to include three of the following: • Timing plan • Identification of authorisation channels • Environmental requirements • Configuring process • Preparation of the model • Preparation of the process • Testing and/or trials • Handover process			
		1.10	Ensure that the modelling and evaluation process complies with relevant regulations and guidelines, including one of the following: • International • National • Manufacturing specific • Company policy and procedures • Industry specific • Statutory bodies			
		1.11	Evaluate the data taken from the physical model against the design data requirements			
		1.12	Make valid decisions about the design based on the data taken from the physical model			
		1.13	Record and present the results of the verification exercise to the appropriate people, according to agreed procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Record the outcomes of the evaluation process in the appropriate company information system, and communicate the outcomes to the relevant people, using the following: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to verify new product designs using a physical model	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations, directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify manage and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the health, safety and environmental requirements applicable to the modelling process activities, location and process/facility being used			
		2.4	Explain how to obtain design data for the modelling and evaluation process			
		2.5	Explain how to use the design data to determine the most suitable method of producing the physical model			
		2.6	Explain the various technologies that can be used in the creation of physical models, such as rapid prototyping, soft tool, handmade			
		2.7	Explain the benefits, constraints and physical limitations of the various modelling processes			
		2.8	Explain the organisational procedures and information systems for verifying designs using physical models			
		2.9	Explain the equipment and methods used to evaluate the physical model (such as tolerance measurement using a coordinate measuring machine (CMM), aerodynamics using wind tunnels)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how the results of the design verification are to be presented: such as, a printed report, electronically (data or design file), exceptions only, a red/yellow/green light or some other type of go/no-go indicators			
		2.11	Explain the principles to be used for the modelling and evaluation process			
		2.12	Explain the factors that should be taken into account for disseminating information			
		2.13	Explain the types of problem that could occur during the modelling process			
		2.14	Explain the methods and techniques used to evaluate design models			
		2.15	Explain how to determine and obtain the resources necessary for the modelling exercise			
		2.16	Explain the regulations and guidelines that are relevant			
		2.17	Explain the company's systems for recording and communicating information			
		2.18	Explain the hazards associated with the various technologies and how to deal with them			
		2.19	Explain how to obtain and interpret information on regulations and guidelines			
		2.20	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 19: Produce New Product Designs for Manufacture and Assembly

Unit reference number: T/505/1045

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce new product designs for manufacture and assembly. 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 Engineering 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 new product designs for manufacture and assembly	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Obtain the correct details for the new product and the available manufacturing and/or assembly process			
		1.3	Review best practice used in the current manufacturing and/or assembly processes to include three of the following: • Tool access • Packaging • Weight • Toxic materials/substances • Sequencing • Handling • Access • Maintenance • Tolerancing • Contamination • Other (specify)			
		1.4	Identify clearly any design or manufacturing and/or assembly constraints			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Collect and analyse manufacturing and/or assembly information, using all of the following: • Strengths, weaknesses, opportunities and threats (SWOT) analysis • Force field analysis • Critical success factor/process matrix • Process failure mode & effects analysis (PFMEA) • Weighted selection • Tree diagram • Attribute analysis • Fishbone diagram • Relationship diagram • Paired comparison • Mind map • Technology/state-of-the-art analysis • Other (specify)			
		1.6	Produce the conceptual design options			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Ensure that the designs comply to relevant regulations/directives, standards and guidelines, from one of the following: • International • National • Manufacturer specific • company policy and procedures • industry specific • Statutory bodies			
		1.8	Develop, in consultation with relevant people, a realistic and thorough build plan for the manufacture and/or assembly of the new product			
		1.9	Discuss and finalise the build plan with the client and any key stakeholders, making changes where necessary			
		1.10	Critique the build plan against the appropriate DFM and/or DFA criteria			
		1.11	Apply value management techniques to the build plan which includes all of the following: • Identifies the non-value added activities and indicates alternatives • Priorities and ranking any alternatives • Includes a risk assessment of alternatives • Identifies the most appropriate alternatives • Provides costing recommendations for management approval • Identifies expected benefits			
		1.12	Determine the feasibility of achieving the desired build plan			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Record details of the build plan, consultation and evaluation process, in the appropriate information system			
		1.14	Present the build plan to the appropriate people, according to agreed procedures			
		1.15	Communicate results of the design activities using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to produce new product designs for manufacture and assembly	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations, directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the specific health and safety requirements that apply to the product manufacturing and/or assembly process to be designed			
		2.4	Explain how to obtain details of the specification of the product and equipment used in the manufacturing and/or assembly process that is to be designed			
		2.5	Explain the types of design constraints that should be considered			
		2.6	Explain the different types of build plan that could be required, including new/state-of-the-art technology			
		2.7	Explain the types of information and level of detail that should be included in a build plan			
		2.8	Explain how to structure and run a Value Management activity			
		2.9	Explain how to carry out Function Analysis			
		2.10	Explain how to carry out process failure mode and effects analysis (PFMEA)			
		2.11	Explain how to carry out design for manufacture (DFM) and/or design for assembly (DFA) activity			
		2.12	Explain how to identify what a customer requires from a product manufacturing and/or assembly process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain how to prioritise and rank the alternatives			
		2.14	Explain how to complete a risk assessment of the alternatives			
		2.15	Explain how to include the findings into build plan proposals			
		2.16	Explain how to monitor and track build plan proposals through to implementation			
		2.17	Explain the regulations and guidelines that are relevant			
		2.18	Explain how to obtain information on regulations and guidelines			
		2.19	Explain when a client should be consulted on a build plan			
		2.20	Explain who should be informed and consulted on the various aspects of a build plan			
		2.21	Explain the company systems for recording build plan information			
		2.22	Explain the importance of using the company information systems			
		2.23	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 20: Plan and Control New Product Manufacturing Process Benchmarking Activities

Unit reference number: J/505/1048

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to plan and control new product manufacturing process benchmarking 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 Engineering 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	Plan and control new product manufacturing process benchmarking activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Conduct a process benchmarking activity for two of the following: • Machining • Welding • Assembling • Casting • Forming • Wiring • Testing/inspection • Packaging • Coating/covering • Electrical components • Electronic components • Fabrication • Joining • Pressing • Storing • Logistics/movement • Processing operations • Moulding • Laying up • Bonding/gluing • Heat treatment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	...continued • Integrated technologies • Computer hardware/software • New technologies • Other (specify)			
		1.3	Obtain all customer requirements and the design specification for the new process			
		1.4	Develop a benchmarking strategy for the new process/design			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Establish the criteria and procedures for process benchmarking for three of the following: • Functionality • Performance/specification • Aesthetics • Materials • Purchase cost • Regulatory requirements • Training cost • Utility cost/usage • Maintenance • Statistical capability • Durability • Interfacing • Operating cost • Safety • Environmental • Other (specify)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Implement the benchmarking activity, using appropriate methods and techniques to include all of the following: • Establish the existing key competitor manufacturing processes • Establish benchmarking criteria from customer requirements and potential new process specifications • Obtain all available information on the competitor designs and assess them against the benchmarking criteria • Identify gaps in current process performance • Identify potential new technologies that could be included in existing and future processes • Establish current state of the art for each of the identified benchmarking criteria • Identify the processes that are the most effective at meeting existing and new customer requirements • Generate ideas for improved process performance			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Analyse the data gained from the benchmarking activity, using approved techniques to include three of the following: • Strengths, weaknesses, opportunities and threats (SWOT) analysis • Force field analysis • Critical success factor/process matrix • Design failure mode and effects analysis • Weighted selection • Tree diagram • Attribute analysis • Fishbone diagram • Relationship diagram • Paired comparison • Mind map • Technology/state-of-the-art analysis • Other (specify)			
		1.8	Make recommendations as to where improvements can be made to the design/product development			
		1.9	Make recommendations where improvements to existing or new manufacturing processes should be used			
		1.10	Present and record the results of the benchmarking exercise to the appropriate people, according to agreed procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Communicate the results of the benchmarking exercise using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to plan and control new product manufacturing process benchmarking activities	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify, manage and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the organisational procedures and information systems for storing benchmarking data			
		2.4	Explain the organisational activities required for the benchmarking process			
		2.5	Explain the importance of establishing and recording responsibilities for benchmarking data collection			
		2.6	Explain who should have responsibility for developing different parts of the benchmarking process			
		2.7	Explain the various procedures that can be used in the benchmarking process			
		2.8	Explain the principles and techniques used in structured process comparison			
		2.9	Explain the factors that should be taken into account for disseminating information			
		2.10	Explain the types of problem that could occur during the benchmarking process			
		2.11	Explain the methods and techniques used to evaluate competitor products and processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.12	Explain how to group critical success factors into categories (such as using fishbone diagrams or tree diagrams)			
		2.13	Explain how to identify gaps in current process performance			
		2.14	Explain what constitutes value adding and non-value adding activities			
		2.15	Explain how to identify what a customer requires from a product and process			
		2.16	Explain how to complete a risk assessment for using alternative new/state-of-the-art technology			
		2.17	Explain how to use decision making and creativity techniques (such as brainstorming, to generate ideas for improvement)			
		2.18	Explain how to prioritise and rank process improvement ideas			
		2.19	Explain why it is important to have benchmarking exercises			
		2.20	Explain what should be included in benchmarking plans			
		2.21	Explain how to prioritise and schedule benchmarking activities			
		2.22	Explain how to obtain information on key competitor products and processes			
		2.23	Explain how to determine what resources are necessary for the benchmarking exercise (such as competitor products, technical specifications/literature)			
		2.24	Explain the regulations and guidelines that are relevant			
		2.25	Explain how to obtain and interpret information on regulations and guidelines			
		2.26	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 21: Establish Manufacturing Process Design Brief for New Product Introduction

Unit reference number: L/505/1049

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to establish a manufacturing process design brief for new product information. 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 Engineering 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	Establish manufacturing process design brief for new product introduction	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Carry out all of the following activities to establish the new manufacturing process design brief: • Identify with the client the reasons or application for the new NPDI manufacturing design process, and establish any constraints which may affect it • Review the critical operational/functional requirements and quality criteria of the NPDI manufacturing process design • Clarify with relevant people any aspects of the manufacturing process design that are ambiguous • Produce the proposed NPDI manufacturing process brief and discuss any changes needed to suit the operational/functional requirements with relevant people • Ensure that the NPDI manufacturing process design brief meets relevant regulations and guidelines • Obtain agreement and sign-off of the NPDI manufacturing process design brief with the client			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Obtain accurate information on the manufacturing requirements of the client to include one of the following: • External – existing client • External – potential client • Internal – existing organisational requirement • Internal – new organisational opportunity			
		1.4	Obtain accurate information to establish manufacturing process design objectives and specifications for six of the following NPDI requirements: • Aesthetics • Quality characteristics • Function • Performance • Resources • Delivery schedule • Usability • Materials • Performance • Cost • Interfacing • Technology • Components • Durability			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Establish information for the development of the NPDI manufacturing process design brief from two of the following sources: • Existing designs • Research • Tests or trials • Client • Suppliers • General or specialist media • Specialists/experts • Engineering department • User groups			
		1.6	Identify any unique or specific manufacturing features that need particular consideration			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Establish the manufacturing process design brief constraints, considering four of the following: • Customer acceptability • Time availability • Cost of resources • Capacity • Copyright • Departmental • Legal • International/national standards • Environmental • Logistical • Safety • Commercial/prestige			
		1.8	Determine the feasibility of achieving the client's manufacturing requirements			
		1.9	Identify clearly any NPDI manufacturing process design constraints			
		1.10	Incorporate all necessary details into the manufacturing design brief			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce a NPDI manufacturing process design brief that effectively encapsulates the requirements of the client to include all of the following: • Confirmation of objectives • Manufacturing process flow diagrams • Feasibility of achieving requirements • Description of proposed implementation, including any special features • Detail of specific issues for consideration (such as quality assurance, health and safety, impending regulation changes, emerging technology) • NPDI manufacturing process design installation review process			
		1.12	Ensure that the NPDI manufacturing process design brief complies with all relevant regulations and guidelines to include one of the following: • International • National • Manufacturer specific • Company policy and procedures • Industry specific • Statutory bodies			
		1.13	Clarify and agree the NPDI manufacturing design brief with the client			
		1.14	Confirm that all participants in the design process are aware of the NPDI manufacturing process design brief			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Communicate the manufacturing process design brief using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			
		1.16	Record the NPDI manufacturing process design brief in the appropriate information systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to establish manufacturing process design brief for new product introduction	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations, directives and guidelines, in the department/organisation where work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI manufacturing process design programme			
		2.3	Explain how to obtain details of the specification of the new product for the new manufacturing process to be designed			
		2.4	Explain the types of manufacturing process design constraints that should be considered			
		2.5	Explain the different types of existing manufacturing process design brief that could be required			
		2.6	Explain the types of information and level of detail that should be included in an NPDI manufacturing process brief			
		2.7	Explain when a client should be consulted on an NPDI manufacturing process design brief			
		2.8	Explain who should be informed and consulted on the various aspects of a new manufacturing process design brief			
		2.9	Explain how to obtain and interpret legislation and regulatory documentation			
		2.10	Explain the clients that they normally work with, and how they fit into the supply chain			
		2.11	Explain how to obtain information from a client, and how to assess whether it is accurate			
		2.12	Explain who they should deal with in a client's organisation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain the procedures for contacting the client's organisation			
		2.14	Explain the types of information necessary for establishing NPDI manufacturing process design requirements			
		2.15	Explain the organisational procedures and information systems for storing NPDI manufacturing process design data			
		2.16	Explain the various technologies that can be used in the NPDI manufacturing process design concepts, and the hazards associated with them			
		2.17	Explain the equipment and methods used to produce the NPDI manufacturing process design concepts			
		2.18	Explain the extent and limit of their own organisation's capabilities for producing various new product designs			
		2.19	Explain the types of design feature that should be considered unique, and why it is important to give these particular consideration			
		2.20	Explain the factors that should be taken into account for disseminating NPDI manufacturing process design information			
		2.21	Explain the types of problem that could occur during the manufacturing process design concept process			
		2.22	Explain the methods and techniques used to evaluate manufacturing process design concepts			
		2.23	Explain why it is important to generate a range of manufacturing process design concepts			
		2.24	Explain how to conduct a risk assessment of the various manufacturing process design concepts, and how to identify associated contingency plans to minimise their effect			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.25	Explain how to determine what resources are necessary for the manufacturing process design concept exercise			
		2.26	Explain how to access the feasibility of achieving the client's requirements for the new manufacturing process design			
		2.27	Explain how to present an NPDI manufacturing process design brief to the client, and the importance of selecting the most appropriate method of presentation			
		2.28	Explain how to obtain and interpret relevant information on regulations and guidelines			
		2.29	Explain the organisational process or procedure for recording new manufacturing process design requirements, and the importance of using this			
		2.30	Explain the extent of their own responsibility and their level of authority when dealing with clients			
		2.31	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 22: Develop a New Product Manufacturing Process Design Strategy

Unit reference number: F/505/1050

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to develop a new product manufacturing process design strategy. 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 Engineering 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	Develop a new product manufacturing process design strategy	1.1	Work safely at all times, complying with health and safety and other relevant regulations/directives and guidelines			
		1.2	Carry out all of the following activities in developing a process design strategy: • Establish a means of storing process documentation and version control (configuration management) • Establish criteria for testing and validation of process design • Establish criteria for the process design (equipment, tooling) • Identify the activities that make up the process design • Establish the responsibility to each activity • Identify the resources required • Identify potential critical problems and effective contingency plans accordingly • Develop a schedule for the process design • Ensure that the strategy takes into account regulations/directives and guidelines • Communicate information to the appropriate people and to the quality management system			
		1.3	Identify the process activities that need to be undertaken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Establish the activities that will make up the process design, including all of the following: • Confirmation of requirements • Review of reference materials • Review historical records for past failures/poor performance			
		1.5	Establish the appropriate procedures to be used during the process design, from all of the following: • Disseminating information • Obtaining resources • Reviewing designs (product, process) • Change management • Configuration management • Resource procurement			
		1.6	Establish the responsibilities for developing specific aspects of the manufacturing process			
		1.7	Review and evaluate historical records from similar process activities			
		1.8	Identify any potentially critical problems and establish effective contingency plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Evaluate appropriate lean techniques for inclusion in the process design to include three of the following: • Single-piece flow • JIT • Kanban • Poke Yoke • Cellular manufacture • Takt time • Design for flexible manning • Bottleneck/constraint management			
		1.10	Ensure that the process design strategy complies with relevant regulations, standards and guidelines to include one from the following: • International • National • Manufacturer specific • Company policy and procedures • Industry specific • Statutory bodies			
		1.11	Make recommendations where improvements to existing or new manufacturing processes should be used			
		1.12	Present and record the results of the exercise to the appropriate people, according to agreed procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Communicate the results of the manufacturing process design exercise, and record it in the relevant company information systems by the following methods: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to develop a new product manufacturing process design strategy	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations/directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the manufacturing processes, skills and people required for the design of the current product range			
		2.4	Explain the organisational procedures and information systems for storing process design data and configuration management			
		2.5	Explain the organisational activities required for the process design			
		2.6	Explain the importance of establishing and recording responsibilities			
		2.7	Explain the various procedures that can be used in the process design			
		2.8	Explain the factors that should be taken into account for disseminating information			
		2.9	Explain the types of problem that could occur during the process design			
		2.10	Explain the principles and application of lean manufacturing techniques to the workplace			
		2.11	Explain why it is important to have contingency plans			
		2.12	Explain what should be included in contingency plans			
		2.13	Explain how to prioritise and schedule manufacturing design activities			
		2.14	Explain how to obtain information on resources			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Explain how to determine what resources are necessary			
		2.16	Explain how to determine the availability of resources			
		2.17	Explain the regulations and guidelines that are relevant			
		2.18	Explain how to obtain and interpret information on regulations and guidelines			
		2.19	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 23: Develop a New Product Manufacturing Process Flow and Floor Plan Layout

Unit reference number: J/505/1051

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to develop a new product manufacturing process flow and floor plan layout. 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 Engineering 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	Develop a new product manufacturing process flow and floor plan layout	1.1	Work safely at all times, complying with health and safety and other relevant regulations/directives and guidelines			
		1.2	Carry out all of the following activities in a planning activity: • Plan the appropriate way to identify customer delivery requirements • Obtain all the necessary capacity requirements data • Construct process flow chart and floor plan layouts, using the appropriate media (such as computer software) • Communicate information to the appropriate people			
		1.3	Establish customer delivery requirements for the new product to include all of the following: • Capacity planning volumes (CPV) • Delivery logistics (eg, pallet size) • Daily planning volumes (DPV)			
		1.4	Establish organisational capacity requirements including operating patterns			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Establish organisational budget constraints for the development exercise to include all of the following: • Capital • Tooling • Revenue • Skills available • Premises (such as alterations, new buildings) • Performance (such as staff needed) • Margins • Other (specify)			
		1.6	Calculate Takt time using data from organisational capacity requirements			
		1.7	Construct a process flow chart for the new product to include all of the following: • Travel • Inspection/testing • Finished goods storage • Manufacturing operations • Rework • WIP storage • Materials storage			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Establish production cell requirements for the manufacture of the new product to include all of the following: • Manufacturing cell design (such as T, U, I, production line) • Gauging • Inventory levels • Fixture design • Operators required • Tool storage • Environmental requirements • Safety requirements (such as guarding, lifting) • Transfers (such as robots, roller track)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Establish optimum layout in the space available for manufacture of the new product to include all of the following: • Transport and movement of parts • Position of associated shared resource • Gangways and walkways • Storage areas (such as WIP, materials) • Load bearing requirements (such as floor, roofs) • Cranes and hoists • Availability of services (such as air, water, electricity) • Exits and entrances (such as fire) • Location of service departments (such as maintenance) • Obstructions (such as pillars, walls, pipework) • Building regulations (such as planning permission) • Other (specify)			
		1.10	Ensure that the layouts comply with relevant regulations, directives, standards and guidelines, from one of the following: • International • National • Manufacturer specific • Company policy and procedures • Industry specific • Statutory bodies			
		1.11	Obtain sign-off and agreement from stakeholders for proposed plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Record the results of the planning exercise, in accordance with agreed procedures			
		1.13	Communicate with stakeholders, and record layouts in the relevant company information systems, by the following methods: • Verbal report Plus one of the following: • Electronic mail • Computer-based presentation • Computer generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to develop a new product manufacturing process flow and floor plan layout	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations, directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the organisational procedures and information systems for storing process flow and floor plan layout data			
		2.4	Explain the importance of establishing and recording responsibilities for the new product process flow and floor plan layout process			
		2.5	Explain who should have responsibility for the different parts of the process flow and floor plan layout process			
		2.6	Explain the mechanism used to establish customer delivery requirements			
		2.7	Explain how to establish organisational capacity requirements (including operating patterns)			
		2.8	Explain how to calculate Takt time			
		2.9	Explain how to establish organisational constraints on working time (such as overtime limits, maintenance availability)			
		2.10	Explain the various procedures that can be used in the process flow and floor plan layout process			
		2.11	Explain the principles and techniques used in a process flow and floor plan layout planning exercise			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.12	Explain the factors that should be taken into account for disseminating information before and after a process flow and floor plan layout planning process			
		2.13	Explain the types of problem that could occur during the process flow and floor plan layout process			
		2.14	Explain the organisational standards for the design of cells			
		2.15	Explain the different types of cell design and tools/equipment used in them			
		2.16	Explain the methods and techniques used to plan process flow and floor plan layouts			
		2.17	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 24: Plan and Manage the Installation of the New Product Manufacturing Process

Unit reference number: R/505/1053

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to plan and mange the installation of the new product manufacturing process. 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 Engineering 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	Plan and manage the installation of the new product manufacturing process	1.1	Confirm customer build dates and delivery schedule requirements for the new product			
		1.2	Carry out all of the following activities in the planning activity: • Prepare installation plans against customer delivery requirements • Construct a master plan that includes delivery, removal and installation plans • Manage the installation of the new manufacturing process against the master plan • Communicate information to the appropriate people			
		1.3	Determine organisational availability of in-house equipment against the planned manufacturing layout to include both of the following: • Shared existing resource • Freely available resource			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Establish new equipment and resource requirements against all of the following: • Off the shelf • Custom built • Storage (such as shelving, floor space) • Additional facilities in existing production areas (such as buffer stock)			
		1.5	Create delivery plans for in-house/new equipment and resources against the planned manufacturing layout			
		1.6	Determine removal/disposal plans for redundant services and equipment from the planned manufacturing area			
		1.7	Establish service requirements for all of the following: • Electrical supplies • Water supplies • Coolant supplies • Pneumatic supplies • Gas supplies • Heating • Lighting • Environmental controls • Fire equipment and alarms • Waste streams • Other (specify)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Establish installation plans for new services in the new manufacturing area against the agreed floor plan layout			
		1.9	Identify and agree individual delivery plans with sub-contractors/machine builders for the manufacturing area			
		1.10	Construct a master plan for the installation of the new manufacturing process against agreed floor plan layout to include all of the following: • Key customer dates • In i house/new equipment delivery and resources plan • Redundant equipment/services removal plan • Installation plan against agreed floor plan layout • Restricted access/barriers needed • Allocation of responsibilities • Key contact persons • Special access/transport requirements • Critical activities • Equipment/service inter-dependencies • Health and safety requirements • Delivery storage requirements • Other (specify)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Agree sub-contractor/machine builder plans that include all of the following categories: • Cost breakdown • Delivery schedules • Performance guarantees • Quality standards • Construction design management (CDM) • Health and safety requirements • Acceptance criteria • Other (specify)			
		1.12	Ensure that all plans comply with relevant regulations, standards and guidelines, from one of the following: • International • National • Manufacturer specific • Company policy and procedures • Industry specific • Statutory bodies			
		1.13	Obtain sign-off and agreement from stakeholders for the master plan			
		1.14	Implement and manage the installation of the new manufacturing process against the master plan			
		1.15	Report project progress to relevant parties at the agreed stages of the plan			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Deal promptly and effectively with any problems during the installation process			
		1.17	Record the results of planning and installation activities, in accordance with agreed procedures			
		1.18	Communicate with stakeholders and record installation plans in the relevant company information systems, by the following method: • Verbal report Plus one of the following: • Electronic mail • Computer-based presentation • Computer- generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to plan and manage the installation of the new product manufacturing process	2.1	Explain the roles and responsibilities of themselves and others under the Health and Safety at Work Act			
		2.2	Explain how to develop specific, measurable, realistic installation objectives and deliverables with sub-contractors/machine builders, allowing progress to be monitored and measured (SMART)			
		2.3	Explain the tools and techniques available for planning and monitoring the installation process			
		2.4	Explain how to breakdown the installation process into individual deliverable activities/tasks			
		2.5	Explain how to allocate specific activities/tasks and responsibilities for the installation process, in accordance with individual skills and abilities			
		2.6	Explain how to determine the specialist help they may require during the installation process, and how this can be obtained			
		2.7	Explain how to present information effectively to management, sub-contractors/machine builders, customers and others			
		2.8	Explain how to solve problems and overcome barriers/difficulties encountered during the installation process			
		2.9	Explain how to apply construction design management (CDM) techniques to ensure compliance with health and safety regulations for the people installing the new process			
		2.10	Explain whom to liaise with and whom to obtain relevant and specific information from to support and assist them during the planning and installation process			
		2.11	Explain how to monitor progress of the installation process in terms of delivery on time, to budget, with agreed levels of quality			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.12	Explain the organisational procedures and information systems for storing installation plans for new product data			
		2.13	Explain the importance of establishing and recording responsibilities for new installation process			
		2.14	Explain who should have responsibility for the different parts of the installation process			
		2.15	Explain the mechanism used to establish customer build and delivery schedule requirements			
		2.16	Explain how to establish the availability of in-house equipment against the planned manufacturing layout requirements			
		2.17	Explain the factors to be considered in evaluating the availability of shared in-house and freely available equipment			
		2.18	Explain the various procedures that can be used in the installation planning process			
		2.19	Explain the principles and techniques used in an installation planning exercise			
		2.20	Explain the factors that should be taken into account for disseminating information before and after an installation planning process			
		2.21	Explain the types of problem that could occur during the installation process, and how to create plans that minimise their effects			
		2.22	Explain the methods and techniques used to plan new services in a planned manufacturing area			
		2.23	Explain the organisational guidelines and procedures for the development and agreement of contracts with sub-contractors/machine builders for new work			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.24	Explain how to construct a master plan for the installation process and manufacturing facilities			
		2.25	Explain how to use project planning software			
		2.26	Explain the limits of their own authority, and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 25: Commission a New Product Manufacturing Process

Unit reference number: T/505/1059

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to commission a new product manufacturing process. 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 Engineering 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	Commission a new product manufacturing process	1.1	Work safely at all times, complying with health and safety and other relevant regulations/directives and guidelines			
		1.2	Carry out all the following activities in a commissioning process: • Approve equipment and tooling for new manufacturing process • Ensure the commissioning complies with specification, regulations/directives and guidelines • Identify and obtain the required resources for the production trials • Implement and monitor pre-production and production trials • Solve problems from the pre-production and production trials • Fine tune the manufacturing process for optimum efficiency following the pre-production and production trials • Communicate appropriate information to all the relevant people • Maintain records for the quality management system			
		1.3	Approve equipment and tooling against agreed specification at the suppliers premises for delivery of the goods to manufacturing area			
		1.4	Ensure that adequate production materials are available for trialling equipment and tooling in the manufacturing area			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Consult with the relevant people to establish the most appropriate methods, techniques and activities to employ during commissioning, including four of the following: • Timing plan • Authorisation channels • Environmental requirements • Configuration process • Preparation of products • Preparation of site • Testing and/or trials • Handover			
		1.6	Initiate and monitor training of key personnel for the new manufacturing process to include all of the following: • Production team leaders • Maintenance personnel • Quality personnel • Key equipment operators			
		1.7	Arrange and monitor installation of equipment and tooling against the requirement of the master installation plan for the new manufacturing process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Conduct safety checks of equipment and tooling used in the new process and address any non-conformances to include all of the following: • Safety barriers • Safety guards • Personal protective equipment (PPE) • Trapping points • Fume extractions • Waste materials • Access points • Coolant extraction • Dangerous emissions/substances • CE compliance • Other (specify)			
		1.9	Initiate and monitor small trials for individual equipment and tooling in the new process against required quality specifications			
		1.10	Initiate and monitor process trials for equipment and tooling working in tandem to produce samples of the new product against required quality specifications			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Work with specialists to line-balance and achieve Takt time for the new process to include eight of the following: • Equipment suppliers/designers • Software specialists • Maintenance personnel • Quality engineers • Purchasing personnel • Bought-out parts suppliers • Equipment specialists (such as robotics, lasers) • Team leaders • Process engineers (such as welding, painting) • Logistics engineers (such as part supply/transport) • Health and safety specialists • Other (specify)			
		1.12	Initiate and monitor planned production trials for the new process against an agreed master plan			
		1.13	Conduct review of production trials problems with specialists and prioritise and plan actions to resolve them promptly and effectively			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Solve production trial problems using of two the of following methods: • Fish-bone diagrams • 5 why technique • Pareto analysis • Capability studies • Activity sampling • Tally charts • Other (specify)			
		1.15	Initiate and monitor fine-tuning of components, jigs and fixtures to meet quality requirements for the finished product to include two of the following: • distortion following welding • part fit up on assembly • ease of equipment loading during assembly • ease of product access for tools • other (specify)			
		1.16	Record the results of the commissioning activities in accordance with agreed procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Communicate the results of the commissioning exercise, and record it in the relevant company information systems by the following methods: • Verbal communication • Visual management techniques Plus one of the following: • Electronic mail • Computer-based presentation • Computer generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to commission a new product manufacturing process	2.1	Explain the importance of working safely at all times, and of complying with health and safety and other relevant regulations, directives and guidelines, in the department/organisation where the new product development and introduction (NPDI) work is being undertaken			
		2.2	Explain how to identify and minimise potential risks to health and safety that could occur during implementation of the NPDI programme			
		2.3	Explain the organisational procedures and information systems for storing commissioning data			
		2.4	Explain the organisational sign-off process and acceptance criteria for equipment and tooling at the supplier premises and at manufacturing area			
		2.5	Explain the organisational activities required for the NPDI team's commissioning process			
		2.6	Explain the importance of establishing and recording responsibilities for commissioning and analysis process			
		2.7	Explain who should have responsibility for the different parts of the commissioning process			
		2.8	Explain the various procedures that can be used in the commissioning and trialling review process			
		2.9	Explain the principles and techniques used in a structured pre-production/product problem-solving review			
		2.10	Explain the factors that should be taken into account for disseminating information before and after a commissioning process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain how to conduct a health and safety risk analysis of the new manufacturing process			
		2.12	Explain the types of problem that could occur during the commissioning process			
		2.13	Explain the methods and techniques used to evaluate product quality specifications			
		2.14	Explain how to use decision making and creativity techniques, such as brainstorming, to generate ideas for process improvement			
		2.15	Explain how to prioritise and rank process improvement ideas			
		2.16	Explain the sources of expert advice that may be accessed during the commissioning process			
		2.17	Explain the organisational sign-off process and acceptance criteria for handover to production personnel at the end of the commissioning process			
		2.18	Explain what should be included in plans for pre-production/ production trials of new products			
		2.19	Explain how to prioritise and schedule commissioning activities			
		2.20	Explain the limits of their own authority, and whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 26: Solve Engineering or Manufacturing Problems

Unit reference number: A/505/0933

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to solve engineering or manufacturing problems. 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 Engineering 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	Solve engineering or manufacturing problems	1.1	Carry out all of the following during the problem solving activity: • Discuss/consult with the relevant people on the nature and extent of the problem • Gather information from appropriate sources to help identify and define the problem • Identify and evaluate possible solutions, considering temporary, short term and long term solutions • Communicate the proposed solution to the relevant people, obtaining feedback where appropriate • Prepare a plan of action for implementation of the appropriate solution • Ensure that the agreed solution is implemented in an effective and timely manner • Ensure that the agreed solution complies with appropriate regulations and guidelines • Monitor the implementation of the solutions and make necessary revisions to the plan of action (plan do check act)			
		1.2	Take prompt action to solve problems and keep all relevant people informed of progress			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Take action to resolve engineering or manufacturing problems arising from four of the following: • Assembly • Manufacturing • Installation • Commissioning • Process operations or sequencing • Maintenance • Quality • Material handling or processing • Deviation from component/product specification • Equipment malfunction • Ergonomics related • Utilities supply (such as gas, electricity, water, air) • Time or schedule problem • Safety related • Personnel problem • External contractual problem • Lack of resources/materials • Environmental problem (pollutants, temperature, irritants, waste materials)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	...continued • Change to requirements (such as customer request) • Design related • Research and development • Company strategy • Deviation from departmental procedures, policies or work instructions • The customer (internal and/or external) • Other problem (specify)			
		1.4	Obtain all relevant information relating to the engineering or manufacturing problems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Obtain and use information on the problem from four of the following: • Statistical data • Historic records (such as maintenance or shift logs) • Quality audits • External sources • Feedback from users, colleagues or customers • Operating procedures/manufacturing manuals • Company procedures • Health and safety information • Environmental documents/reports • Process mapping • Approved and controlled tests, trials or experiments • Observation			
		1.6	Identify correctly the nature, extent and root cause of any engineering or manufacturing problems that arise			
		1.7	Evaluate all realistic engineering solutions to solve engineering or manufacturing problems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Evaluate possible solutions to the problems, by considering six of the following: • Operational effectiveness • Ease of implementation • Timescale for implementation • Financial impact • Customer impact (internal and/or external) • Regulations, standards, directives or codes of practice • Functionality of the system, product, component, or equipment • Environmental impact • Staffing implications • Training and development • Conformity with company policies, procedures or work instructions • Health and safety implications • Other (specify)			
		1.9	Identify the most effective solution for solving engineering or manufacturing problems			
		1.10	Implement engineering solutions for two of the following timescales: • Temporary (interim solution) • Short term (will require further action) • Long term (permanent solution)			
		1.11	Ensure that solutions are implemented correctly and promptly			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Ensure that the solutions to engineering or manufacturing problems comply with three of the following: • Organisational guidelines and codes of practice • Equipment manufacturer's operating specification • Health, safety and environmental requirements • Recognised compliance agency/body's standards • Customer standards and requirements specification • British, European, International standards or directives			
		1.13	Report and communicate solutions to problems, using: • Verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to solve engineering or manufacturing problems	2.1	Explain the health, safety and environmental requirements applicable to the engineering or manufacturing area			
		2.2	Explain the importance of wearing protective clothing and other appropriate safety equipment during the investigation of the problem, and where it may be obtained			
		2.3	Explain how to obtain details of engineering or manufacturing problems			
		2.4	Explain the importance of getting to the root cause of the problem			
		2.5	Explain the techniques used to get to the root cause of the problem such as the 5 why analysis, cause and effect diagrams, fault trees, flowcharting, process flow analysis			
		2.6	Explain the criticality of different types of problem, and how to prioritise the problems to be solved			
		2.7	Explain methods used to contain the problem such as in relation to non conformance of a product of process			
		2.8	Explain how to obtain and interpret relevant data and information such as drawings, charts, specifications, manufacturers' manuals, history/maintenance reports and other documents needed for the problem solving process			
		2.9	Explain the engineering or manufacturing processes and operating procedures within the area of their responsibility			
		2.10	Explain the engineering or manufacturing principles and processes within the function where the problem exists			
		2.11	Explain how to, obtaining any necessary ancillary equipment or resources, to support the investigation or solution to the problem under investigation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.12	Explain the typical problems that occur in your area of responsibility			
		2.13	Explain the factors that have to be taken into account when selecting the solution to a problem			
		2.14	Explain the techniques used to obtain information on problems, and the sources of information			
		2.15	Explain what factors need to be taken into consideration when prioritising the problems to be solved			
		2.16	Explain the methods and techniques involved in evaluating information			
		2.17	Explain the factors to be taken into account when selecting the corrective action to a problem			
		2.18	Explain the methods used to monitor the effectiveness of the corrective action			
		2.19	Explain why it is important to review the problem solving process to understand the lessons learned			
		2.20	Explain how to obtain and interpret relevant documentation associated with legislation, regulations, standards, directives or codes of practice			
		2.21	Explain how to obtain and interpret company policy and personnel procedures			
		2.22	Explain the reporting procedures and documentation, and their application			
		2.23	Explain who to inform of actions taken, and by what means			
		2.24	Explain how to retrieve necessary data from company information systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.25	Explain the types of monitoring systems/techniques available, and their application			
		2.26	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 27: Undertake Project Management Activities

Unit reference number: T/505/0963

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to undertake project management 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 Engineering 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	Undertake project management activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Ensure that the project delivery and outcomes comply with three of the following: • Organisational guidelines and procedures • Recognised compliance agency/body's standards, directives or codes of practice • Equipment manufacturer's operating specification/range • Customer standards and requirements • British, European or International standards or directives • Health, safety and environmental requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Undertake project management activities in one of the following areas: • Manufacturing (such as machining, fabrication, welding, material finishing or manufacture, assembly, joining) • Product or system installation • Commissioning • Decommissioning or recycling • Environmental or sustainability • Operational processes (such as movement of materials and logistics) • Maintenance practices (such as preventative, corrective, predictive, reactive or prevention) • Processing operations • Service supplies (such as gas, water, electricity) • Design • Research and development • Engineering support functions (such as procurement, quality assurance, inspection, testing, scheduled safety audits and risk assessments, business improvement, finance, technical sales)			
		1.4	Establish the need for the project and determine the project scope			
		1.5	Gain authorisation to plan, undertake and complete the project outcomes			
		1.6	Develop a full project plan which accurately identifies the project aims and objectives			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Develop project plans, which clearly identify all the following: • Project outcomes and objectives • Success criteria of the project • Cost of the project • Time scale required for the project • Resources required • Individual tasks within the project • Milestones and deliverables to be met			
		1.8	Obtain authorisation and support for the release of the necessary resources to carry out the project			
		1.9	Consult with appropriate people in order to secure access to four of the following resources: • Personnel • Documentation and supporting data • Finance • Equipment • Materials • Facilities/work area • Other specific resource			
		1.10	Establish a project team with the skill sets required to deliver the project objectives			
		1.11	Determine and agree individual roles and responsibilities within the project team			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Agree the review and monitoring processes and procedures to be used during the project			
		1.13	Monitor the project deliverables in accordance with the project plan			
		1.14	Monitor and review the progress of the project to include all of the following: • Project objectives are on target • Issues or problems are highlighted and resolved • Timelines are within agreed parameters • Budgets are within agreed limits • Agreed processes and procedures are being followed			
		1.15	Report on project progress to relevant parties at the agreed stages			
		1.16	Deal promptly and effectively with any problems within their control and report those that cannot be resolved			
		1.17	Make adjustments the project plan where required and agreed			
		1.18	Report project completion and closure to relevant personnel			
		1.19	Report and communicate final project outcomes, using: • Verbal report Plus one from the following: • Computer-based presentation • Computer generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to undertake project management activities	2.1	Explain the health, safety and environmental requirements applicable to the area the project is to be undertaken			
		2.2	Explain the legislative, regulatory, standards, directives or codes of practices that must be adhered to			
		2.3	Explain how to identify the project scope to determine the need for a full project plan and organisation approval			
		2.4	Explain the factors that may affect the feasibility or constraints of the project			
		2.5	Explain how to develop specific, measurable, realistic project objectives and deliverables, allowing progress to be monitored and measured			
		2.6	Explain the criteria to determine if the project has been successful or not			
		2.7	Explain the tools and techniques available for project planning and monitoring			
		2.8	Explain how to communicate effectively, listen and question, provide feedback, support others			
		2.9	Explain how to break the project down into individual deliverable tasks/metrics			
		2.10	Explain the format and systems used for communicating the project aims, objectives and specific deliverables			
		2.11	Explain how to form and develop the project team required to meet the identified objectives			
		2.12	Explain how to allocate specific tasks and responsibilities to the project team members according to individual skills and abilities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain the methods of assessing the project team performance			
		2.14	Explain the importance of enabling the project team to contribute to the development and review of the project and the methods used to achieve this			
		2.15	Explain how to determine the specialist help they may require in the project, and how this can be obtained			
		2.16	Explain how to conduct a project meeting			
		2.17	Explain how to present information effectively to management, peers, team members and customers			
		2.18	Explain how to solve problems and overcome barriers/difficulties encountered during the life of the project			
		2.19	Explain who to liaise with and who to obtain relevant and specific information from to support and assist them in running the project			
		2.20	Explain how to monitor progress of the project in terms of delivery on time, to budget, with agreed levels of quality			
		2.21	Explain how to negotiate changes to the project plan and secure agreement from all relevant parties			
		2.22	Explain the importance of keeping all parties updated on the progress of the project and any changes that have been made			
		2.23	Explain the implications for the project if changes are not communicated effectively			
		2.24	Explain how to report project closure, completion and final status to management, teams and customers			
		2.25	Explain the importance of evaluating the project and to identify where improvements could be made for future projects			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.26	Explain the company systems for recording project outcomes			
		2.27	Explain how limits of authority are agreed in the scope of the project			
		2.28	Explain the process to be followed to identify whom they should report to in the event of encountering problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 28: Determine the Requirements for Engineering Activities

Unit reference number: Y/505/0941

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to determine the requirements for 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 Engineering 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	Determine the requirements for engineering activities	1.1	Carry out all of the following when determining the requirements for engineering activities: • Obtain details of the required engineering activity • Review the critical requirements and quality criteria of the activity • Clarify with relevant people any aspects of the activity that are unclear • Discuss and facilitate any changes needed to suit the engineering requirements, with the relevant people • Ensure that methods and procedures to be used meet relevant regulations and guidelines • Define the engineering requirements and communicate them to the relevant people			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Determine requirements for one of the following engineering activities: • Manufacturing (such as machining, fabrication, welding, material finishing or manufacture, assembly, joining) • Design • Research • Product or system installation • Commissioning • Decommissioning or recycling • Environmental or sustainability • Operational processes (such as movement of materials and logistics) • Maintenance practices (such as preventative, corrective, predictive, reactive or prevention) • Processing operations • Service supplies (such as gas, water electricity • Engineering support functions (such as procurement, quality assurance inspection, testing, scheduled safety audits and risk assessments, business improvement)			
		1.3	Obtain accurate details of the engineering products or processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Obtain accurate details of the requirements for the engineering activity, from two of the following sources: • Design office • Production engineering • Process engineering • Quality engineering • Sales department • Safety engineering • Plant engineering • Industrial engineering • The client • Contractors/specialists • Component/product manufacturers • Material/component supplier • HR/personnel			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Establish requirements for one of the following: • Equipment/component/system capacity or capability studies • Equipment/component/system performance • Equipment/component/system life cycles • Maintenance and repair • People performance • People capacity or capability • Product or process quality • Supplier capacity or capability • Business support function capacity or capability			
		1.6	Review and interpret the specification requirements of the engineering products or processes to assess their characteristics			
		1.7	Clarify aspects of the engineering products or processes that are unclear			
		1.8	Specify the quality criteria for the engineering products or processes			
		1.9	Identify and confirm any changes to the engineering products or processes required to achieve the required outcomes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Identify the methods, quality criteria and plans to be used, covering two of the following: • Processing parameters • Equipment preparation/selection • Scheduling/planning • Configuring/reconfiguring • Inspection or testing • Purchasing • Safety checks/procedures • Commissioning • Installation • Servicing, maintenance and repair • People responsibilities • Product/process monitoring • Financial monitoring • Feedback/communication • Movement of equipment/resources • Stock control • Logistics • Business improvements • Staff development • Infrastructure requirements • Co-ordinating contracts			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Ensure that the requirements comply with three of the following: • Organisational guidelines and procedures • Recognised compliance agency/body standards, directives or codes of practice • Equipment manufacturers operating specification/range • British, European or International standards or directives • Health, safety and environmental requirements • Statutory bodies' requirements			
		1.12	Agree and confirm any changes required with two of the following: • Design department • Production department • Installation/commissioning team • Customer • Supplier • Purchasing/buying department • Quality/inspection department • Contracting department • Sales/marketing department • Other personnel (please specify)			
		1.13	Record the requirements in the appropriate information systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Record and communicate the requirements to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to determine the requirements for engineering activities	2.1	Explain the health, safety and environmental requirements applicable to the engineering activities to be carried out			
		2.2	Explain how to obtain details of engineering requirements from company information systems			
		2.3	Explain how to interpret drawings, charts, specifications, information, data, reports, manuals and other documents needed to understand the requirements of the engineering activity			
		2.4	Explain the critical characteristics of engineering activities			
		2.5	Explain the methods and techniques for assessing and clarifying aspects of engineering activities that could be unclear			
		2.6	Explain the quality criteria that apply to the particular engineering activity			
		2.7	Explain how to identify and interpret changes to requirements for engineering activities			
		2.8	Explain who to contact for clarification of the engineering requirements			
		2.9	Explain who should authorise any changes to engineering activities			
		2.10	Explain the different methods that relate to engineering activities within their area of responsibility			
		2.11	Explain how to predict and resolve potential problems with the engineering activities			
		2.12	Explain how to specify and communicate engineering requirements to others			
		2.13	Explain the importance of using the company information systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain the information systems that are in use within their organisation, and how to record data to the system			
		2.15	Explain how to obtain and interpret legislative and regulatory documentation			
		2.16	Explain how to obtain and interpret company policy and procedures			
		2.17	Explain the relevant reporting procedures, documentation and their application			
		2.18	Explain who to inform of actions taken, and by what means			
		2.19	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 29: Produce Engineering Specifications

Unit reference number: J/505/0935

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce engineering specifications. 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 Engineering 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 specifications	1.1	Obtain the design requirements from the company information system, or from one of the following types of client: • External – existing client • External – potential client • Internal – existing organisational requirement • Internal – new organisational opportunity			
		1.2	Produce a specification for the engineering product or process that meets the requirements of the client			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Prepare specifications incorporating client requirements, to include six of the following: • Function • Performance/capability • Aesthetics • Materials • Manufaturing methods • Resources • Budget • Technologies • Volume • Life cycles • Timing/delivery schedule • Inspection/testing • Usability • Interfacing • Ongoing support • Environmental/sustainability • Packaging • Communication plan • Manufacturer's specifications • Monitoring/servicing/maintenance frequency • Specific/special facilities or equipment • Other specific requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Incorporate all necessary details into the specification			
		1.5	Ensure that the specification is capable of being implemented			
		1.6	Ensure that specifications comply with three of the following: • Organisational guidelines and codes of practice • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards • Customer standards and requirements • British, European or International standards or directives			
		1.7	Consult with the client on all of the following: • Evidence that the specifications are capable of being achieved • Acceptability of specification formats and supporting documentation • Any suggested changes to requirements, and why they are necessary • The regulations, directives and guidelines considered in the specification, and their implications			
		1.8	Agree the specification with the client at appropriate points in the design process			
		1.9	Provide a suitable rationale for any requirements that cannot be achieved or any changes to the specification			
		1.10	Produce the specification in the agreed formats with the necessary supporting documents			
		1.11	Record the specification in the appropriate information systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Record and communicate specifications to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to produce engineering specifications	2.1	Explain the different types of specification that are required by various clients			
		2.2	Explain the types of detail that should be included in a specification			
		2.3	Explain the appropriate level of detail that is required in a specification			
		2.4	Explain how to assess whether the specification is capable of being achieved			
		2.5	Explain how to consult with a client on a specification, and when it is most appropriate to do so			
		2.6	Explain the types of change to a specification that could be necessary			
		2.7	Explain how to identify alternatives when it is necessary to make changes to specifications			
		2.8	Explain the different formats used for specifications, and their acceptability to the client			
		2.9	Explain the regulations, directives and guidelines that are relevant to different types of specification			
		2.10	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.11	Explain the company systems for recording information			
		2.12	Explain the importance of using the company information systems			
		2.13	Explain the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 30: Specify Methods and Procedures to Achieve Engineering Requirements

Unit reference number: D/505/0942

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to specify methods and procedures to achieve engineering requirements. 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 Engineering 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	Specify methods and procedures to achieve engineering requirements	1.1	Carry out all of the following when specifying engineering methods and procedures: • Gather data on the requirements for engineering methods and procedures • Select the appropriate engineering activity for the engineering methods • Identify and evaluate control parameters and resources (including equipment, quality, materials and manpower) • Specify engineering activities, methods and procedures, and their implementation requirements • Ensure that the specified methods and procedures meet relevant regulations and guidelines			
		1.2	Obtain accurate details of the engineering requirements for engineering products or processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Obtain accurate details of engineering requirements from the appropriate company information system or sources, including four the following: • Production department • Maintenance department • Contractors/specialist • Material control department • Design department • Research specialists • Quality assurance/control department • Equipment manufacturers • Personnel/HR department • Operating procedures/manufacturing manuals • Company procedures • Health and safety information • Environmental/sustainability sources • Environmental documents • External sources • Specific plant/utility installations • Sales and marketing • Purchasing department • Contracting department • British, European or International standards or directives. • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Identify the engineering activity required to implement the engineering methods, from one of the following: • Manufacturing (such as machining, fabrication, welding, material finishing or manufacture, assembly, joining) • Design • Research • Product or system installation • Commissioning • Decommissioning or recycling • Environmental or sustainability • Operational processes (such as movement of materials and logistics) • Maintenance practices (such as preventative, corrective, predictive, reactive or prevention) • Processing operations • Service supplies (such as gas, water electricity • Engineering support functions (such as procurement, quality assurance inspection, testing, scheduled safety audits and risk assessments, business improvement			
		1.5	Select the most effective methods to achieve engineering requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Identify the resources needed to implement the engineering methods, to include two of the following: • Personnel • Materials • Facilities • Process • Equipment • Finance			
		1.7	Identify the activities required to achieve the engineering requirements			
		1.8	Identify the control parameters for the equipment to be used			
		1.9	Specify clearly the methods and procedures to be used			
		1.10	Specify engineering methods and procedures, using one of the following: • Paper based documentation • Computer based documentation • Combined paper and computer based presentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Ensure that the methods and procedures comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards, directives or codes of practice • Customer standards and requirements • British, European or International standards or directives			
		1.12	Record the methods and procedures in the appropriate information systems			
		1.13	Record and communicate details of the methods and procedures to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to specify methods and procedures to achieve engineering requirements	2.1	Explain the health, safety and environmental requirements applicable to their area of responsibility or activity			
		2.2	Explain the implications of risk assessment, safety and environmental systems, and their application to engineering methods and procedures			
		2.3	Explain how to obtain details of engineering requirements from company information systems			
		2.4	Explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports and other documents needed to specify methods and procedures			
		2.5	Explain the communication and research techniques that could be used to obtain the necessary information			
		2.6	Explain the engineering principles, processes and procedures undertaken in the area of their responsibility			
		2.7	Explain the engineering methods that could be used for different types of engineering process or activity			
		2.8	Explain the different types of equipment, and how they should be used for various engineering methods			
		2.9	Explain the engineering activities that could be used for different engineering methods			
		2.10	Explain the approved company format for presenting engineering methods and procedures			
		2.11	Explain how to obtain information on resources			
		2.12	Explain how to determine the resources that are necessary			
		2.13	Explain how to determine the availability and suitability of resources			
		2.14	Explain who will require the procedures being specified			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Explain the different types of procedure to be used for different groups of people			
		2.16	Explain the level of detail and content required for engineering procedures			
		2.17	Explain the regulations and guidelines applicable to their area of responsibility			
		2.18	Explain how to obtain information on regulations and guidelines			
		2.19	Explain how to obtain and interpret company policy and personnel procedures			
		2.20	Explain the methods and procedures for recording new systems or working practices			
		2.21	Explain the company systems for recording information			
		2.22	Explain the importance of using the company information systems			
		2.23	Explain who to inform of actions taken, and by what means			
		2.24	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 31: Schedule Engineering Activities

Unit reference number: H/505/0943

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to schedule 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 Engineering 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	Schedule activities for engineering methods and procedures	1.1	Carry out all of the following when scheduling operational activities: • Refer to any existing schedules that may be appropriate • Determine the engineering activities to be scheduled • Identify applicable engineering methods, processes and procedures (including any specific sequencing requirements) • Identify and schedule time and resources • Review the schedule, and develop contingency plans to eliminate any difficulties • Ensure that the schedule complies with all relevant regulations, standards and guidelines • Communicate the schedule to all relevant people			
		1.2	Confirm the activities and resources that are required to achieve the engineering methods and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Obtain data for engineering activities from three of the following: • Management • Client • Quality engineering • Safety engineering • Technical data, charts, reference tables or manuals • Design office • Plant engineering • Suppliers • Production engineering • Industrial engineering • Process engineering • Purchasing • Company information system • HR/personnel • External technical consultants/experts			
		1.4	Identify the most suitable sequence of activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Establish requirements for one of the following: • Equipment/component/system capacity or capability • Equipment/component/system performance • Equipment/component/system life cycle • Maintenance and repair • People performance • People capacity or capability • Product or process quality • Supplier capacity or capability • Business support function capacity or capability			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Schedule engineering activities for one of the following: • Manufacturing (such as machining, fabrication, welding, material finishing or manufacture, assembly, joining) • Design • Research • Product or system installation • Commissioning • Decommissioning or recycling • Environmental or sustainability • Operational processes (such as movement of materials and logistics) • Maintenance practices (such as preventative, corrective, predictive, reactive or prevention) • Processing operations • Service supplies (such as gas, water electricity) • Engineering support functions (such as procurement, quality assurance inspection, testing, scheduled safety audits and risk assessments, business improvement)			
		1.7	Schedule the time and resources available for undertaking the activities			
		1.8	Ensure that schedules are capable of meeting all relevant requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Prepare and review schedules of resources, including four of the following: • Personnel • Skills required • Equipment • Facilities • Materials • Finance • Time			
		1.10	Incorporate new schedules into the engineering process with minimal disruption			
		1.11	Identify potential difficulties and produce appropriate contingency plans			
		1.12	Confirm that schedules meet requirements, or produce a contingency plan, including one of the following: • Agree revised requirements with management/client • Change timescales in agreement with management/clients • Reschedule • Obtain additional/alternative resources • Recommend a change to the process • Other specific change			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Ensure that schedules comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards, directives or codes of practice • Customer standards and requirements • British, European or International standards or directives			
		1.14	Specify clearly the schedules and record them in the appropriate information systems			
		1.15	Report and communicate schedules to the appropriate people, using: • Verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to schedule activities for engineering methods and procedures	2.1	Explain the health and safety and environmental requirements applicable to the engineering schedule			
		2.2	Explain how to interpret engineering schedules			
		2.3	Explain how to obtain information on the processes to be scheduled			
		2.4	Explain the different types of engineering activities, methods and processes			
		2.5	Explain how different engineering activities relate to each other			
		2.6	Explain how to determine the time and resources required for different types of engineering activity			
		2.7	Explain the factors that should be accounted for when scheduling time and resources			
		2.8	Explain the potential disruption that can be caused through the implementation of new engineering schedules			
		2.9	Explain the methods and techniques for dealing with engineering difficulties			
		2.10	Explain the approved techniques for the scheduling of engineering activities			
		2.11	Explain how to develop contingency plans			
		2.12	Explain the company systems for recording information			
		2.13	Explain the importance of using the company information recording systems			
		2.14	Explain the reporting procedures, documentation, and their application			
		2.15	Explain who to inform of actions taken, and by what means			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.16	Explain how to obtain and interpret legislative and regulatory documentation			
		2.17	Explain how to obtain and interpret company policy and procedures			
		2.18	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 32: Obtain Resources for the Implementation of Engineering Activities

Unit reference number: K/505/0944

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to obtain resources for the implementation of 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 Engineering 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	Obtain Resources for the Implementation of Engineering Activities	1.1	Carry out all of the following when obtaining resources for engineering activities: • Select the engineering activity for which resources are required • Identify potential problems which may affect the provision of resources • Specify the resources required, and check for their availability • Obtain the resources, using the appropriate organisational procedures and authorisations • Resolve any resource supply or quality issues • Record all resource data on the appropriate company information system			
		1.2	Assess the engineering requirements and any factors that could affect them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Obtain and review resource information from two of the following sources: • Company information systems • Specifications • Production/planning documentation • Drawings or CAD data • Parts/component lists • Financial data • Purchase orders • Contracts • Electronic mail • Standard operating procedures • Personnel training records • Other (to be specified)			
		1.4	Specify clearly the resources required to implement engineering activities			
		1.5	Specify the resources for three of the following: • People • Materials • Equipment • Finance • Facilities • Information			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Consult with all relevant people on the resources that are available			
		1.7	Use the appropriate organisational procedures to obtain the required resources			
		1.8	Obtain resources for two of the following engineering activities: • Manufacturing (such as machining, fabrication, welding, material finishing or manufacture, assembly, joining) • Design • Research • Product or system installation • Commissioning • Decommissioning or recycling • Environmental or sustainability • Operational processes (such as movement of materials and logistics) • Maintenance practices (such as preventative, corrective, predictive, reactive or prevention) • processing operations • Service supplies (such as gas, water electricity • Engineering support functions (such as procurement, quality assurance inspection, testing, scheduled safety audits and risk assessments, business improvement			
		1.9	Obtain the resources, using both of the following organisational procedures: • Communication procedures • Authorisation procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Resolve any issues relating to the resources in the appropriate manner			
		1.11	Resolve resource issues, including three of the following: • Availability (materials, equipment, information, finance, people, facilities) • Quality (materials, equipment, information, facilities) • Skills (personnel) • Time • Other issues (such as timescales)			
		1.12	Record information on the resources in the appropriate information systems			
		1.13	Record and communicate details of the resources obtained, to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to obtain resources for the implementation of engineering activities	2.1	Explain the specific health safety and environmental issues that apply to the implementation of the engineering activities			
		2.2	Explain the engineering methods and procedures that could be used for different types of engineering activity			
		2.3	Explain how to obtain details of engineering resource requirements from company information systems			
		2.4	Explain the quality assurance systems that are being used			
		2.5	Explain how to obtain information on resources			
		2.6	Explain how to determine the necessary resources			
		2.7	Explain how to determine the availability and suitability of resources			
		2.8	Explain the procedures for obtaining resources			
		2.9	Explain the types of issue that could occur when obtaining resources, and how to resolve them			
		2.10	Explain the company systems for recording information			
		2.11	Explain why it is important to use the company information systems			
		2.12	Explain the regulations, directives and guidelines that are relevant			
		2.13	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.14	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 33: Implement Engineering Processes

Unit reference number: M/505/0945

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to implement engineering processes. 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 Engineering 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	Implement engineering processes	1.1	Confirm that conditions are suitable to implement engineering methods and procedures			
		1.2	Confirm conditions for four of the following: • Appropriate authorisation is obtained • Availability of resources • Preparation of products or processes • Preparation of site • Health and safety • Environmental			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Implement an engineering process for one of the following: • Manufacturing (such as machining, fabrication, welding, material finishing or manufacture, assembly, joining) • Design • Research • Product or system installation • Commissioning • Decommissioning or recycling • Environmental or sustainability • Operational processes (such as movement of materials and logistics) • Maintenance practices (such as preventative, corrective, predictive, reactive or prevention) • Processing operations • Service supplies (such as gas, water electricity) • Engineering support functions (such as procurement, quality assurance inspection, testing, scheduled safety audits and risk assessments, business improvement)			
		1.4	Provide clear and accurate instructions to all the relevant people			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Provide instructions for one of the following: • Equipment/component/system capacity or capability • Equipment/component/system performance • Maintenance and repair • People performance • People capacity or capability • Product or process quality • Supplier capacity or capability • Business support function capacity or capability			
		1.6	Obtain accurate information on the activities being undertaken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Obtain information from two of the following: • Management • Design office • Industrial engineering • Client • Plant engineering • Process engineering • Quality engineering • Suppliers • Purchasing • Safety engineering • Technical data, charts, reference tables or manuals • Production engineering • Company information system • Human resources (HR) personnel • External technical consultants/experts			
		1.8	Ensure that quality assurance systems are correctly implemented			
		1.9	Ensure that engineering support systems are operating correctly			
		1.10	Control the use of resources to achieve the most effective results			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Ensure that all support and control systems operate effectively for two of the following: • Quality assurance systems • Transport • Logistics • Procurement • Supervision or leadership structures • Utilities • Resource supply (such as materials, equipment, personnel) • Other technical support requirements (to be specified)			
		1.12	Identify opportunities to improve the engineering methods and procedures.			
		1.13	Implement engineering processes that comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards, directives or codes of practice • Customer standards and requirements • British, European or International standards or directives			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Implement engineering processes that include four of the following: • A record of the implementation process on appropriate company media • An evaluation of the effectiveness of the implementation process • Any deviations from specifications of the implemented activity • Recommendations for improvements to the implemented activity • Plans to monitor and evaluate the effect(s) of any improvements made to the implemented process			
		1.15	Ensure that the implementation of engineering methods and procedures complies with all relevant regulations, directives and guidelines			
		1.16	Report and communicate methods and procedures for the engineering process, using: • Verbal report Plus one from the following: • Electronic mail • Computer generated report • Specific company form • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to implement engineering processes	2.1	Explain the methods and procedures that could be used for different types of engineering process			
		2.2	Explain the conditions that are suitable and not suitable for different types of engineering process			
		2.3	Explain how to obtain details of the engineering processes being implemented			
		2.4	Explain the activities that are required for different engineering methods			
		2.5	Explain the quality assurance systems that are being used			
		2.6	Explain the engineering support systems that are operating			
		2.7	Explain the procedures for obtaining information on resources			
		2.8	Explain how to determine the necessary resources			
		2.9	Explain how to determine the availability and suitability of resources			
		2.10	Explain what type of impact the implementation could have on the organisation			
		2.11	Explain who requires instructions on the engineering process or processes being implemented			
		2.12	Explain the different and most appropriate ways of instructing people on the engineering process or processes			
		2.13	Explain the types of recommendation that could emerge from evaluation of the implemented engineering process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain the regulations, directives and guidelines that are relevant			
		2.15	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.16	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 34: Monitor and Evaluate Engineering Processes

Unit reference number: T/505/0946

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to monitor and evaluate engineering processes. 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 Engineering 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	Monitor and evaluate engineering processes	1.1	Plan the most appropriate way for evaluating the engineering process			
		1.2	Establish clear and precise criteria for evaluating the engineering process			
		1.3	Establish criteria for monitoring and evaluation of one of the following: • Equipment capability • Equipment performance measurement • The use of computer based records systems for engineering processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Evaluate the effectiveness of the engineering process, taking into account six of the following: • Standard operating procedures/work instructions • Process/quality control or assurance documentation • Organisation documentation used (such as for purchasing, planning scheduling, contracting, sales and marketing) • IT systems • Non conformances/defects • Use of equipment • Use of materials/resources • Staff training and development • Supplier data and information • Customer data and information • Schedules and plans • Costs • Available technologies • Performance/capability • Process outcomes • Reliability • Maintenance and repair • Health and safety • Environmental and sustainability factors • Recycling • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Ensure that the monitoring and evaluation processes comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards, directives or codes of practice • Customer standards and requirements • British, European or International standards or directives			
		1.6	Obtain accurate information on the engineering process from all valid sources			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Monitor and evaluate two engineering processes for one of the following: • Manufacturing (such as machining, fabrication, welding, material finishing or manufacture, assembly, joining) • Design • Research • Product or system installation • Commissioning • Decommissioning or recycling • Environmental or sustainability • Operational processes (such as movement of materials, logistics) • Maintenance practices (such as preventative, corrective, predictive, reactive or prevention) • Processing operations • Service supplies (such as gas, water, electricity) • Engineering support functions (such as procurement, quality assurance inspection, testing, scheduled safety audits and risk assessments, business improvement)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Gather data from two of the following sources of information during the evaluation process: • Monitoring and audit processes • Clients • General media • Benchmarking partners • Colleagues • Suppliers • Specialised media			
		1.9	Review all relevant information relating to the engineering process			
		1.10	Prepare the results of the evaluation, to include all of the following: • An appraisal of the effectiveness of the engineering process • Evaluation of the cost effectiveness of the engineering process • An appraisal of the compliance of the engineering process with defined criteria • A recommendation of feasible changes or improvements to the engineering process • A proposed method for monitoring the impact of the improvements to the engineering process • An appraisal of the effectiveness of evaluation process			
		1.11	Consult with all relevant people during the evaluation			
		1.12	Assess the potential impact of any changes to be recommended			
		1.13	Recommend feasible changes or improvements to the engineering process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Present the results of the evaluation to the appropriate people according to agreed procedures			
		1.15	Report and communicate results of the monitoring and evaluation, using: • Verbal methods Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to monitor and evaluate engineering processes	2.1	Explain the specific safety precautions to be taken when monitoring and evaluating engineering processes			
		2.2	Explain when to monitor and evaluate engineering processes			
		2.3	Explain the quality assurance systems that are being used			
		2.4	Explain the methods and tools that are available for monitoring and evaluating engineering process, and the procedures that should be used for evaluation			
		2.5	Explain the evaluation criteria that should be used for each type of engineering process within their area of operation			
		2.6	Explain the methods that could be used for obtaining information on the engineering processes			
		2.7	Explain the relevant sources of information on a particular engineering process			
		2.8	Explain how to obtain and interpret information on engineering processes			
		2.9	Explain the people that should be involved in the evaluation process			
		2.10	Explain the types of recommendation that could emerge from evaluations			
		2.11	Explain the type and level of impact that could result from the evaluation outcomes			
		2.12	Explain the people requiring information on evaluations, and the procedures for informing them			
		2.13	Explain the types of issue that could occur when monitoring and evaluating engineering processes, and how to resolve them			
		2.14	Explain the company systems available for recording information			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Explain why it is important to use the appropriate company information systems			
		2.16	Explain how to present information and recommendations			
		2.17	Explain the regulations, directives and guidelines relevant to the engineering processes being monitored and evaluated			
		2.18	Explain how to obtain and interpret information on the relevant regulations, directives and guidelines			
		2.19	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 35: Provide Technical Advice and Guidance on Engineering or Manufacturing Requirements

Unit reference number: F/505/0951

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to provide technical advice and guidance on engineering or manufacturing requirements. 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 Engineering 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	Provide technical advice and guidance on engineering or manufacturing requirements	1.1	Work safely at all times, complying with health and safety legislation, regulations, directives and other relevant guidelines			
		1.2	Understand the recipients requirements for technical advice or guidance			
		1.3	Confirm that they have interpreted the requirements correctly and accurately			
		1.4	Ensure that any data and information drawn upon for which advice and guidance is sought is up to date, valid, reliable and sufficient to meet the recipients requirements			
		1.5	Ensure that any data and information drawn upon for which advice and guidance is sought is up to date, valid, reliable and sufficient to meet the recipients requirements			
		1.6	Provide technical advice and guidance for two of the following groups of people: • Colleagues in the same work group • Colleagues outside work group • Contractors • Client/customers • Others working on related technical activity areas			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Provide technical guidance for one of the following activities: • Drawing/design activities (such as mechanical, electrical/electronic, automotive, aerospace, marine) • Manufacturing activities (such as machining, detail fitting, fabrication of components, pressing) • Material processing activities (such as heat treatment, casting, injection moulding, purification) • Composite manufacture (such as wet lay-up, pre-preg laminating, resin infusion, blow moulding) • Finishing activities (such as stripping finishes, painting, plating, anodising, veneering, lacquering) • Assembly activities (such as mechanical, structural, fluid power, electrical/electronic, woodworking) • Installation activities (such as mechanical, electrical/electronic, avionic, structural, environmental equipment) • Plant and equipment (such as site preparation, plant layout, equipment changeover, equipment replacement) • Equipment capability studies/performance measurement • Movement of materials, components or finished goods • Business improvement activities • Engineering safety audits or risk assessments • Quality control/quality assurance			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	...continued • Maintenance activities • Modification and repair activities • Commissioning/decommissioning • Research and development • Testing and/or trialling • Engineering support services • Environmental/sustainability activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Provide technical advice and guidance on four of the following: • Equipment operation • Specific or specialist tools, equipment or components required • Equipment/component/process performance parameters • Materials required/used • Physical characteristics of components or products • Timing/delivery details • Environmental considerations/operating conditions • Cost/budget information • Manufacturing methods • Aesthetics/finish details • Manufacturing detail • Quality requirements/control • Processing requirements • Monitoring/servicing frequency • Work instructions or procedures • Training required • Number/volume required • Customer interface requirements • Resource requirements • Safety regulations and requirements • Equipment/component interfacing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Provide advice and guidance resulting from two of the following: • Reported problems found during the engineering or manufacturing activity • Recorded deviations from agreed plans and schedules • Customer requests or complaints • Training, development or mentoring			
		1.10	Provide technical advice and guidance by the following methods: • Specific company documentation Plus by one other method from the following: • Verbally • Computer generated report • Electronic mail • Computer based presentation • Other appropriate media			
		1.11	Ensure technical advice and guidance provided is in line with company policies, procedures and constraints			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Ensure that the technical advice and guidance complies with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • Recognised compliance agency/body's standards, directives or codes of practice • Customer standards and requirements • British, European, International standards or directives • Health, safety and environmental requirements			
		1.13	Ensure that technical advice and guidance provided complies with any relevant legislation, standards, directives or codes of practice			
		1.14	Provide appropriate technical advice and guidance to the recipient in the correct format and to agreed timescales			
		1.15	Confirm the recipient understands the advice and guidance provided			
		1.16	Provide any follow up advice and guidance where required			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to provide technical advice and guidance on engineering or manufacturing requirements	2.1	Explain the specific safety precautions to be taken in the work areas where technical guidance is being given			
		2.2	Explain the regulations, directives and guidelines that are relevant to the work area			
		2.3	Explain how to obtain information on regulations, standards, directives and guidelines			
		2.4	Explain how to obtain and interpret drawings, charts, specifications or other documents that can be used when giving technical advice and guidance			
		2.5	Explain the activities in which the technical advice and guidance is being given			
		2.6	Explain the importance of presenting and communicating advice and guidance clearly and accurately			
		2.7	Explain how to plan and prepare for providing technical guidance			
		2.8	Explain the importance of providing up to date, valid and reliable advice and guidance			
		2.9	Explain the approach to be taken when there is a range of options/alternatives when responding to requests for advice and guidance			
		2.10	Explain the methods and techniques involved in providing advice and guidance			
		2.11	Explain how to deal with customer requests for advice and guidance			
		2.12	Explain the internal procedures to be followed when providing advice and guidance			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain the relevant document that should be completed as part of the advice and guidance process			
		2.14	Explain how to ensure the recipient understands the advice and guidance provided			
		2.15	Explain how to gain feedback from the recipient confirming that the advice and guidance provided has met their requirements			
		2.16	Explain how to review and adjust approaches to the provision of technical guidance, in the light of experience gained			
		2.17	Explain the importance of maintaining, where appropriate individual, customer or company confidentiality			
		2.18	Explain the extent of their own responsibility, and whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 36: Implement Quality Assurance Methods and Procedures

Unit reference number: J/505/0949
QCF level: 4
Credit value: 16
Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to implement quality assurance methods and procedures. 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 Engineering 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	Implement quality assurance methods and procedures	1.1	Carry out all of the following during the quality assurance activity: • Establish clear criteria as the basis of the quality assurance process • Obtain accurate information from appropriate sources for consideration in the process • Assess and specify the quality requirements for the engineering products or processes • Identify suitable quality assurance methods, techniques and procedures • Assess the implications of implementing the quality assurance procedures • Present recommendations for improvements to the quality assurance process to the appropriate people			
		1.2	Establish clear and precise criteria for assuring the quality of engineering products or processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Identify suitable quality assurance methods and procedures for four of the following: • Design • Research and development • Product and material specifications • Patents • Quality assurance • Product/component performance checks • Inspection/testing • Staff training and development plans • Production methods • Maintenance and repair • Installation methods • Commissioning/decommissioning methods • Process parameters • Schedule monitoring • Contractor performance • Business improvements • Purchasing • Logistics • Legal requirements • The use of appropriate international/national standards • Company procedures and policy • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Ensure that the specified quality assurance methods and procedures are implemented correctly			
		1.5	Obtain accurate information from valid sources on the engineering product or process being quality assured			
		1.6	Obtain accurate information from five of the following sources: • Quality assurance department • Manufacturers' manuals/specifications • Engineering drawings/models • Product specifications • Regulations and guidelines • International/national standards • Legal/patented information • Company documentation • Customer specifications			
		1.7	Develop quality assurance procedures that cover two of the following: • New product/process • Revisions to existing product/process • Legal/legislative requirement • International/national standards • Company standard operating procedures			
		1.8	Specify clearly the required quality of engineering products or processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Assess accurately and realistically the quality of the engineering products or processes			
		1.10	Ensure that information on quality is provided to the appropriate people			
		1.11	Ensure that the quality assurance methods and procedures comply with four of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification • Health, safety and environmental requirements • Recognised compliance agency/body's standards, directives or codes of practice • Customer standards and requirements • British, European or International standards or directives			
		1.12	Recommend improvements to quality to the appropriate people			
		1.13	Report and communicate quality assurance methods and procedures, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to implement quality assurance methods and procedures	2.1	Explain the specific safety precautions to be taken when working on engineering products or processes			
		2.2	Explain the quality criteria that could be used for different types of engineering product or process			
		2.3	Explain the quality assurance methods that are available			
		2.4	Explain the statistical methods for recording and analysing engineering processes			
		2.5	Explain the other non-statistical methods that could be used for obtaining information on engineering products or processes			
		2.6	Explain the relevant sources of valid information on engineering products or processes			
		2.7	Explain who should be involved in the quality assurance process			
		2.8	Explain the type of impact that quality assurance could have on the organisation			
		2.9	Explain who requires information on quality assurance, and the procedures for informing them			
		2.10	Explain how to obtain information on resources			
		2.11	Explain how to determine the resources that are necessary			
		2.12	Explain how to determine the availability and suitability of resources			
		2.13	Explain the regulations, directives and guidelines relevant to their area of responsibility			
		2.14	Explain how to obtain and interpret information on regulations, directives and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Explain the types of recommendation that could emerge from the quality assurance process			
		2.16	Explain the methods of presenting quality assurance recommendations			
		2.17	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 37: Improve the Quality of Engineering Products or Processes

Unit reference number: A/505/0950

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to improve the quality of engineering products or processes. 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 Engineering 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	Improve the quality of engineering products or processes	1.1	Carry out all of the following when implementing the quality improvements: • Plan the implementation of quality improvements so as to minimise disruption to normal working • Identify and use suitable quality improvement methods, techniques and procedures • Control the use of resources for the implementation of the quality improvements • Carry out the quality improvements in accordance with the implementation plan • Solve any problems that occur during the implementation • Assess the impact of the improvements on the quality of products or processes			
		1.2	Plan the introduction of improvements to the quality of engineering products or processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Plan the introduction of quality improvements for one of the following: • New product/process • Revisions to existing product/process • Legal/legislative requirement • International/national standards requirements • Company standard operating procedures			
		1.4	Specify clearly the improvements that should be implemented			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Specify quality improvements to the product or process, to include three of the following: • Components • Equipment • Materials • Inspection/testing procedures • Design • Research and development • Maintenance/servicing • Services • Business systems • Safety • Environmental impact • Supplier • Logistics • Buying • Technologies • Product or process flow • Setting or preparation activities • Employee related (such as numbers, training, deployment) • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Obtain information to improve quality from five of the following: • Quality assurance department • Design department • Research department • Manufacturer's specifications • Product specifications • Regulations, guidelines or directives • International/national standards • Benchmarking • Technical experts • Customer feedback • Legal/patented information • Company documentation and records • Direct observation • Supplier data and information • Other (to be specified)			
		1.7	Confirm that conditions are suitable to implement the improvements			
		1.8	Provide clear and accurate instructions to all the relevant people			
		1.9	Control the use of resources to achieve the most effective results			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Monitor the use of three of the following resources to ensure effective results: • Personnel • Materials • Facilities • Utilities • Equipment • Finance			
		1.11	Ensure that the improvements are implemented according to plan, recorded and comply with all relevant regulations, directives and guidelines			
		1.12	Identify and solve any implementation problems that occur			
		1.13	Ensure that the quality improvements conform to three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards, directives or codes of practice • Customer standards and requirements • British, European or other international standards or directives			
		1.14	Assess the impact of the improvements on the quality of engineering products or processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Assess the outcome of the quality improvement implementation, to include two of the following: • Impact of the improvements on the quality of products or processes • Cost effectiveness of the process/actions • Effect of changes to quality assurance methods or procedures • Quality of data held on the company information system • Effectiveness of reporting procedures • Lessons learned			
		1.16	Report and communicate the product/process quality improvements, using: • Verbal methods Plus one from the following: • Electronic mail • Computer generated report • Specific company form • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to improve the quality of engineering products or processes	2.1	Explain the health, safety and environmental requirements applicable to the area in which the quality improvements are to be implemented			
		2.2	Explain the importance of wearing protective clothing (PPE) and other appropriate safety equipment during the implementation, and where it may be obtained			
		2.3	Explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports and other documents needed for the implementation of quality improvements			
		2.4	Explain the engineering processes and operating procedures in the area associated with the quality issues			
		2.5	Explain the types and effects of quality improvement, and their impact			
		2.6	Explain the factors that have to be taken into account when selecting the solution to a quality problem			
		2.7	Explain the techniques used to obtain information			
		2.8	Explain the methods and techniques involved in quality improvement implementation			
		2.9	Explain the methods and techniques involved in evaluating information			
		2.10	Explain how to obtain and interpret legislative and regulatory documentation			
		2.11	Explain how to obtain and interpret company policy and personnel procedures			
		2.12	Explain the organisational reporting procedures and documentation, and their application			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain who to inform of actions taken, and by what means			
		2.14	Explain how to retrieve the necessary data from company information systems			
		2.15	Explain the types of impact assessment systems/techniques available, and their application			
		2.16	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 38: Specify Risk Reduction Methods and Procedures

Unit reference number: F/505/0948

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to specify risk reduction methods and procedures. 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 Engineering 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	Specify Risk Reduction Methods and Procedures	1.1	Obtain existing risk analysis information for two of the following engineering activities: • Manufacturing (such as machining, fabrication, welding, material finishing or manufacture, assembly, joining) • Design • Research • Product or system installation • Commissioning • Decommissioning or recycling • Environmental or sustainability • Operational processes (such as movement of materials and logistics) • Maintenance practices (such as preventative, corrective, predictive, reactive or prevention) • Processing operations • Service supplies (such as gas, water, electricity) • Engineering support functions (such as procurement, quality assurance, inspection, testing, scheduled safety audits and risk assessments, business improvement)			
		1.2	Obtain accurate details of the risks			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Consider the effect and cost of changes or improvements on all of the following: • Materials used • The operational process • Equipment, equipment systems or related technologies • Personal protective equipment (PPE) • Training and development • Operational instructions/procedures • Workplace environment/sustainability • Health and safety • Work patterns • System reliability • Quality of products or services • Logistics • Marketing/branding • Employee downtime • Staff availability • Other (to be specified)			
		1.4	Select the most effective methods to reduce risks			
		1.5	Identify the resources that are necessary to implement the risk reduction methods			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Specify or use three of the following resources necessary to implement risk reduction methods: • Process or operation expertise • Additional personnel • HSE or similar expert help • Engineering design/research or similar expertise • Human resources (HR) personnel department information • Auditing and monitoring services • External expertise • Regulations, directives and guidance documentation • Company policy advice • Other (to be specified)			
		1.7	Identify the activities required to implement the risk reduction methods			
		1.8	Specify clearly the procedures for implementing the risk reduction methods			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Ensure that risk reduction methods and procedures comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • Health, safety and environmental requirements • Recognised compliance agency/body's standards, directives or codes of practice • Customer standards and requirements • British, European or International standards or directives			
		1.10	Specify risk reduction methods that take into account all of the following as appropriate: • Health and safety requirements and appropriate codes of practice • The potential for further risks occurring • Data gathering • Revised management procedures • When to implement risk reduction actions • Prioritisation and decision making • Consideration of interim effects on the process • Recording of risk analysis data • Other (to be specified)			
		1.11	Utilise opportunities to promote the implementation of the risk reduction methods			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Record the risk reduction methods and procedures in the appropriate information systems			
		1.13	Record and communicate the risk reduction methods and procedures to the appropriate people using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Computer-based presentation • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to Specify Risk Reduction Methods and Procedures	2.1	Explain how to obtain details of the potential risks, and of any risk analyses previously conducted			
		2.2	Explain the risk reduction methods that could be used			
		2.3	Explain how different types of equipment can be used for different risk reduction methods			
		2.4	Explain the activities that are required for the implementation of risk reduction methods			
		2.5	Explain how to obtain information on the resources required for the risk reduction			
		2.6	Explain how to determine the internal and external resources necessary			
		2.7	Explain how to ensure the availability and suitability of resources			
		2.8	Explain the person or people who will be carrying out the risk reduction procedures			
		2.9	Explain the different ways in which to specify procedures for different groups of people			
		2.10	Explain what to include in the procedures, and the level of detail required			
		2.11	Explain the regulations, directives and guidelines that are relevant to the risk reduction activities			
		2.12	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.13	Explain the company systems for recording information			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain the importance of using the appropriate company information systems			
		2.15	Explain the extent of their own authority, and to whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 39: Evaluate Engineering Risk Assessments

Unit reference number:	**A/505/0947**
QCF level:	**4**
Credit value:	**16**
Guided learning hours:	**56**

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to evaluate engineering risk assessments. 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 Engineering 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	Evaluate engineering risk assessments	1.1	Establish clear criteria for the evaluation activity			
		1.2	Plan the most appropriate method for evaluating risk assessments			
		1.3	Confirm the completed risk assessments are current, valid and reliable			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Evaluate risk assessment activities for one of the following: • Manufacturing (such as machining, fabrication, welding, material finishing or manufacture, assembly, joining) • Design • Research • Product or system installation • Commissioning • Decommissioning or recycling • Environmental or sustainability • Operational processes (such as movement of materials and logistics) • Maintenance practices (such as preventative, corrective, predictive, reactive or prevention) • Processing operations • Service supplies (such as gas, water, electricity) • Engineering support functions (such as procurement, quality assurance, inspection, testing, scheduled safety audits and risk assessments, business improvement)			
		1.5	Ensure that any relevant regulations, directives or guidelines relating to the risks have been identified			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Evaluate the potential risks by considering the impact on three of the following: • Personnel • Equipment • Property/assets • Quality • Environment • Impact on the business (such as finance, branding, market) • Other (to be specified)			
		1.7	Evaluate and rank the potential impact of the risks identified			
		1.8	Recommend appropriate actions that includes three of the following: • A risk reduction process • Allowing a period of time before re-analysis • Implementing a special monitoring processes • Continuing (such as the risk ranking result is acceptable) • Suspending operation and rectifying immediately • Implementing interim containment action			
		1.9	Ensure that the evaluation outcomes of the risks are communicated to the appropriate people			
		1.10	Monitor and review the effectiveness of the risk assessment process			
		1.11	Make amendments to the process where improvements have been identified			
		1.12	Record the evaluation or risk assessments in the appropriate systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Record the risk information and include references to six of the following: • The company health and safety policy • Accident and or 'near miss' reports • Identification of regulations and or guidelines • The method of assessing and ranking the risk • Predictable and preventable risks • A description of the risk(s) and their ranking • The implication of a risk occurring • General management organisation • Frequency and duration of exposure to the risk • Analysis, decisions and recommendations			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to evaluate engineering risk assessments	2.1	Explain the specific safety precautions to be observed when carrying out a risk analysis			
		2.2	Explain the organisational engineering activities where risk analysis is deemed to be necessary			
		2.3	Explain the process-related attributes from which risks could occur			
		2.4	Explain the types of risk that can arise from different engineering activities			
		2.5	Explain the factors that could relate to the risks			
		2.6	Explain how to obtain information on the risk factors			
		2.7	Explain the types of risk analysis and evaluation methods that are appropriate to different types of risk			
		2.8	Explain the type of supporting information and documentation that is required			
		2.9	Explain the amount of supporting information that should be provided			
		2.10	Explain who is affected by the risks			
		2.11	Explain who requires information on the risks			
		2.12	Explain the potential implications of the risks			
		2.13	Explain the regulations, directives and guidelines that are relevant to the areas being analysed			
		2.14	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.15	Explain the various company systems for recording risks and risk-related issues			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.16	Explain the importance of using the appropriate company information systems			
		2.17	Explain the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 40: Investigate Incidents Relating to Engineering Activities

Unit reference number: K/505/0961

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to investigate incidents relating to 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 Engineering 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	Investigate incidents relating to engineering activities	1.1	Investigate incidents related to three of the following engineering activities: • Production activities (such as processing materials, fabrication, finishing, assembly, joining) • Installation activities (such as commissioning/decommissioning, site preparation, equipment installation) • Operational activities (such as movement of materials, quality systems and audit, scheduled safety audits and risk assessments) • Maintenance activities (such as planned preventive maintenance (PPM), part or sub-assembly exchange, breakdown response maintenance records systems, line setting) • Design and research			
		1.2	Plan the most appropriate way for investigating the incident			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Produce an investigation plan that includes all of the following: • The (possible) severity of an injury • Who will carry out the investigation • The damage to equipment • Estimated cost of the investigation • Potential business loss • Ethical considerations • Community (public) opinion • The nature of the incident potential • Employee concerns • Involvement of emergency services • Mandatory responsibilities • Staff representation • Breach of health and safety • The immediate process effect • Legal implications • Equipment supplier (such as responsibilities, implications)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Review all of the following information during an investigation: • Health and safety standards • Extent of any injuries and their affects • Events leading up to and associated with the incident • Post incident risk prevention recommendations • Foreseeable and preventative incident risk conjecture • Actual and potential effect of an incident • Actual immediate incident management • Improvements to the engineering activity • Responsibilities • Equipment damage • Contributory factors • Business cost • Time lost • Role of the emergency services • The (likely) cause(s)			
		1.5	Obtain sufficient relevant and accurate information from valid sources relating to the incident			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Gather and evaluate information using five of the following sources: • CCTV or photographic evidence • Personnel records • Material or substance data sheets • Legislative information • Health and safety executive accident statistics • Re-enactment • Shift reports • Site history of incidents and `near misses' • Incident reports • Dangerous occurrence reports • Maintenance history • Process change records • Operational procedures • Drawings or diagrams • Equipment detail • Expert statements • Witness statements			
		1.7	Identify the potential causes of the incident			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Consider all of the following when investigating the possible cause of the incident: • Workplace environment (such as housekeeping, activities, products and materials) • Management quality (such as supervision, policy, discipline) • Work hours (such as overtime, shift patterns) • Nature of the incident (such as an explosion, gas discharge or hot metal discharge) • Equipment (such as ergonomics, malfunction or a safety function failure) • Skill levels (such as competence, instruction, training) • Human related (such as deliberate misconduct, sabotage, error of judgement or fatigue) • Other (to be specified)			
		1.9	Evaluate all relevant information relating to the incident			
		1.10	Specify the contributory factors that led to the incident			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Consider all of the following when identifying contributory factors that led to the incident: • Care and welfare of employees • Maintenance • Discipline • General conditions and facilities • Level of supervision • Work demands • Skills, experience and knowledge • Housekeeping • Stress • Use of direct or indirect labour • Morale • Provisions and aids			
		1.12	Provide clear and justifiable conclusions on the causes of the incident			
		1.13	Recommend improvements to the engineering product or process associated with the incident			
		1.14	Record and present the results of the investigation to the appropriate people			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Record and communicate the results of the investigation to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer-based presentation • Computer generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to investigate incidents relating to engineering activities	2.1	Explain the engineering activities within their organisation where incidents could occur			
		2.2	Explain the types of incident that could occur			
		2.3	Explain the factors that should be taken into account when planning an investigation			
		2.4	Explain how to prepare an investigation plan, and the appropriate company format to use			
		2.5	Explain the methods that could be used for obtaining information on an incident			
		2.6	Explain the valid and relevant sources if information to use when investigating incidents			
		2.7	Explain the amount of information that should be collected			
		2.8	Explain the methods that are available for evaluating information on incidents			
		2.9	Explain the potential contributory factors to consider when determining the cause of incidents			
		2.10	Explain how to assess the impact of each of the different contributory factors			
		2.11	Explain the importance of providing clear and justifiable conclusions on the causes of an incident			
		2.12	Explain the type and amount of evidence necessary to support their conclusions			
		2.13	Explain the type of impact the investigation could have on the organisation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain who requires the information, and the procedures for informing them			
		2.15	Explain how to instigate training, special instructions or procedures as a result of incident investigations			
		2.16	Explain the types of recommendation that could emerge from an investigation			
		2.17	Explain methods for error proofing or mistake proofing (such as Poke Yoke)			
		2.18	Explain how to present their recommendations			
		2.19	Explain the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 41: Configure Engineering Products, Processes or Facilities

Unit reference number: H/505/0957

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to configure engineering products, processes or facilities. 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 Engineering 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	Configure engineering products, processes or facilities	1.1	Work safely at all times, complying with health and safety, environmental and other relevant regulations, directives and guidelines			
		1.2	Carry out all of the following during the configuring process: • Identify the customer's requirements for the configuration • Plan the most appropriate way to carry out the configuring • Determine and obtain suitable resources • Ensure and verify that the configuring process achieves the client requirements • Confirm that the configuring complies with relevant regulations, directives and guidelines • Record and communicate information on the configuring to appropriate people			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Consult with the customer to determine the configuring requirements for two of the following: • Production line • Process or flow line • Specification change • Process change • Equipment • Tooling • Product/system change • Storage • Software/hardware • Add or remove operations • Manufacturer agreed modifications • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Establish a plan to achieve three of the following customer requirements: • Timing plan • Preparation of product, system or equipment • Identification of authorisation channels • Preparation of process • Environmental requirements • Testing and/or trials • Configuring process • Handover process			
		1.5	Determine and obtain three of the following resources: • Equipment • Plant • Personnel • Facilities • Components • Services • Finance • Materials • Other (to be specified)			
		1.6	Follow all relevant setting-up and operating specifications for the product or asset being configured			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Follow the defined procedures and set up the equipment correctly ensuring that all operating parameters are achieved			
		1.8	Ensure that the configuration complies with three of the following: • Organisational guidelines and procedures • Recognised compliance agency/body's standards, directives or codes of practice • Equipment manufacturer's operating specification/range • Customer standards and requirements • Health, safety and environmental requirements • British, European or International standards or directives			
		1.9	Monitor the configuration process to ensure that all of the following are achieved: • Correct implementation, to the agreed plan • Effective use of resources • Identification and solving of any problems that occur			
		1.10	Deal promptly and effectively with problems within their control and report those that cannot be solved			
		1.11	Check that the configuration is complete and that the equipment operates to specification			
		1.12	Complete all relevant documentation accurately and legibly			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Record and communicate details of the configuration process to the appropriate people, using: • A verbal report Plus one of the following • Electronic mail • Computer-based presentation • Computer generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to configure engineering products, processes or facilities	2.1	Explain the health, safety and environmental requirements applicable to the configuring activities, location and product/process/facility being configured			
		2.2	Explain the specific safety precautions to be taken when configuring engineering products, processes or facilities			
		2.3	Explain how to obtain details of which engineering products, processes or facilities require configuration			
		2.4	Explain the types of configuration methods applicable to different types of engineering products, processes or facilities			
		2.5	Explain how to obtain information on customer requirements			
		2.6	Explain engineering principles appropriate to the configuring of engineering products, processes or facilities			
		2.7	Explain the types of problem that could occur with the configuration, and how to solve them			
		2.8	Explain how to obtain information on resources			
		2.9	Explain how to determine the resources necessary for the configuration process			
		2.10	Explain how to determine the availability and suitability of resources			
		2.11	Explain the regulations, directives and guidelines that are applicable to the configuration activity			
		2.12	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.13	Explain the specifications and expected outcomes from the engineering products, processes or facilities being configured, and how to evaluate whether they are being achieved			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain evaluation techniques for confirming that the configuring process is being carried out correctly			
		2.15	Explain the company systems for recording and communicating information			
		2.16	Explain the importance of using the company information systems			
		2.17	Explain the most appropriate ways of communicating the results of the configuration (to the customer and others)			
		2.18	Explain the extent of their own responsibility and to whom they should report if they have issues that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 42: Transfer Control of Engineering Products, Processes or Facilities

Unit reference number: K/505/0958

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to transfer control of engineering products, processes or facilities. 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 Engineering 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	Transfer control of engineering products, processes or facilities	1.1	Confirm the procedures for transferring control of the engineering product or process.			
		1.2	Carry out all of the following during the transfer of control: • Identify the specifications and requirements that apply • Identify the personnel involved, and ensure that they have the appropriate information • Plan the transfer of control to minimise disruption to normal working • Prepare the products, processes or facilities for transfer • Transfer control, in accordance with the appropriate procedures • Verify that the transfer has been successful, and that the products, processes or facilities meet the requirements of the customer • Confirm that all relevant specifications, regulations, directives and guidelines have been complied with • Document and communicate the appropriate information to all relevant personnel			
		1.3	Ensure that the engineering product or process is ready for transfer and complies with all relevant specifications and requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Determine all of the following requirements for transferring control: • The product, process or facility description • The personnel from whom control is being transferred • Any specific requirements • The personnel to whom control is to be transferred			
		1.5	Establish plans to transfer control that includes two of the following: • Timing plan • Preparation of product, process or facility • Identification of authorisation channels • Testing and/or trials • Safety and environmental requirements • Handover			
		1.6	Ensure that the transfer of control complies with three of the following: • Organisational guidelines and procedures • Recognised compliance agency/body's standards, directives or codes of practice • Equipment manufacturer's operating specification/range • Customer standards and requirements • Health, safety and environmental requirements • British, European or International standards or directives			
		1.7	Provide clear and accurate information to the relevant personnel on the engineering product or process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Identify and explain any aspects of the engineering product or process that vary from the agreed specifications and requirements			
		1.9	Carry out one of the following actions during a transfer of control: • Change the specification • Seek authority to proceed without compliance with the specification • Change the product or process			
		1.10	Obtain acceptance of the engineering product or process according to the agreed transfer procedures			
		1.11	Transfer control and obtain acceptance for all of the following: • Confirmation of the agreed specification and procedures • Confirmation that products, processes or facilities comply with specifications and requirements • Details of any variation from, or non-compliance with, the agreed specifications and requirements			
		1.12	Ensure that all relevant documentation is correctly completed and recorded in the appropriate information systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Record and communicate the transfer of control to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer-based presentation • Computer generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to transfer control of engineering products, processes or facilities	2.1	Explain the health, safety and environmental requirements applicable to the control transferring activities, and how they apply to the product, process or facility being transferred			
		2.2	Explain the relevant regulations, directives and guidelines applicable to transferring of control of engineering processes			
		2.3	Explain how to obtain information on regulations, directives and guidelines			
		2.4	Explain how to define the key factors for the product, process or facility that might be affected by the transfer of control			
		2.5	Explain how to liaise with customers to determine their requirements for transferring control			
		2.6	Explain who to communicate with customers regarding the transfer of control			
		2.7	Explain the procedures for transferring control for products, processes or facilities			
		2.8	Explain the techniques for assessing and dealing with aspects of the products, processes or facility, that may not comply with specifications or requirements			
		2.9	Explain the specifications and expected outcomes from the engineering products, processes or facility, and how to evaluate whether these are being achieved at the time of the transfer of control			
		2.10	Explain the organisational systems for recording information			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain the importance of using company information systems			
		2.12	Explain the various and most appropriate ways of achieving acceptance of the process from the receiving person or organisation			
		2.13	Explain the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 43: Propose Decommissioning of Engineering Equipment, Processes or Facilities

Unit reference number: M/505/0959

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to propose decommissioning of engineering equipment, processes or facilities. 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 Engineering 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	Propose decommissioning of engineering equipment, processes or facilities	1.1	Carry out all of the following activities when proposing equipment, processes or facilities for decommissioning: • Select a process, facility or item of equipment for potential decommissioning • Determine the extent of the decommissioning (partial or complete) • Gather all relevant information on the equipment, process or facility that they propose to decommission • Determine the decommissioning requirements of the equipment, process or facility • Ensure that proposed decommissioning methods and procedures meet relevant regulation, directives and guidelines • Present the decommissioning proposal with full justification and assessment of alternatives			
		1.2	Assess the effectiveness of the engineering products or processes in delivering the required outputs			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Assess the effectiveness of products, processes or facilities against all of the following: • Safety • Technology • Process capability • Legislation/regulations • Forecasts/trends • Obsolescence • Financial viability • Viability of services/utilities • Scrap levels • Environmental impact • Quality performance • Other (to be specified)			
		1.4	Identify the options for decommissioning engineering products or processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Determine the level and extent of the proposed decommissioning from all of the following aspects: • Shutdown • Isolation • Deactivation • Disposal • Removal • Other (to be specified)			
		1.6	Obtain accurate details of the engineering products or processes that could potentially be decommissioned			
		1.7	Review all relevant aspects of the engineering products or processes to assess their decommissioning			
		1.8	Assess the advantages and disadvantages of decommissioning the engineering products or processes			
		1.9	Identify the safety and environmental requirements of the decommissioning process			
		1.10	Establish that the decommissioning complies with all relevant regulations, directives and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Identify decommissioning requirements from three of the following: • Organisational guidelines and procedures • Recognised compliance agency/body's standards, directives or codes of practice • Equipment manufacturer's operating specification/range • Customer standards and requirements • Health, safety and environmental requirements • British, European or International standards			
		1.12	Recommend engineering products or processes for decommissioning			
		1.13	Recommend two of the following for decommissioning: • Assets • Services • Equipment • Systems • production processes • Installations • Facilities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Prepare a proposal for decommissioning that includes all of the following: • Recommendations for decommissioning • Reason/justification for the selection • Details of options • Advantages and disadvantages of the various options • Cost implications • Timing considerations • Environmental considerations • Regulations, directives and guidelines involved			
		1.15	Record and communicate proposals for decommissioning to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer-based presentation • Computer generated report • Specific company document • Other appropriate media			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to propose decommissioning of engineering equipment, processes or facilities	2.1	Explain the health, safety and environmental requirements applicable to the proposed decommissioning			
		2.2	Explain how to obtain details of what engineering equipment, processes or facilities are not performing to the required standards			
		2.3	Explain the methods and techniques involved in assessing which equipment, processes or facilities should be decommissioned			
		2.4	Explain the different levels of decommissioning that could be applied			
		2.5	Explain how to obtain details about the equipment, process or facility proposed for decommissioning			
		2.6	Explain the advantages and disadvantages of decommissioning a particular process, facility or item of equipment			
		2.7	Explain how to obtain and interpret the relevant legislative and regulatory documentation			
		2.8	Explain how to obtain and interpret company policy			
		2.9	Explain how to prepare a proposal for decommissioning, and the appropriate format to use			
		2.10	Explain how to present reports and recommendations			
		2.11	Explain the company reporting procedures, documentation and their application			
		2.12	Explain whom to inform of the proposal(s), and by what means			
		2.13	Explain the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 44: Plan and Decommission Engineering Equipment, Processes or Facilities

Unit reference number: H/505/0960

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to plan and decommission engineering equipment, processes or facilities. 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 Engineering 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	Plan and decommission engineering equipment, processes or facilities	1.1	Carry out all of the following during the decommissioning process: • Identify the equipment, processes or facilities to be decommissioned • Plan the decommissioning process to minimise disruption to normal working • Identify the necessary resources and timescales for the decommissioning • Anticipate potential problems and produce appropriate contingency plans • Confirm that the conditions are suitable for the decommissioning to proceed • Carry out the decommissioning in accordance with regulations and guidelines • Confirm that the completed decommissioning has met all the requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Identify and confirm that all of the following conditions are met for the decommissioning: • Authorisation • Preparation of site • Availability of resources • Compliance with regulations, directives and guidelines • Preparation of products or processes • Environmental			
		1.3	Plan the most appropriate way to decommission the engineering product or process			
		1.4	Identify potential decommissioning problems and produce appropriate contingency plans			
		1.5	Identify potential decommissioning problems and produce appropriate contingency plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Specify appropriate methods and procedures to be used in the decommissioning of all of the following: • Isolation from services (such as gas, electricity, water, air) • Safe handling and disposal of dangerous substances or items • Shutdown or deactivation of the equipment, process or facility • Safe handling and disposal of waste or scrap • Safety checks prior to and after decommissioning (such as to verify isolation, discharge stored energy, minimise hazards) • Relocation of re-usable items or materials • Restoration of services to the area (as appropriate) • Dismantling or decommissioning			
		1.7	Confirm that conditions are suitable to implement the decommissioning methods and procedures			
		1.8	Calculate the resources and timescales required to implement the decommissioning			
		1.9	Identify the decommissioning timescales that will be required, and three of the following resources: • Equipment • Materials • Personnel • Facilities • Finance			
		1.10	Control the use of resources to achieve the most effective results			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Ensure that the decommissioning is implemented according to plan and complies with all relevant regulations, directives and guidelines			
		1.12	Ensure that the decommissioning complies with three of the following: • Organisational guidelines and procedures • Recognised compliance agency/body's standards, directives or codes of practice • Equipment manufacturer's operating specification/range • Customer standards and requirements • Health, safety and environmental requirements • British, European or International standards or directives			
		1.13	Implement the decommissioning process using all of the following: • Maintaining efficient use of resources • Monitoring the process against the decommissioning plan • Identifying and solving problems as they occur			
		1.14	Identify and solve any decommissioning problems that occur			
		1.15	Verify the decommissioned status of the engineering product or process			
		1.16	Assess the results of the decommissioning on the remaining engineering products or processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Record and communicate the decommissioning process to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer-based presentation • Written or typed report • Specific company document			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to plan and decommission engineering equipment, processes or facilities	2.1	Explain the health, safety and environmental requirements applicable to the decommissioning activities, the location and the equipment, process or facility being decommissioned			
		2.2	Explain how to obtain details of the decommissioning proposal			
		2.3	Explain the factors that could affect plans for decommissioning			
		2.4	Explain the types of decommissioning problems that could occur, and how to solve them			
		2.5	Explain how to prepare contingency plans for any anticipated problems			
		2.6	Explain the alternative decommissioning practices that could be used for different engineering equipment, processes or facilities			
		2.7	Explain how to verify that the decommissioning activity has been completed			
		2.8	Explain the affect and impact the decommissioning could have on other engineering equipment, processes or facilities			
		2.9	Explain the range of conditions that should be considered before undertaking the decommissioning			
		2.10	Explain how to obtain information on resources			
		2.11	Explain how to determine the resources necessary			
		2.12	Explain how to ensure that the necessary resources are available and suitable			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain the regulations, directives and guidelines that are applicable to the decommissioning activity			
		2.14	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.15	Explain the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 45: Commission Engineering Products, Processes or Facilities

Unit reference number: M/505/0962

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to commission engineering products, processes or facilities. 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 Engineering 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	Commission engineering products, processes or facilities	1.1	Carry out all of the following during the commissioning process: • Identify products, processes or facilities to be commissioned • Clarify the commissioning requirements with the customer • Plan the commissioning to minimise disruption to others • Ensure that the commissioning complies with specifications, regulations and guidelines • Identify and obtain the necessary resources • Implement and monitor the commissioning process • Communicate appropriate information to all relevant people			
		1.2	Establish four of the following during commissioning: • Timing plan • Preparation of products • Authorisation channels • Preparation of site • Environmental requirements • Testing and/or trials • Configuration process • Handover			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Specify the methods and procedures for commissioning the engineering product or process			
		1.4	Plan the most appropriate way to commission the engineering product or process			
		1.5	Confirm that conditions are suitable to implement the commissioning			
		1.6	Confirm that conditions are suitable to implement the commissioning process, including all of the following: • The implementation plan for the commissioning activity is agreed and authorised • Appropriate resources are available • Contingency plans are in place to deal with problems as they occur • Outputs of the commissioning process have been identified for the subsequent handover report			
		1.7	Determine and obtain the resources required to undertake the commissioning			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Obtain appropriate resources, including two of the following: • Equipment • Materials • Personnel • Facilities • Plant equipment • Services • Finance • Other specific resources			
		1.9	Ensure that the commissioning is implemented correctly			
		1.10	Identify and solve any commissioning problems			
		1.11	Assess the results of the commissioning to identify the outputs of the engineering product or process			
		1.12	Confirm that the engineering product or process meets specifications and complies with all relevant regulations, directives and guidelines			
		1.13	Ensure that the commissioning meets specifications for all of the following: • Functions • Materials used • Performance • Environmental • Aesthetics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Ensure that the commissioning complies with three of the following: • Organisational guidelines and procedures • Recognised compliance agency/body's standards, directives or codes of practice • Equipment manufacturer's operating specification/range • Customer standards and requirements • Health, safety and environmental requirements • British, European or International standards or directives			
		1.15	Communicate with two of the following during the commissioning process: • Customer • Management • Suppliers • Sub contractors • Colleagues • Other (to be specified)			
		1.16	Ensure that the results of the commissioning are recorded in the appropriate information systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Record and communicate the results of the commissioning process to the appropriate people, using: • A verbal report Plus one from the following: • Electronic mail • Computer generated report • Specific company document • Commissioning hand over documentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to commission engineering products, processes or facilities	2.1	Explain the health, safety and environmental requirements applicable to the commissioning activities, location and product/process/facility being commissioned			
		2.2	Explain how to obtain details of which engineering products, processes or facilities require commissioning			
		2.3	Explain the commissioning methods and procedures to be used, and whom to consult with in the planning process			
		2.4	Explain the alternative commissioning practices that could be used for different engineering products, processes or facilities			
		2.5	Explain the factors that should be taken into account when planning the commissioning			
		2.6	Explain range of conditions that could be encountered, and potential effects on the commissioning process			
		2.7	Explain how to ensure that the commissioning is being implemented correctly			
		2.8	Explain the types of problem that could occur, and how to solve them			
		2.9	Explain the specifications and expected outputs from the engineering products, processes or facilities being commissioned, and how to evaluate that they are being achieved			
		2.10	Explain the assessment techniques for confirming that the commissioning process is being carried out correctly			
		2.11	Explain how to obtain information on resources			
		2.12	Explain how to determine what resources are necessary			
		2.13	Explain how to determine the availability of resources			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain the relevant regulations, directives and guidelines applicable to their area of responsibility			
		2.15	Explain how to obtain and interpret information on regulations, directives and guidelines			
		2.16	Explain how to assess the results of the commissioning process			
		2.17	Explain the company information and recording systems available			
		2.18	Explain the importance of using the appropriate company information and recording systems			
		2.19	Explain the extent of their own responsibility and to whom they should report if they have issues that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 46: Determine Welding and Related Technical Requirements to Achieve Objectives

Unit reference number: D/505/0987

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to determine welding and related technical requirements to achieve objectives. 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 Engineering 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	Determine Welding and Related Technical Requirements to Achieve Objectives	1.1	Clearly identify and confirm the objectives to be achieved			
		1.2	Gather and combine up-to-date information on specified objectives covering all of the following: • Product quality • Timescale • Health, safety and environmental requirements			
		1.3	Assess the work circumstances and their technical implications			
		1.4	Obtain information on the welding and/or related activities, using four of the following sources: • Parent material certificates • Consumables certificates • Specifications for work • Plans and/or schedules • Welding procedures • Welders' qualification(s) • Observation of work conditions • Drawings			
		1.5	Identify technical requirements that could deliver the specified objectives			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Take into account all of the following when determining the technical requirements: • Preparation of materials to be welded • Flow of materials to be welded • Preparation of welding equipment and consumables • Welding equipment capability studies • Welding operation • Heat treatment (pre- or post-welding) if required • Inspection requirements • Health and safety requirements • Disposal of waste			
		1.7	Identify technical requirements, including six of the following: • Methods, work instructions or procedures • Materials/component/equipment supply • Consumables supply • Quality control of processes, procedures and materials • Necessity, or otherwise of preparation of 'mock-ups' • Training required • Location of components and/or equipment • Resources required • Specialist equipment required • Qualified welders			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Ensure that the technical requirements take account of all of the following working conditions: • Availability of resources (such as people, materials, equipment, facilities, utilities) • Availability of support facilities (such as craneage, testing, heat treatment) • Environmental and safety conditions (such as heating, lighting, hazardous materials, safety equipment, accessibility)			
		1.9	Select and specify for implementation the most appropriate technical requirements to achieve the objectives			
		1.10	Identify and report those requirements which cannot be achieved			
		1.11	Communicate and confirm the technical requirements and any associated problems with the appropriate people using two of the following methods: • Written or typed report • Electronically • Verbally • Specific company form			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to Determine Welding and Related Technical Requirements to Achieve Objectives	2.1	Explain the specific safety precautions to be taken when working in a welding and related environment (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop and site safety practice, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)			
		2.2	Explain the personal protective clothing and equipment that should be worn (such as eye protection, ear and head protection)			
		2.3	Explain the hazards associated with working in a welding environment (such as electric arc flashes; fumes and gases; hot metal; grinding and mechanical metal/slag removal), and explain how they can be minimised			
		2.4	Explain the welding processes being used, and their technology (such as basic principles of fusion welding, AC and DC power sources, power ranges, manual metal arc (MMA), MIG, MAG or cored-wire arc welding, tungsten arc welding (TIG), submerged arc, gas and plasma welding, electron beam, resistance welding, laser and friction welding and other relevant fusion welding processes)			
		2.5	Explain how the various materials behave during welding (such as structure and property of metals; heat treatment requirements; types of steel and cracking phenomena, cast iron, copper, nickel, stainless steel, aluminium and their alloys; joining dissimilar materials)			
		2.6	Explain the construction and design of welded joints (such as design principles of welded construction, joint design, behaviour of welded structures under static and dynamic loading)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.7	Explain the general principles of welding components and structures (such as use of jigs, fixtures and manipulating devices; residual stresses and distortion; types of defect and their avoidance; quality control during manufacture)			
		2.8	Explain the types and features of welded joints in plate, tube and sections (including fillet and butt welds, single and multi-run welds, welding positions, weld quality)			
		2.9	Explain how to obtain the required information on welding and related activities, and the types of information that will be available			
		2.10	Explain how to access and use the appropriate information and documentation systems, and their organisation's regulations, guidelines and procedures			
		2.11	Explain how to extract the information required from drawings and welding procedure specifications (such as interpretation of welding symbols; scope, content and application of the welding procedure specification) to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken			
		2.12	Explain the codes and conventions that are used in the welding specifications			
		2.13	Explain the factors to be taken into account when determining the welding technical requirements, especially those relating to health and safety and working conditions			
		2.14	Explain the types of data that should be included in the technical information			
		2.15	Explain the types of resource that are associated with the different types of welding and related activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.16	Explain the importance of maintaining records of the technical requirements; what needs to be recorded, and where records are kept			
		2.17	Explain who needs to be informed about the welding technical requirements			
		2.18	Explain the organisational procedures for providing information to different people, and the various ways of presenting this information			
		2.19	Explain the importance of providing the right information at the right time			
		2.20	Explain the types of problem that can occur when identifying the welding technical requirements and how to avoid them			
		2.21	Explain the extent of their own responsibility, and explain to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 47: Plan Welding Production Resources and Activities

Unit reference number: H/505/0988

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to plan welding production resources and 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 Engineering 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	Plan Welding Production Resources and Activities	1.1	Collect the information needed to prepare the plan			
		1.2	Carry out all of the following when determining and producing the welding production plans: • Use the correct issue of company information, including drawings if applicable • Check that all essential information and data needed to produce the plans are available • Collect relevant information on the welding requirements, operations, methods and resources • Determine the availability of resources required • Ensure that health and safety regulations and safe working practices are taken into account • Ensure that the influence of working conditions is recognised and included in the plans • Present the plans in the appropriate formats			
		1.3	Identify health and safety issues and safe working practices and procedures that must be followed			
		1.4	Identify the operations to be carried out and determine their sequence			
		1.5	Establish which methods are required and what resources are to be used			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Prepare plans that include the use of all of the following resources: • People with the necessary skills and qualifications • Materials (both raw/parent materials and consumable) • Welding equipment (to include welding plant, jig/fixtures) • Space • Facilities • Utilities • Ancillary equipment (such as fume extraction, measuring and test equipment) • Support services (such as material treatment, NDT testing, lifting and moving equipment)			
		1.7	Identify any special requirements and incorporate them in the plan			
		1.8	Ensure that plans include relevant regulations, standards and guidelines from all of the following, as appropriate: • Organisational guidelines and codes of practice • Health, safety and environmental requirements • Recognised compliance agency/body's standards • Customer/client standards and requirement • National and international standards			
		1.9	Estimate timescales required			
		1.10	Prepare and record the plan			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce welding plans which consider five of the following: • Welding production trials • Welding production operations • Welding equipment changeover and replacement • Welding equipment maintenance activities • Welding equipment installation and commissioning • Welding equipment capability studies • Research and development • Lifting and moving large components and assemblies • Checking and testing of completed welds			
		1.12	Prepare plans that include all of the following: • 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) • The timescales to be met • Any special requirements that must be met • Details of health and safety issues			
		1.13	Record the plans, using two of the following methods: • Specific company documentation • Written or typed report • Electronic mail • Computer based presentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Inform the appropriate people when the plan is completed			
		1.15	Deal effectively with problems within their control and report those that cannot be solved			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to Plan Welding Production Resources and Activities	2.1	Explain how to access information on health and safety regulations and guidelines relating to the welding and related activities to be used and plans being produced			
		2.2	Explain the implications of not taking account of legislation, regulations, standards and guidelines when producing the welding plans			
		2.3	Explain the importance of proper planning of the welding activities, and the factors to be taken into account			
		2.4	Explain the welding processes being planned, and their technology (such as basic principles of fusion welding, AC and DC power sources, power ranges, manual metal arc (MMA), MIG, MAG or cored-wire arc welding, tungsten arc welding (TIG), submerged arc, gas and plasma welding, electron beam, resistance welding, laser and friction welding and other relevant fusion welding processes)			
		2.5	Explain how the various materials behave during welding (such as structure and property of metals; heat treatment requirements; types of steel and cracking phenomena, cast iron, copper, nickel, stainless steel, aluminium and their alloys; joining dissimilar materials)			
		2.6	Explain the construction and design of the welded joints (such as design principles of welded construction, joint design, behaviour of welded structures under static and dynamic loading)			
		2.7	Explain the general principles of welding components and structures (such as use of jigs, fixtures and manipulating devices; residual stresses and distortion; types of defect and their avoidance; quality control during manufacture)			
		2.8	Explain the types and features of welded joints in plate, tube and sections (including fillet and butt welds, single and multi-run welds, welding positions, weld quality)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Explain how to obtain information on welding and related activities, and the types of information that will be available			
		2.10	Explain how to access and use the appropriate information and documentation systems, and their organisation's regulations, guidelines and procedures			
		2.11	Explain how to extract the information required from the drawings and welding procedure specifications (such as interpretation of welding symbols; scope, content and application of the welding procedure specification) to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken			
		2.12	Explain the types of data that should be included in the welding plans (such as activities to be carried out, sequence in which they must be carried out, timescales, resource requirements, health and safety issues)			
		2.13	Explain the factors to be taken into account when determining the welding technical requirements, especially those relating to health and safety and working conditions			
		2.14	Explain the types of resource that are associated with the different types of welding and related activities			
		2.15	Explain the products (or assets) involved in the activity being planned, and their availability			
		2.16	Explain the development of the welding production plans (to include both master documents and working instructions, along with their purpose, content and status)			
		2.17	Explain how to prepare the plans (to include the structure, style, clarity and compliance with relevant standards)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Explain the process used in the organisation to validate the plans produced			
		2.19	Explain the control procedure for ensuring that the plans are maintained and kept up to date			
		2.20	Explain the procedures for changing the plans, and why control procedures are used			
		2.21	Explain the importance of maintaining records of the plans; what needs to be recorded, and where records are kept			
		2.22	Explain who needs to be informed about the welding plans			
		2.23	Explain the organisational procedures for providing information to different people, and the various ways of presenting this information			
		2.24	Explain the importance of providing the right information at the right time			
		2.25	Explain the types of problem that can occur during the implementation of the plan, and explain how these problems can be rectified			
		2.26	Explain the sources of technical expertise if they have problems that they cannot solve			
		2.27	Explain the extent of their own responsibility, and explain to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 48: Implement Welding Production Methods and Procedures

Unit reference number: K/505/0989

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to implement welding production methods and procedures. 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 Engineering 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	Implement Welding Production Methods and Procedures	1.1	Confirm that conditions are suitable to implement engineering methods and procedures			
		1.2	Ensure that the conditions and relevant documentation are in place for the welding production required, including all of the following: • Welding and related equipment • Human resources • Materials or components • Pre-production preparation of materials or components • Pre-production preparation of the workplace or site • Environmental conditions • Authority to proceed with production • Health and safety conditions • Welder and welding procedure approvals • Quality assurance procedure or quality plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Implement welding production methods and procedures for two of the following: • Manual • Mechanised • Automatic • Robotic			
		1.4	Implement welding production methods in two processes from one of the following groups: • Arc welding (MMA, MIG/MAG, TIG, Plasma) • Solid phase welding (friction, flash, diffusion) • Resistance welding (spot, seam, projection) • Brazing, soldering, gas welding Or One process from the following group: • High-energy density welding (laser welding or electron beam)			
		1.5	Provide clear and accurate instructions to all the relevant people			
		1.6	Obtain accurate information on the activities being undertaken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Monitor and record welding production methods, using two of the following: • Observation of the welding production process • Checking records of the production process • Producing and maintaining records of the production process • Consideration and, where appropriate, recommendation of improvements			
		1.8	Ensure that quality assurance systems are correctly implemented			
		1.9	Ensure that engineering support systems are operating correctly			
		1.10	Control the use of resources to achieve the most effective results			
		1.11	Identify opportunities to improve the engineering methods and procedures			
		1.12	Ensure that the implementation of engineering methods and procedures complies with all relevant regulations and guidelines			
		1.13	Consider all of the following, taking account of relevant health and safety requirements, and work in accordance with all those deemed applicable: • Standards • Regulations • Specifications • Guidelines • Company procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to Implement Welding Production Methods and Procedures	2.1	Explain how to access information on health and safety regulations and guidelines relating to the welding production activities to be implemented			
		2.2	Explain the specific safety precautions to be taken when working with welding production and related processes			
		2.3	Explain the implications of not taking account of legislation, regulations, standards and guidelines when implementing the welding production processes			
		2.4	Explain the welding production processes being implemented, and their technology (such as basic principles of fusion welding, AC and DC power sources, power ranges, manual metal arc (MMA), MIG, MAG or cored-wire arc welding, tungsten arc welding (TIG), submerged arc, gas and plasma welding, electron beam, resistance welding, laser and friction welding and other relevant fusion welding processes)			
		2.5	Explain how the various materials behave during welding (such as structure and property of metals; heat treatment requirements; types of steel and cracking phenomena, cast iron, copper, nickel, stainless steel, aluminium and their alloys; joining dissimilar materials)			
		2.6	Explain the construction and design of welded joints (such as design principles of welded construction, joint design, behaviour of welded structures under static and dynamic loading)			
		2.7	Explain the general principles of welding components and structures (such as use of jigs, fixtures and manipulating devices; residual stresses and distortion; types of defects and their avoidance; quality control during production)			
		2.8	Explain the types and features of welded joints in plate, tube and sections (including fillet and butt welds, single and multi-run welds, welding positions, weld quality)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Explain how to obtain information on the welding production requirements, and the types of information available (such as customer requirements and instructions, quality control requirements, product specification, production methods)			
		2.10	Explain how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken)			
		2.11	Explain the types of data that they will require to implement the welding activity (such as activities to be carried out, sequence in which they must be carried out, timescales, resource requirements, health and safety issues)			
		2.12	Explain the production methods that could be used for different types of welding			
		2.13	Explain how to identify conditions that are suitable for the different types of welding production activities			
		2.14	Explain how to obtain details of the welding production activities being undertaken			
		2.15	Explain the factors to be taken into account when implementing the welding production activity, especially those covering working conditions and safety			
		2.16	Explain the main types of resource involved with different types of production welding activities			
		2.17	Explain how to verify that resources are suitable, and available within or to the organisation			
		2.18	Explain the timescales for carrying out the specific production welding activities, and why they must be adhered to			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Explain the procedures for making changes in the implementation, to take account of changed circumstances or improvements in the process			
		2.20	Explain the importance of monitoring the production process and maintaining records; what needs to be recorded, and where the records are kept			
		2.21	Explain the quality assurance systems that are being used			
		2.22	Explain the types of problem that can occur during the implementation of the welding production activity, and explain how these problems can be rectified			
		2.23	Explain the extent of their own authority, and explain to whom they should report in the event of problems that they cannot resolve			
		2.24	Explain the sources of technical expertise if they have problems that they cannot solve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 49: Solve Welding Problems in Production

Unit reference number: D/505/0990

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to solve welding problems in production. 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 Engineering 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	Solve Welding Problems in Production	1.1	Take prompt action to solve engineering problems and keep all relevant people informed of progress			
		1.2	Carry out all of the following during the problem solving activity: • Discuss/consult with the relevant people on the nature and extent of the problem and its impact on the welding activity • Gather information from appropriate sources to help identify and define the problem • Identify and evaluate possible solutions, considering temporary, short term and long term solutions • Select the most appropriate solution to rectify the problem • Communicate the proposed solution to the relevant people, obtaining feedback where appropriate • Prepare a plan of action for implementation of the agreed solution • Ensure that the agreed solution is implemented in an effective and timely manner • Ensure that the agreed solution complies with appropriate regulations and guidelines • Implement preventive measures (where applicable) to ensure that the problem does not reoccur			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Resolve two welding production problems from each of the following groups: Before welding: • Parent materials • Preparation for welding • Welder qualifications • Welding consumables • Fit-up of joint • Welding and associated equipment • Welding procedure During welding: • Welding equipment performance • Welder performance • Quality control • Weld profile • Defects • Distortion • Low output • Health and safety After welding • Dimensions • Defects • Weld properties			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Obtain all relevant information relating to the engineering problems			
		1.5	Gather and use all relevant information on welding production problems from six of the following: • Fabrication drawings • Material certificates • Consumables certificates • Welding records • Inspection or NDT reports • Mechanical test reports • Heat treatment records • Welding equipment procedures and operation • Comments from the welder (written or verbal) • Applicable codes, specifications and procedures • Welding procedure qualification and welder approval certificate			
		1.6	Identify correctly the nature and extent of any engineering problems that arise			
		1.7	Evaluate all realistic engineering solutions to solve engineering problems			
		1.8	Identify the most effective engineering solution for solving engineering problems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Evaluate possible solutions to the problems, by considering all of the following: • Operational effectiveness • Ease of implementation • Timescale for implementation • Financial impact • Functionality of the system • Environmental impact • Staffing implications • Conformity with company policy • Health and safety implications • Other specific are			
		1.10	Ensure that engineering solutions are implemented correctly and promptly			
		1.11	Implement the solution for two of the following timescales, taking into account the urgency of the problem: • Temporary (interim solution – will require further action) • Medium term (may require further action) • Long term (permanent solution)			
		1.12	Ensure that solutions to engineering problems comply with all relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Ensure that the solution complies with relevant regulations, standards and guidelines, from all of the following, as appropriate: • Statutory bodies • Company policy and procedures • Industry specific • Client requirements • Manufacturer specific • National • International			
		1.14	Update the quality assurance system, as appropriate, and communicate the solution of the problem to the relevant people, using the following methods: • Verbal report Plus one more from the following: • Specific company documentation • Written or typed report • Electronic mail • Computer based presentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to Solve Welding Problems in Production	2.1	Explain the specific safety precautions to be taken when working with production welding and related equipment (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)			
		2.2	Explain the personal protective clothing and equipment that should be worn (such as eye protection, ear protection, safety clothing)			
		2.3	Explain the hazards associated with the production welding and related processes (such as arc flashes, fumes and gases, safety in enclosed/confined spaces, handling hot welded components/structures), and explain how they can be minimised			
		2.4	Explain how to access information on health and safety regulations and guidelines relating to the welding production activities to be implemented			
		2.5	Explain the implications of not taking account of legislation, regulations, standards and guidelines when determining solutions to the welding problems			
		2.6	Explain the welding production processes being used, and their technology (such as basic principles of fusion welding, AC and DC power sources, power ranges, manual metal arc (MMA), MIG, MAG or cored-wire arc welding, tungsten arc welding (TIG), submerged arc, gas and plasma welding, electron beam, resistance welding, laser and friction welding and other relevant fusion welding processes)			
		2.7	Explain how the various materials behave during welding (such as structure and property of metals; heat treatment requirements; types of steel and cracking phenomena, cast iron, copper, nickel, stainless steel, aluminium and their alloys; joining dissimilar materials)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.8	Explain the construction and design of welded joints (such as design principles of welded construction, joint design, behaviour of welded structures under static and dynamic loading)			
		2.9	Explain the general principles of welding components and structures (such as use of jigs, fixtures and manipulating devices; residual stresses and distortion; types of defect and their avoidance; quality control during production)			
		2.10	Explain the types and features of welded joints in plate, tube and sections (including fillet and butt welds, single and multi-run welds, welding positions, weld quality)			
		2.11	Explain how to obtain information on the production welding requirements, and the types of information available (such as customer requirements and instructions, quality control requirements, product specification, manufacturing methods, equipment manuals/specifications)			
		2.12	Explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports and other documents needed in the problem solving process			
		2.13	Explain how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken)			
		2.14	Explain the principles of effective problem solving; the main problem solving methods and techniques in use, and how to apply them			
		2.15	Explain the importance of collecting as much relevant information as possible, and of collating such information in a way that facilitates decision making, and the methods to achieve this			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.16	Explain action planning (to include risk analysis, testing decisions, determining timescales and protecting the user/customer)			
		2.17	Explain the importance of analysing problems from a variety of perspectives			
		2.18	Explain how to define and verify the root cause of a problem			
		2.19	Explain the importance of involving a range of relevant people in generating possible solutions			
		2.20	Explain the importance of developing a range of possible options in solving problems			
		2.21	Explain the factors to be taken into account when solving problems and determining suitable solutions, especially those covering working conditions and safety			
		2.22	Explain how to present possible solutions in a way that helps relevant people to reach an informed and realistic judgement			
		2.23	Explain how to determine and select permanent corrective actions (to include decision making, assessing the criteria and determining the risks, costs and generating alternatives)			
		2.24	Explain how to prevent recurrence of the problems (to include proposed changes to management systems, operating systems and procedures, and the identification of opportunities for improvements)			
		2.25	Explain the importance of maintaining records of the problem solving activities; what needs to be recorded, and where records are kept			
		2.26	Explain the different ways in which the solutions can be reported back			
		2.27	Explain who should be informed of actions taken, and by what means			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.28	Explain the extent of their own responsibility, and explain to whom they should report if they have problems that they cannot resolve			
		2.29	Explain the sources of technical expertise if they have problems that they cannot solve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 50: Monitor Welding Activities in Production

Unit reference number: H/505/0991

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to monitor welding activities in production. 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 Engineering 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	Monitor Welding Activities in Production	1.1	Ensure that the required company methods and procedures for monitoring welding in production are available, to include four of the following: • Welding equipment manufacturer's recommendations • Quality assurance procedures and quality plans • Method statements • Manufacturing instructions • Risk assessments • Permits to work • Evaluation of weld properties			
		1.2	Monitor the engineering process at suitable opportunities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Ensure that implementation of the specified monitoring activities occurs in four of the following forms: • Observation • Data collection • Sampling • Testing, inspection or measurement of the product • Welding equipment records • Records produced by production or testing personnel • Periodic checking of equipment settings • Checking of production rate			
		1.4	Ensure effective use of resources, by checking two of the following: • Scrap volumes • Down times • Repair rates • Compliance with specified scheduling			
		1.5	Confirm that the materials used during the engineering process comply with specifications			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Ensure that the materials used comply with specifications and are in accordance with company, client and welding procedures, by means of two of the following: • Parent material certificates • Welding consumables certificates • Non-destructive test (NDT) reports • Destructive test reports • Release notes • Positive material identification (PMI)			
		1.7	Confirm that suitable engineering methods and procedures have been used			
		1.8	Identify any variations from agreed plans and schedules			
		1.9	Ensure that any problems with the engineering process are identified			
		1.10	Take action, in accordance with company procedures, if any problem or lack of compliance with specifications is identified, to include carrying out two of the following: • Stopping production • Quarantining defective goods/materials • Taking planned remedial action • Reporting to a higher authority • Increasing sampling rates			
		1.11	Ensure that the outputs of the engineering process comply with specifications			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Ensure that the engineering process complies with all relevant regulations and guidelines			
		1.13	Ensure that the monitoring process complies with relevant regulations, standards and guidelines from all of the following, as appropriate: • Statutory bodies • Company policy and procedures • Industry specific • Client requirements • Manufacturer specific • National • International			
		1.14	Communicate the outcomes of the monitoring activity to the relevant people, using the following methods: • Verbal report Plus one more method from the following: • Specific company documentation • Written or typed report • Electronic mail • Computer-based presentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to Monitor Welding Activities in Production	2.1	Explain the specific safety precautions to be taken when working with production welding and related equipment (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)			
		2.2	Explain the personal protective clothing and equipment that should be worn (such as eye protection, ear protection, safety clothing)			
		2.3	Explain the hazards associated with the production welding and related processes (such as arc flashes, fumes and gases, safety in enclosed/confined spaces, handling hot welded components/structures), and explain how they can be minimised			
		2.4	Explain the welding production processes being monitored, and their technology (such as basic principles of fusion welding, AC and DC power sources, power ranges, manual metal arc (MMA), MIG, MAG or cored-wire arc welding, tungsten arc welding (TIG), submerged arc, gas and plasma welding, electron beam, resistance welding, laser and friction welding and other relevant fusion welding processes)			
		2.5	Explain how the various materials behave during welding (such as structure and property of metals; heat treatment requirements; types of steel and cracking phenomena, cast iron, copper, nickel, stainless steel, aluminium and their alloys; joining dissimilar materials)			
		2.6	Explain the construction and design of welded joints (such as design principles of welded construction, joint design, behaviour of welded structures under static and dynamic loading)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.7	Explain the general principles of welding components and structures (such as use of jigs, fixtures and manipulating devices; residual stresses and distortion; types of defects and their avoidance; quality control during production)			
		2.8	Explain the types and features of welded joints in plate, tube and sections (including fillet and butt welds, single and multi-run welds, welding positions, weld quality)			
		2.9	Explain the monitoring methods and procedures that can be used (including when and how monitoring should be used), for the types of production welding activity within their area of responsibility			
		2.10	Explain the potential variations from plans and schedules that might occur during the production process			
		2.11	Explain the types of problem that could occur with the production or monitoring process, and explain the organisational methods and procedures for resolving them			
		2.12	Explain the importance of solving problems quickly			
		2.13	Explain how to check the outputs of the production process against those specified			
		2.14	Explain the quality assurance systems that are being used			
		2.15	Explain the procedures for obtaining information on resources, and how to verify that the resources used are suitable			
		2.16	Explain the importance of maintaining records of the monitoring activities			
		2.17	Explain the types of information to be recorded, and the amount of detail required			
		2.18	Explain where records are kept, and the procedure for obtaining them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Explain the importance of ensuring that any records that they use are correctly updated and returned to the appropriate location			
		2.20	Explain the different ways of presenting information to different people			
		2.21	Explain the organisational reporting processes and lines of communication			
		2.22	Explain the extent of their own responsibility, and explain to whom they should report if they have problems that they cannot resolve			
		2.23	Explain the sources of technical expertise if they have problems that they cannot solve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 51: Inspect Welded Components or Structures for Visual Quality and Dimensional Accuracy

Unit reference number: K/505/0992

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to inspect welding components or structure for visual quality and dimensional accuracy. 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 Engineering 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	Inspect Welded Components or Structures for Visual Quality and Dimensional Accuracy	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			
		1.2	Carry out all of the following during the inspection process: • Observe all the required safety procedures for the work area/activity • Obtain and use the correct issue of drawings, job instructions and welding procedure specifications • Obtain and check the condition and calibration dates of tools, measuring instruments and equipment used • Follow specified or appropriate inspection procedures • Identify and record out-of-specification features, in the appropriate format • Mark and identify areas where non-compliance with specification or defect indications are found • Leave the work area in a safe and tidy condition on completion of the inspection activities			
		1.3	Follow the correct specification for the product or equipment being inspected			
		1.4	Use the correct equipment to carry out the inspection			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Ensure that they have the required inspection equipment and that it is in good working order, to include six of the following, as appropriate to the operation/features being checked: • Weld measuring gauge • Rule, tape or other linear measuring device • Adjustable square/protractor • Depth gauge • Borescope • Roughness measuring equipment • CCTV viewing system • Magnifying glass • Mirror • Portable lighting • Means of marking defective areas			
		1.6	Identify and confirm the inspection checks to be made and acceptance criteria to be used			
		1.7	Carry out the inspection checks to one or more of the following: • Approved construction drawings • Client specifications/detail drawings • Applicable national and international standards • Welding procedure specification			
		1.8	Carry out all required inspections as specified			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Carry out specified prefabrication or sub-assembly inspection checks, to include all of the following: • Checking the condition of joint preparations • Welded joint preparation dimensions • Flatness or profile of sheets or plates, and linearity of sections • Set-up arrangements for welding • Condition of consumables			
		1.10	Carry out the inspection of two of the following types of welded fabrication: • Fabricated frames • Structures • Square/rectangular tanks • Curved/profiled structures • Pipe sections • Cylindrical components • Conical components • Tubular structures • Transition pieces • Segmented bends • Modular components • Other specific fabrications			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Carry out specified inspection during fabrication, to check all of the following: • Condition of weld root zone (where possible) and inter-runs • Cleanliness of weld faces and surfaces • Distortion and shrinkage			
		1.12	Carry out the specified final inspection checks, to include all of the following: • Overall dimensional tolerances • Extent of distortion, shrinkage or misalignment • Surface finish or roughness • Visual appearance of welds/weld profile • Evidence of damage requiring restoration • Freedom from arc strikes • Defect indications manifested on weld or parent metal surface • Extent of excess metal, undercut, penetration or lack of penetration			
		1.13	Identify any defects or variations from the specification			
		1.14	Record the results of the inspection in the appropriate format			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Complete the inspection documentation, to include one from the following, and pass to the appropriate people: • Weld inspection report • Job card • Customer specific documentation • Concession report			
		1.16	Deal promptly and effectively with problems within their control and report those that cannot be solved			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to Inspect Welded Components or Structures for Visual Quality and Dimensional Accuracy	2.1	Explain the specific safety precautions to be taken when inspecting welded components/structures (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)			
		2.2	Explain the personal protective clothing and equipment (PPE) that should be worn (such as leather gloves, eye protection, ear protection, safety harness)			
		2.3	Explain the hazards associated with inspecting welded components/structures (such as working at height, safety in enclosed/confined spaces, handling welded components/structures, slips, trips and falls), and explain how they can be minimised			
		2.4	Explain the welding processes being used, and their technology (such as basic principles of fusion welding, AC and DC power sources, power ranges, manual metal arc (MMA), MIG, MAG or cored-wire arc welding, tungsten arc welding (TIG), submerged arc, gas and plasma welding, electron beam, resistance welding, laser and friction welding and other relevant fusion welding processes)			
		2.5	Explain how the materials behave during welding (such as structure and property of metals; heat treatment requirements; types of steel and cracking phenomena, cast iron, copper, nickel, stainless steel, aluminium and their alloys; joining dissimilar materials)			
		2.6	Explain the construction and design of welded joints (such as design principles of welded construction, joint design, behaviour of welded structures under static and dynamic loading			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.7	Explain the general principles of welding components and structures (such as use of jigs, fixtures and manipulating devices; residual stresses and distortion; types of defect and their avoidance; quality control during manufacture)			
		2.8	Explain how and where to obtain the required drawings and related specifications, and how to check that they are current and complete			
		2.9	Explain how to extract the information required from the drawings and welding procedure specifications (such as interpretation of welding symbols; scope, content and application of the welding procedure specification) to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken			
		2.10	Explain the types and features of welded joints in plate, tube and sections (including fillet and butt welds, single and multi-run welds, welding positions, weld quality)			
		2.11	Explain the use of British, European, international and client standards in determining if welded fabrications are fit for purpose			
		2.12	Explain the general principles of quality assurance systems and procedures			
		2.13	Explain the preparations to be undertaken before the welded fabrications are inspected (such as access to welded area, cleanliness and physical condition of welded area)			
		2.14	Explain the visual and dimensional inspection methods and techniques that are used for welded components/structures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Explain the equipment that is used to carry out the various inspection checks (such as rules and tapes, weld measuring gauge, borescope, optical aids (such as magnifying glass and mirror), CCTV viewing system)			
		2.16	Explain the items to be checked prior to welding the components/structures (such as joint preparation, joint setup, parent metal condition, condition of consumables, equipment settings)			
		2.17	Explain the features of the welded joints that must be checked (such as linearity or profile, weld root run, inter-runs, final dimensional tolerances, distortion, shrinkage, visual appearance of welds, excess weld metal, undercut, penetration and profile)			
		2.18	Explain how to calculate allowances for weld gaps and weld shrinkage, in order to attain overall global tolerances			
		2.19	Explain the acceptance criteria to be used, and the influence of defects on the service performance of the welded components/structures (including risks and consequences of failure)			
		2.20	Explain the importance of carrying out the checks and recording the results in the appropriate documentation			
		2.21	Explain the procedure to be followed when inspected products are out of specification			
		2.22	Explain the importance of completing inspection documentation; what must be recorded, and where records are kept			
		2.23	Explain the extent of their own responsibility and explain to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 52: Lead Welding and Fabrication Activities

Unit reference number: L/505/0967

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead welding and fabrication 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 Engineering 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	Lead welding and fabrication activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the welding and fabrication activities by carrying out all the following: • Interpret the Health and Safety Regulations for the welding and fabrication environment and apply controls, mitigation and protective equipment to address the risk factors associated with welding, cutting, grinding and NDT • Obtain accurate details of the products to be welded or fabricated • Review and interpret the product specification and documentation to assess their characteristics and requirements • Clarify any aspects of the product specification or timescales that are unclear • Communicate the welding, inspection, testing and fabrication activities to be undertaken with the team • Involve the team in planning how the welding and fabrication activities will be achieved • Provide clear and accurate instructions to all the relevant people • Advise welding personnel on welding instructions and techniques • Secure, monitor and control the use of resources to achieve the most effective results • Confirm and communicate any changes to the product specification and/or timescales required by the customer • Allocate specific jobs/tasks to appropriate personnel • Motivate the team to present their own ideas on improvements that could be made to the manufacturing process and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	...continued • Encourage the team and/or individuals to take the lead where appropriate • Deal efficiently and effectively with problems affecting production/inspection output • Produce and agree contingency plans when required			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out all the following whilst leading the welding and fabrication activities: • Interpret weld drawings and weld symbols, understand and apply the correct codes, standards and welding procedures for the scope of production • Review and verify that welder qualifications are valid for the scope of production, assign welders and control their deployment • Select the correct welding and associated equipment and verify that it is serviceable and calibrated • Select, supply and control the traceability of verified parent materials, check joint preparation, fit-up and cleanliness before welding • Identify welding consumables, verify welding consumables against documentation, and control their storage and supply • Control the welding parameters, techniques, sequences, preheating, heat input and heat treatment • Apply visual inspection to the control of weld finish and dimensions, and control of the shape and dimensions of the part, component or assembly • Assign appropriate non-destructive testing of the welds • Assess inspection and test reports and identify the factors affecting weld defects and apply acceptance criteria from relevant codes, standards or specifications • Identify the nature and extent of production problems, evaluate and select solutions, and control weld repair and rework • Prepare, review, maintain and archive inspection reports and weld quality records			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Develop, gain agreement and review departmental budgets			
		1.5	Produce, agree and update departmental schedules and plans			
		1.6	Prepare and plan welding and fabrication activities by carrying out all of the following: • Select materials, welding process, equipment and consumables based on weld and fabrication drawings and application standards or contract specifications • Compile and review welding procedures for welded components in accordance with national and international standards • Interpret and apply standards to the qualification of a welding procedure, recognising the main variables and its range of qualification • Determine the main variables for a particular welder/welding operator qualification and its range of qualification, and initiate and maintain welder qualification tests and records • Select and apply appropriate fixtures, jigs or positioners to improve weldability or productivity in a particular welded fabrication • Select and apply auxiliary equipment, and cables, heat treatment equipment and temperature controls for a particular welding procedure • Analyse welding production rates and costs and schedule welding and handling activities to achieve requirements			
		1.7	Ensure that schedules and plans are capable of meeting the required outputs			
		1.8	Lead welding or fabrication activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Lead one of the following activities : Weld Repair • Produce a welding procedure qualification, recognising the problems of making repair welds • Coordinate the safety requirements for an in-service weld repair, with regard to specific needs such as hot working permit, fume control and special access or confined space training • Select appropriate welding personnel, equipment and consumables to be applied to a specific weld repair procedure Or Welding of reinforcing steel • Select appropriate joints for load bearing and non-load bearing • Determine joint length and preheat for specified steel types and diameters • Select appropriate welding processes welding of reinforcing steel to satisfy requirements of standards (such as ISO 17660 series and National Standards) and specifications			
		1.10	Complete and save relevant welding or fabrication data and documentation accurately			
		1.11	Identify and lead on making improvements to processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Identify and implement improvements in the manufacturing/inspection department to achieve four of the following: • Reduced production costs • Reduced lead times • Improved quality • Improved equipment/tooling efficiency • Improved staff utilisation • Improved working practices • Improved equipment downtime • Improved equipment utilisation • Improved use of production/inspection technologies • Improved use of information technology • Improved health and safety • Improved visual management systems/documentation • Improved resource planning • Improved staff development and training • Reduction in waste • Reduction in energy usage • Improved environmental impact • Improved customer service • Other (to be specified)			
		1.13	Ensure welding or fabrication activities are carried out correctly in line with approved company processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Lead Quality Assurance and Quality Control activities for welding and fabrication by carrying out all of the following: • Produce and implement effective quality control procedures • Interpret and apply relevant standards (such as. ISO 9000, and ISO 3834) to storage, supply, control and traceability of materials and consumables, including calibration of equipment • Recognise the basic factors related to personnel and equipment that influence the quality in a welded fabrication, and control them to achieve specified results • Apply Inspection Quality Test Plans/Written Schemes of Examination in accordance with application standards or contract specifications, and demonstrate correct use of acceptance standards for weld imperfections • Control welding quality, residual stresses and distortion through measurement of welding parameters and measurement and control of heat treatment operations			
		1.15	Ensure welded or fabricated products complies with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.16	Create and update visual management documentation and systems to support the activities of the department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Create and maintain management data and information to include the following: • Welding or fabrication work plans/delivery schedules Plus supporting documentation associated with three of the following • Quality records/defects • Problem history/resolution • Resources/materials requisitions • Budgets • Equipment performance • Equipment maintenance • Equipment downtime/failure • Equipment utilisation • Health and safety • Staff development and training • Department procedures/work instructions • Tests and trials • Regulatory compliance • Justification of the purchase and/or application of innovative/new welding equipment			
		1.18	Report and evaluate the impact of improvement activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	Complete the relevant documentation to include one from the following: • Job/route cards • Company-specific production recording system			
		1.20	Produce and maintain departmental competency skills matrix of team members			
		1.21	Provide technical advice and guidance as required			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to lead welding and fabrication activities	2.1	Explain the health and safety requirements of the area in which the welding or fabrication activity is to take place and the responsibility these requirements place on them			
		2.2	Explain the information systems that are in use within their organisation and how to record data to the system			
		2.3	Explain how to obtain and interpret legislative and regulatory documentation			
		2.4	Explain how to obtain and interpret company policies and procedures			
		2.5	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.6	Explain the process to be followed to develop and gain agreement on departmental budgets			
		2.7	Explain the importance of regularly monitoring departmental budgets and the implications for the business if this is not carried out			
		2.8	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.9	Explain the importance of ensuring that teams have the required skills, knowledge, experience, behaviours and where appropriate qualifications in order to weld or fabricate components to the required standards			
		2.10	Explain how to access training and development programmes once a training need has been identified			
		2.11	Explain the specific health and safety precautions to be applied during the welding or fabrication and process and their effects on others			
		2.12	Explain how to complete and review risk assessments			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain the hazards associated with carrying out activities in the department and how to minimise these and reduce any risks			
		2.14	Explain the importance of ensuring employees wear protective clothing and other appropriate safety equipment during the welding or fabrication process			
		2.15	Explain the importance of having access to up to date data and information such as drawings, specifications, manufacturers' manuals and other documents needed in the welding or fabrication process			
		2.16	Explain who to contact if clarification is required on the welding or fabrication requirements			
		2.17	Explain who should be involved in authorising any changes required to welding or fabrication activities			
		2.18	Explain the methods used to calculate how long it should take to complete specific work outputs			
		2.19	Explain the procedure for purchasing/obtaining materials and other consumables necessary for the welding or fabrication activities			
		2.20	Explain the criteria for selection and application of different welding consumables			
		2.21	Explain the classification, properties and typical applications of steels, aluminium alloys and other engineering materials in common use			
		2.22	Explain the methods for identification of relevant materials and components			
		2.23	Explain the characteristics and application of welding and cutting processes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.24	Explain the operation, maintenance and calibration requirements of the principal components of welding power sources and ancillary equipment			
		2.25	Explain the characteristics and benefits of automated and mechanised welding processes			
		2.26	Explain the terms, symbols and definitions used in weld and fabrication drawings and specifications			
		2.27	Explain the principles of quality assurance and quality control and recognise the related standards and their application to welded fabrication as a special process			
		2.28	Explain the requirements and function of Quality Control during manufacture, the standards related to welding operators and welding procedure qualification including joint traceability methods, the need for calibration, and monitoring of process parameters			
		2.29	Explain the main factors affecting welding stress and distortion in welded fabrications and how these effects can be measured and minimised			
		2.30	Explain the need for, and function of, auxiliary equipment, jigs and fixtures from the viewpoint of quality, economics and the environment			
		2.31	Explain the methods of controlling the properties of welded joints, including strength, toughness, hardness, and corrosion resistance			
		2.32	Explain the effect of heat treatment, including normalising, annealing, preheating, quench and tempering, solution treatment and post-weld heat treatment			
		2.33	Explain the methods and equipment used for heat treatment			
		2.34	Explain the purpose and application of hydrostatic test methods			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.35	Explain the need for and application of destructive mechanical testing			
		2.36	Explain the purpose and application of inspection quality test plans or written schemes of examination			
		2.37	Explain the requirements for measurement, control and recording during welding and allied operations			
		2.38	Explain the principles of imperfections and acceptance criteria			
		2.39	Explain the use of Non Destructive Testing as applied to welding fabrications			
		2.40	Explain the economics of welding operations applied to welded fabrications			
		2.41	Explain the problems of repair welding both for in manufacture and in-service situations			
		2.42	Explain the principles of choice of joints in reinforcing steels and their design			
		2.43	Explain the importance of keeping up to date with new technologies, welding and fabrication methods and techniques			
		2.44	Explain the quality assurance and control methods that are used in the department			
		2.45	Explain the personnel involved to ensure that the quality of product outcomes are fit for purpose and their responsibilities to ensure this is achieved			
		2.46	Explain the process and procedures to be followed when defective products are identified both during production/on completion of the welding or fabrication process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.47	Explain the organisational procedure(s) to be adopted for the safe disposal of all types of waste materials			
		2.48	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.49	Explain how to use “root cause” problem solving analysis using the 5 whys/how technique			
		2.50	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.51	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.52	Explain how to create, review and modify Standard Operating Procedures (SOP's) and correlate work activities into them			
		2.53	Explain the techniques required to communicate information using visual control systems (such as, card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.54	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 53: Lead Rail Welding Activities

Unit reference number: R/505/0968

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead rail welding 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 Engineering 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	Lead rail welding activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the rail welding activities by carrying out all the following: • Interpret the Health and Safety regulations for the rail welding environment and apply controls, mitigation and protective equipment to address the risk factors associated with welding, cutting, grinding and NDT • Obtain accurate details of the rails to be welded • Review and interpret the rail welding specification and documentation to assess their characteristics and requirements • Clarify any aspects of the rail welding specification or timescales that are unclear • Involve the team in planning how the rail welding activities will be achieved • Select, check, issue and brief safe systems of work plans, method statements, work package plans, work plans and briefing documents for specified track maintenance or renewal tasks • Provide clear and accurate instructions to all the relevant people • Advise welding personnel on welding instructions • Secure, monitor and control the use of resources to achieve the most effective results • Confirm and communicate any changes to the rail welding specification and/or timescales required by the customer • Allocate specific jobs/tasks to appropriate and competent personnel • Motivate the team to present their own ideas on improvements that could be made to the manufacturing process and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	...continued • Encourage the team and/or individuals to take the lead where appropriate • Deal efficiently and effectively with problems affecting the rail welding activities • Produce and agree contingency plans when required			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out all the following whilst leading rail welding activities: • Interpret weld drawings and weld symbols, understand and apply the correct codes, standards and welding procedures • Review and verify that welder qualifications are valid, assign welders and control their deployment • Select the correct welding and associated equipment and verify that it is serviceable and calibrated • Select, supply and control the traceability of verified parent materials, check joint preparation, fit-up and cleanliness before welding • Identify welding consumables, verify welding consumables against documentation, and control their storage and supply • Control the welding parameters, techniques, sequences, preheating, heat input and heat treatment • Apply visual inspection to the control of weld finish and dimensions, and control of the shape and dimensions of the welded rails • Assign appropriate non-destructive testing of the welds • Assess inspection and test reports and identify the factors affecting weld defects and apply acceptance criteria from relevant codes, standards or specifications • Identify the nature and extent of production problems, evaluate and select solutions, and control weld repair and rework • Prepare, review, maintain and archive inspection reports and weld quality records			
		1.4	Correctly develop, gain agreement of and review departmental budgets			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Produce, agree and update effective departmental schedules and plans			
		1.6	Prepare and plan rail welding activities by carrying out all of the following: • Select materials, equipment and consumables based on weld drawings and application standards or contract specifications • Compile and review welding procedures for welded components in accordance with specifications, national and international standards • Interpret and apply standards to the qualification of a welding procedure, recognising the main variables and its range of qualification • Determine the main variables for a particular welder/welding operator qualification and its range of qualification, and initiate and maintain welder qualification tests and records • Select and apply appropriate plant, fixtures, jigs or positioners to improve weldability or productivity • Analyse welding production rates and costs and schedule welding and handling activities to achieve requirements			
		1.7	Ensure that schedules and plans are capable of meeting the required outputs			
		1.8	Lead rail welding activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Lead one of the following activities: • Rail welding using aluminothermic and flash – butt processes • Determine the safe systems of work for track access, mechanical and oxy-fuel gas cutting, aluminothermic and flash-butt welding processes, and NDT for rail welding • Select appropriate procedures for specified rail types and materials • Select appropriate welding and inspection personnel, equipment and consumables to be applied • Select and apply appropriate testing and measurement techniques and apply acceptance criteria to results Or Rail or track component repair using arc welding • Determine the safe systems of work for track access, grinding/gouging, welding processes and NDT for rail repair • Identify and measure in-service defects and direct application of grinding/gouging and NDT for preparation or the surface for repair • Produce a welding procedure qualification, recognising the problems of making repair welds • Select appropriate welding personnel, equipment and consumables to be applied to a specific weld repair procedure • Select and apply appropriate testing and measurement techniques and apply acceptance criteria to results			
		1.10	Accurately complete and save relevant rail welding data and documentation accurately			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Identify and implement effective improvements to processes and procedures			
		1.12	Identify and implement improvements in the delivery unit/inspection department to achieve four of the following: • Reduced production costs • Reduced lead times • Improved quality • Improved equipment/tooling efficiency • Improved staff utilisation • Improved working practices • Improved equipment downtime • Improved equipment utilisation • Improved use of production/inspection technologies • Improved use of information technology • Improved health and safety • Improved visual management systems/documentation • Improved resource planning • Improved staff development and training • Reduction in waste • Reduction in energy usage • Improved environmental impact • Improved customer service • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Ensure rail welding activities are carried out correctly in line with approved company processes and procedures			
		1.14	Lead Quality Assurance and Quality Control activities for rail welding by carrying out all of the following: • Produce and implement effective quality control procedures • Interpret and apply relevant standards (such as ISO 9000, and ISO 3834) to storage, supply, control and traceability of materials and consumables, including calibration of equipment • Recognise the basic factors related to personnel and equipment that influence weld quality, and control them to achieve specified results • Develop surveillance plans and inspection programmes in accordance with application standards or contract specifications, and demonstrate correct use of acceptance standards for in-service defects and weld imperfections • Apply appropriate methods of measurement to the control of welding and allied operations • Control welding quality, residual stresses and distortion through measurement of welding parameters and measurement and control of welding sequence and heat input			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Ensure welded rails complies with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.16	Accurately create and update visual management documentation and systems to support the activities undertaken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Create and maintain management data and information to include the following: • Rail welding work plans/delivery schedules Plus supporting documentation associated with three of the following: • Quality records/defects • Problem history/resolution • Resources/materials requisitions • Budgets • Equipment performance • Equipment maintenance • Equipment downtime/failure • Equipment utilisation • Health and safety • Staff development and training • Department procedures/work instructions • Tests and trials • Regulatory compliance			
		1.18	Evaluate and report on the impact of improvement activities			
		1.19	Produce and maintain a competency skills matrix of team members to effectively manage personnel competence in accordance with requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.20	Complete the relevant documentation to include one from the following: • Job cards • Company-specific recording system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to lead rail welding activities	2.1	Explain the health and safety requirements of the area in which the rail welding activity is to take place, and the responsibilities that these requirements place on them			
		2.2	Explain the information systems that are in use within their organisation, and how to record data to the system			
		2.3	Explain how to obtain and interpret legislative and regulatory documentation			
		2.4	Explain how to obtain and interpret company policies and procedures			
		2.5	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.6	Explain the process to be followed to develop and gain agreement on departmental budgets			
		2.7	Explain the importance of regularly monitoring departmental budgets and the implications for the business if this is not carried out			
		2.8	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.9	Explain the importance of ensuring that teams have the required skills, knowledge, experience and behaviours in order to weld rails to the required standards			
		2.10	Explain how to access training and development programmes once a training need has been identified			
		2.11	Explain the specific health and safety precautions to be applied during the rail welding and their effects on others			
		2.12	Explain how to complete and review risk assessments			
		2.13	Explain the hazards and risks associated with carrying out activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain the methods and practices that should be used to minimise hazards and risks			
		2.15	Explain the importance of ensuring employees wear protective clothing and other appropriate safety equipment during the rail welding			
		2.16	Explain the importance of having access to up to date data and information such as drawings, specifications, manufacturers' manuals and other documents needed in the rail welding process			
		2.17	Explain who to contact if clarification is required on the rail welding tasks to be completed			
		2.18	Explain who should be involved in authorising any changes required to the rail welding activities			
		2.19	Explain the methods used to calculate how long it should take to complete specific work tasks			
		2.20	Explain the procedure for purchasing/obtaining materials and other consumables necessary for the rail welding activities			
		2.21	Explain the health and safety hazards associated with rail welding and fabrication processes, including techniques to minimise them			
		2.22	Explain the classification and properties of rail grades and profiles, including the metallurgy and weldability of cast metals, steels, aluminium alloys and other engineering materials in common use			
		2.23	Explain the development of modern track technology, including standards and abbreviations			
		2.24	Explain the design principles, different types of loading, in-service defects, failure types and the influence of ambient conditions on rail constructions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.25	Explain the principles of quality assurance and quality control as applied to rail welding			
		2.26	Explain the factors affecting welding stress and distortion in welded rail and how these effects can be measured and minimised			
		2.27	Explain the characteristics and application of rail welding and cutting processes, including aluminothermic welding, flash-butt welding, arc welding, mechanical cutting and gas cutting			
		2.28	Explain the operation, maintenance and calibration requirements of the principal components of welding and ancillary equipment			
		2.29	Explain the application of cutting and arc welding processes to rail including repair and maintenance			
		2.30	Explain the development of arc welding procedure specifications for rail welding			
		2.31	Explain the production and use of process manuals			
		2.32	Explain the use of Non Destructive Testing as applied to rail welds and track components			
		2.33	Explain the special requirements and necessary activities in the application of rail welding (such as rail industry documentation, standards and specifications)			
		2.34	Explain the need for, and function of plant, auxiliary equipment, jigs and fixtures from the viewpoint of quality, economics and the environment			
		2.35	Explain the methods of controlling the properties of welded joints, including strength, toughness, hardness, and corrosion resistance			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.36	Explain the purpose and application of surveillance programmes and inspection plans for identification and monitoring of in-service defects and acceptance of welds			
		2.37	Explain the requirements for measurement, control and recording during welding and allied operations			
		2.38	Explain the principles of imperfections and acceptance criteria			
		2.39	Explain the remedial actions necessary for welds that do not meet the acceptance criteria			
		2.40	Explain the economics of welding operations applied to rail fabrication and renewal			
		2.41	Explain the problems of repair welding both for on and off track situations			
		2.42	Explain the quality assurance and control methods that are used			
		2.43	Explain the personnel involved to ensure that the quality of product outcomes are fit for purpose and their responsibilities to ensure this is achieved			
		2.44	Explain the process and procedures to be followed when defective products are identified during and on completion of the rail welding activity			
		2.45	Explain the organisational procedure(s) to be adopted for the safe disposal of all types of waste materials			
		2.46	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.47	Explain how to use “root cause” problem solving analysis using the 5 whys/how technique			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.48	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.49	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.50	Explain how to create, review and modify Standard Operating Procedures (SOP's) and correlate work activities into them			
		2.51	Explain the techniques required to communicate information using visual control systems (such as card systems, colour coding, graphs and charts, team boards)			
		2.52	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 54: Lead Maintenance Activities

Unit reference number:	**A/505/0964**
QCF level:	**4**
Credit value:	**16**
Guided learning hours:	**56**

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead maintenance 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 Engineering 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	Lead maintenance activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Maintain equipment which complies with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.3	Develop, gain agreement and review maintenance budgets			
		1.4	Produce, agree and update maintenance procedures, schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Develop and update maintenance procedures, schedules and plans to include three of the following: • Preventive maintenance (routine inspections and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development)			
		1.6	Produce and maintain a departmental competency skills matrix of team members			
		1.7	Plan, schedule and carry out maintenance activities using two of the following resources: • Complete in-house staff • Combined in-house/contract staff • Complete contract maintenance staff			
		1.8	Ensure that schedules and plans are capable of meeting all relevant outputs required			
		1.9	Lead maintenance activities within the department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Lead a maintenance team by carrying out all the following: • Communicate the maintenance activities to the team • Involve the team in planning how the maintenance activities will be undertaken • Allocate specific maintenance activities to each team member • Motivate the team to present their own ideas on improvements that could be made to the maintenance process and procedures • Encourage the team and/or individuals to take the lead where appropriate			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Lead maintenance activities on two of the following types of equipment: • Mechanical equipment (such as cyclic and rotational devices, gearboxes, drives, linkages) • Production machinery (such as machine tools, presses, transfer mechanisms) • Process equipment (such as furnaces, chemical baths) • Rotating electrical machinery (such as generators, motors) • Stationary electrical equipment (such as transformers, switchgear) • Stationary plant and equipment (such as air receivers, accumulators, tanks, piping) • Emergency standby or alarm/warning systems and equipment • Fluid power equipment (such as pipework, cylinders/actuators, pumps) • Process controller (such as program controller, input/output interfacing, wiring/cabling, monitoring sensors) • Electrical components (such as power supplies, switch gear and distribution panels, control systems) • Environmental systems (such as air conditioning, lighting, fume extraction) • Engines (such as piston, turbine) • Rotating or reciprocating machinery (such as pumps, compressors) • Integrated systems (such mechanical electrical, fluid power, process control)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	...continued • Structural equipment /components (such as aircraft wings, bodies, boat hulls/super structures) • Services (such as water, gas, air, electricity)			
		1.12	Complete and store relevant maintenance data and documentation accurately			
		1.13	Identify and lead on making improvements to maintenance processes and procedures			
		1.14	Identify and implement improvements in the services provided by the maintenance team to include four of the following: • Equipment downtime during maintenance • Equipment performance monitoring systems • Overall equipment effectiveness (OEE) • Maintenance procedures • Operator instructions • Visual management systems/documentation • Resource planning • Costs • Staff development and training • Health and safety • Procurement • Other (to be specified)			
		1.15	Ensure maintenance activities are carried out correctly in line with agreed company processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Create and update visual management documentation and systems to support the activities of the maintenance department			
		1.17	Create and maintain visual management records to include three of the following: • Preventive maintenance (routine inspections, and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) Plus supporting documentation associated with four of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Operator manuals/working instructions • Regulatory compliance			
		1.18	Report and evaluate the impact of maintenance programmes and improvement activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	Complete the relevant maintenance documentation to include one from the following: • Job cards • Permit to work/formal risk assessment and/or sign-on/off procedures • Maintenance log or report • Company-specific documentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to lead maintenance activities	2.1	Explain the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain the information systems that are in use within their organisation, and how to record data to the system			
		2.3	Explain how to obtain and interpret legislative and regulatory documentation			
		2.4	Explain how to obtain and interpret company policies and procedures			
		2.5	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.6	Explain the process to be followed to develop and gain agreement on departmental budgets			
		2.7	Explain the importance of regularly monitoring departmental budgets and the implications for the business if this is not carried out			
		2.8	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.9	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards			
		2.10	Explain how maintenance teams access training and development programmes once a need training need has been identified			
		2.11	Explain the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others			
		2.12	Explain how to complete and review risk assessments			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain hazards associated with carrying out activities (such as handling oils, greases, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise these and reduce any risks			
		2.14	Explain the importance of ensuring employees wear protective clothing and other appropriate safety equipment during maintenance process			
		2.15	Explain the importance of having access to up to date data and information such as drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process			
		2.16	Explain the importance of implementing an effective maintenance strategy to reduce the amount of equipment/component failures/downtime			
		2.17	Explain how to deal with changes requested to the maintenance schedules			
		2.18	Explain who to contact for clarification of the maintenance requirements or problem			
		2.19	Explain who should be involved in authorising any changes required to maintenance activities			
		2.20	Explain the principles of the different types of maintenance programmes such as preventive, corrective and predictive and their benefits			
		2.21	Explain the procedure for purchasing/obtaining replacement parts, materials and other consumables necessary for the maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.22	Explain how to determine the resources that are required to undertake the maintenance activities			
		2.23	Explain the methods and parameters used to calculate how long it should take to complete specific maintenance activities			
		2.24	Explain the company policy on repair/replacement of equipment or components during the maintenance process			
		2.25	Explain the procedures to be adopted for the dismantling/re-assembly of various types of assemblies			
		2.26	Explain the process to determine if products or service supplies are fit for purpose			
		2.27	Explain the basic principles of how the equipment functions, operation sequence, the working purpose of individual units/components and how they interact			
		2.28	Explain the importance of keeping up to date with new technologies, manufacturing processes and systems			
		2.29	Explain the applications of mechanical and electrical measuring and testing equipment			
		2.30	Explain the importance of keeping up to date maintenance documentation and/or reports			
		2.31	Explain the equipment operating and control procedures to be applied during the maintenance activity			
		2.32	Explain the problems associated with the maintenance activity, and how they can be overcome			
		2.33	Explain the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.34	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.35	Explain how to use “root cause” problem solving analysis using the 5 whys/how technique			
		2.36	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.37	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.38	Explain how to create Standard Operating Procedures (SOP's) and correlate work activities into them			
		2.39	Explain the techniques required to communicate information using visual control systems (such as card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.40	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 55: Lead Mechanical Manufacturing or Inspection Activities

Unit reference number: F/505/0965

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead mechanical manufacturing or inspection 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 Engineering 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	Lead mechanical manufacturing or inspection activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the mechanical manufacturing/inspection team by carrying out all the following: • Obtain accurate details of the products to be manufactured/inspected • Review and interpret the product specification and documentation to assess their characteristics and requirements • Clarify any aspects of the product specification or timescales that are unclear • Communicate the manufacturing/inspection activities to be undertaken with the team • Involve the team in planning how the manufacturing/inspection activities will be achieved • Provide clear and accurate instructions to all the relevant people • Secure, monitor and control the use of resources to achieve the most effective results • Confirm and communicate any changes to the product specification and/or timescales required by the customer • Allocate specific jobs/tasks to each team member • Motivate the team to present their own ideas on improvements that could be made to the manufacturing process and procedures • Encourage the team and/or individuals to take the lead where appropriate • Deal efficiently and effectively with problems affecting production/inspection output • Produce and agree contingency plans when required			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Develop, gain agreement and review manufacturing/inspection departmental budgets			
		1.4	Obtain operational information from three of the following: • Design office • Industrial engineering • Quality engineering • Process engineering • Production engineering • Company information systems • Customer • Sales department • Component/product manufacturers • Material/component supplier • Other (to be specified)			
		1.5	Produce, agree and update departmental production/inspection schedules and plans			
		1.6	Ensure that schedules and plans are capable of meeting all relevant outputs required			
		1.7	Lead mechanical manufacturing/inspection activities within the department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Lead mechanical manufacturing/inspection activities for one of the following processes: • Machining • Assembly • Welding • Fabrication • Toolmaking • Product overhaul, test and repair • Metal production • Composite manufacture • Woodworking, pattern or modelmaking • Materials processing and finishing • Inspection or testing of products/components • Other product/component manufacturing/processing operations			
		1.9	Complete and save relevant production/inspection data and documentation accurately			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Create and maintain management data and information to include the following: • Production/inspection plans/delivery schedules Plus supporting documentation associated with three of the following • Quality records/defects • Problem history/resolution • Resources/materials requisitions • Budgets • Equipment performance • Equipment maintenance • Equipment downtime/failure • Equipment utilisation • Health and safety • Staff development and training • Department procedures/work instructions • Tests and trials • Regulatory compliance			
		1.11	Identify and lead on making improvements to processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Identify and implement improvements in the manufacturing/inspection department to achieve four of the following: • Reduced production costs • Reduced lead times • Improved quality • Improved equipment/tooling efficiency • Improved staff utilisation • Improved working practices • Improved equipment downtime • Improved equipment utilisation • Improved use of production/inspection technologies • Improved use of information technology • Improved health and safety • Improved visual management systems/documentation • Improved resource planning • Improved staff development and training • Reduction in waste • Reduction in energy usage • Improved environmental impact • Improved customer service • Other (to be specified)			
		1.13	Ensure manufacturing/inspection activities are carried out correctly in line with agreed company processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Ensure manufactured products comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.15	Create and update visual management documentation and systems to support the activities of the department			
		1.16	Complete the relevant documentation to include one from the following: • Job cards • Company-specific production recording system			
		1.17	Report and evaluate the impact of improvement activities			
		1.18	Produce and maintain departmental competency skills matrix of team members			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to lead mechanical manufacturing or inspection activities	2.1	Explain the health and safety requirements of the area in which the mechanical manufacturing/inspection activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain the information systems that are in use within their organisation, and how to record data to the system			
		2.3	Explain how to obtain and interpret legislative and regulatory documentation			
		2.4	Explain how to obtain and interpret company policies and procedures			
		2.5	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.6	Explain the process to be followed to develop and gain agreement on departmental budgets			
		2.7	Explain the importance of regularly monitoring departmental budgets and the implications for the business if this is not carried out			
		2.8	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.9	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to manufacture or inspect the products/components to the required standards			
		2.10	Explain how to access training and development programmes once a training need has been identified			
		2.11	Explain the specific health and safety precautions to be applied during the manufacturing/inspection process and their effects on others			
		2.12	Explain how to complete and review risk assessments			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain hazards associated with carrying out activities in the department (such as handling oils, greases, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down procedures) and how to minimise these and reduce any risks			
		2.14	Explain the importance of ensuring employees wear protective clothing and other appropriate safety equipment during manufacturing/inspection process			
		2.15	Explain the importance of having access to up to date data and information such as drawings, specifications, manufacturers' manuals and other documents needed in the manufacturing/inspection process			
		2.16	Explain how to interpret drawings, charts, specifications, information, data, reports, manuals and other documents needed to understand the requirements of the manufacturing/inspection activity			
		2.17	Explain how interpret changes to the requirements for the manufacturing/inspection activities			
		2.18	Explain who to contact for clarification of the manufacturing/inspection requirements			
		2.19	Explain who should be involved in authorising any changes required to manufacturing/inspection activities			
		2.20	Explain the operating principles and processes of the manufacturing/inspection equipment used in their area of responsibility			
		2.21	Explain the manufacturing/inspection methods that could be used for different types of processes or activity			
		2.22	Explain the different types of equipment, and how they should be used for various manufacturing/inspection methods			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.23	Explain how to determine the resources that are required for the manufacturing activities			
		2.24	Explain the methods used to calculate how long it should take to complete specific work outputs			
		2.25	Explain the procedure for purchasing/obtaining materials and other consumables necessary for the manufacturing/inspection activities			
		2.26	Explain the company policy on repair/replacement of equipment required to manufacture/inspect products efficiently and effectively			
		2.27	Explain the importance of keeping up to date with new technologies, manufacturing/inspection processes and systems			
		2.28	Explain the common problems associated with the manufacturing/inspection activity			
		2.29	Explain the quality criteria that must be used for the different products or process			
		2.30	Explain the quality assurance and control methods that are used in the department			
		2.31	Explain the personnel involved to ensure that the quality of product outcomes are fit for purpose and their responsibilities to ensure this is achieved			
		2.32	Explain the tools and equipment used to ensure the products meet the customers quality requirements			
		2.33	Explain the process and procedures to be followed when defective products are identified both during production/on completion of the manufacturing/inspection process			
		2.34	Explain the organisational procedure(s) to be adopted for the safe disposal of all types of waste materials			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.35	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.36	Explain how to use “root cause” problem solving analysis using the 5 whys/how technique			
		2.37	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.38	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.39	Explain how to create, review and modify Standard Operating Procedures (SOP's) and correlate work activities into them			
		2.40	Explain the techniques required to communicate information using visual control systems (such as, card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.41	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 56: Lead Installation or Commissioning Activities

Unit reference number: J/505/0966

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead installation or commissioning 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 Engineering 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	Lead installation or commissioning activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the installation or commissioning team by carrying out all the following: • Obtain accurate details of the products to be installed or commissioned • Review and interpret the product specification and documentation to assess their characteristics and requirements • Clarify any aspects of the product specification or timescales that are unclear • Communicate the installation or commissioning activities to be undertaken with the team • Involve the team in planning how the installation or commissioning activities will be achieved • Provide clear and accurate instructions to all the relevant people • Secure, monitor and control the use of resources to achieve the most effective results • Confirm and communicate any changes to the product specification and/or timescales required by the customer • Allocate specific jobs/tasks to each team member • Motivate the team to present their own ideas on improvements that could be made to the installation or commissioning processes and procedures • Encourage the team and/or individuals to take the lead where appropriate • Deal efficiently and effectively with problems affecting installation or commissioning activity • Produce and agree contingency plans when required			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	...continued • Ensure that the work area will be accessible, free from obstructions or hazards, and suitably prepared for the installation/commissioning to take place • Ensure that appropriate utilities will be available (such as gas, water, air, electricity) • Obtain clearance to carry out the installation or commissioning activities • Confirm that everyone involved accepts the equipment or components are in a satisfactory condition for handover to take place with the customer • Confirm the handover date with the customer and the precise moment of transfer of responsibility			
		1.3	Develop, gain agreement and review installation/commissioning departmental budgets			
		1.4	Produce, agree and update departmental installation/commissioning schedules and plans			
		1.5	Ensure that schedules and plans are capable of meeting all relevant outputs required			
		1.6	Lead installation/commissioning activities within the department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Lead the installation or commissioning activities for one of the following: • Mechanical equipment • Electrical/electronic equipment • Equipment to produce an engineered system • Instrumentation and control equipment • Fluid power equipment • Fabricated and welded components/assemblies • Process controller equipment • Production lines and equipment • Emergency electrical power generation equipment • Environmental pollution control equipment • Workplace environmental control equipment • Workplace access control equipment • Heating and ventilation equipment • Air conditioning and ventilation equipment • Compressed air equipment • Waste/foul water distribution equipment • Fresh water distribution equipment • Refrigeration equipment • Composite components and assemblies • Lift/escalator components and assemblies			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	...continued • Aircraft components and assemblies • Marine components and assemblies • Automotive components and assemblies • Other equipment/components (to be specified)			
		1.8	Complete and save relevant installation/commissioning data and documentation accurately			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Create and maintain management data and information to include the following: • Installation or commissioning plans/delivery schedules Plus supporting documentation associated with three of the following: • Quality records/defects • Problem history/resolution • Resources/materials requisitions • Budgets • Equipment performance • Equipment maintenance • Equipment downtime/failure • Equipment utilisation • Health and safety • Staff development and training • Department procedures/work instructions • Tests and trials • Regulatory compliance			
		1.10	Identify and lead on making improvements to processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Identify and implement improvements in the installation or commissioning activity to achieve four of the following: • Reduced costs • Reduced lead times • Improved quality • Improved equipment/tooling efficiency • Improved staff utilisation • Improved working practices • Improved equipment downtime • Improved equipment utilisation • Improved use of new installation/commissioning technologies • Improved use of information technology • Improved health and safety • Improved visual management systems/documentation • Improved resource planning • Improved staff development and training • Reduction in waste • Reduction in energy usage • Improved environmental impact • Improved customer service • Other (to be specified)			
		1.12	Ensure installation/commissioning activities are carried out correctly in line with agreed company processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Ensure manufactured products comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.14	Create and update visual management documentation and systems to support the activities of the department			
		1.15	Complete the relevant documentation to include one from the following: • Job cards • Company-specific production recording system			
		1.16	Report and evaluate the impact of improvement activities			
		1.17	Produce and maintain departmental competency skills matrix of team members			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Obtain operational information from three of the following: • Design office • Industrial engineering • Quality engineering • Process engineering • Production engineering • Company information systems • Customer • Sales department • Component/product manufacturers • Material/component supplier • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to lead installation or commissioning activities	2.1	Explain the health and safety requirements of the area in which the installation/commissioning activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain the information systems that are in use within their organisation and how to record data to the system			
		2.3	Explain how to obtain and interpret legislative and regulatory documentation			
		2.4	Explain how to obtain and interpret company policies and procedures			
		2.5	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.6	Explain the process to be followed to develop and gain agreement on departmental budgets			
		2.7	Explain the importance of regularly monitoring departmental budgets and the implications for the business if this is not carried out			
		2.8	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.9	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to install/commission equipment or components to the required standards			
		2.10	Explain how to access training and development programmes once a training need has been identified			
		2.11	Explain the specific health and safety precautions to be applied during the installation or commissioning activity and their effects on others			
		2.12	Explain how to complete and review risk assessments			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain the hazards associated with carrying out installation or commissioning activities in the department (such as handling oils, greases, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down procedures) and how to minimise these and reduce any risks			
		2.14	Explain the importance of ensuring employees wear protective clothing and other appropriate safety equipment during installation or commissioning process			
		2.15	Explain the importance of having access to up to date data and information such as drawings, specifications, manufacturers' manuals and other documents needed in the installation or commissioning process			
		2.16	Explain how to interpret drawings, charts, specifications, information, data, reports, manuals and other documents needed to understand the requirements of the installation or commissioning activity			
		2.17	Explain how interpret changes to the requirements for the installation or commissioning activities			
		2.18	Explain who to contact for clarification of the installation or commissioning requirements			
		2.19	Explain who should be involved in authorising any changes required to installation or commissioning activities			
		2.20	Explain the operating principles and processes of the installed or commissioned equipment or components in their area of responsibility.			
		2.21	Explain the installation or commissioning methods used for different types of equipment or components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.22	Explain the different types of tools and equipment used in the installation or commissioning activity and how they should be used			
		2.23	Explain how to determine the resources that are required for the installation or commissioning activity			
		2.24	Explain the methods used to calculate how long it should take to complete specific work outputs			
		2.25	Explain the procedure for purchasing/obtaining materials and other consumables necessary for the installation or commissioning activities			
		2.26	Explain the company policy on repair/replacement of equipment required to support the installation or commissioning activity efficiently and effectively			
		2.27	Explain the importance of keeping up to date with new technologies and tools and equipment used to install or commission equipment or components			
		2.28	Explain the common problems associated with the installation or commissioning activity			
		2.29	Explain the quality criteria that must be used for the different products or processes			
		2.30	Explain the quality assurance and control methods that are used in the department			
		2.31	Explain the personnel involved to ensure that the quality of equipment or product installations are fit for purpose and their responsibilities to ensure this is achieved			
		2.32	Explain the process and procedures to be followed when defective products are identified both during and on completion of the installation or commissioning process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.33	Explain the organisational procedure(s) to be adopted for the safe disposal of all types of waste materials			
		2.34	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.35	Explain how to use “root cause” problem solving analysis using the 5 whys/how technique			
		2.36	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.37	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.38	Explain how to create, review and modify Standard Operating Procedures (SOP's) and correlate work activities into them			
		2.39	Explain the techniques required to communicate information using visual control systems (such as card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.40	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 57: Lead Electrical/Electronic Product Manufacturing or Testing Activities

Unit reference number: Y/505/0969

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead electrical/electronic product manufacturing or testing 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 Engineering 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	Lead electrical/electronic product manufacturing or testing activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the electrical/electronic manufacturing team by carrying out all the following: • Obtain accurate details of the products to be manufactured/tested • Review and interpret the product specification and documentation to assess their characteristics and requirements • Clarify any aspects of the product specification or timescales that are unclear • Communicate the manufacturing/testing activities to be undertaken with the team • Involve the team in planning how the manufacturing/testing activities will be achieved • Provide clear and accurate instructions to all the relevant people • Secure, monitor and control the use of resources to achieve the most effective results • Confirm and communicate any changes to the product specification and/or timescales required by the customer • Allocate specific jobs/tasks to each team member • Motivate the team to present their own ideas on improvements that could be made to the manufacturing process and procedures • Encourage the team and/or individuals to take the lead where appropriate • Deal efficiently and effectively with problems affecting production output • Produce and agree contingency plans when required			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Develop, gain agreement and review manufacturing/test departmental budgets			
		1.4	Obtain operational information from three of the following: • Design office • Industrial engineering • Quality engineering • Process engineering • Production engineering • Company information systems • Customer • Sales department • Component/product manufacturers • Material/component supplier • Other (to be specified)			
		1.5	Produce, agree and update departmental production/test schedules and plans			
		1.6	Ensure that schedules and plans are capable of meeting all relevant requirements			
		1.7	Lead electrical/electronic manufacturing/test activities within the department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Lead electrical/electronic manufacturing/testing activities for one of the following: • Printed circuit board manufacture • Electronic component manufacture • Semi conductor manufacture • Electronic control unit manufacture • Testing electronic products/components • Transformer and inductor manufacture • Electrical motor and generator manufacture • Electrical control system and equipment manufacture • Instrumentation and control equipment manufacture • Cable forms and loom manufacture • Testing electrical equipment and systems • Other product/component manufacturing/processing operations (to be specified)			
		1.9	Complete and save relevant production/test data and documentation accurately			
		1.10	Identify and lead on making improvements to processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Identify and implement improvements in the manufacturing department to achieve four of the following: • Reduced production costs • Reduced lead times • Improved quality • Improved equipment/tooling efficiency • Improved staff utilisation • Improved working practices • Improved equipment downtime • Improved equipment utilisation • Improved use of production technologies • Improved use of information technology • Improved health and safety • Improved visual management systems/documentation • Improved resource planning • Improved staff development and training • Reduction in waste • Reduction in energy usage • Improved environmental impact • Improved customer service • Other (to be specified)			
		1.12	Ensure manufacturing/test activities are carried out correctly in line with agreed company processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Ensure manufactured products complies with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.14	Create and update visual management documentation and systems to support the activities of the department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Create and maintain management data and information to include the following: • Production or testing planning/delivery schedules Plus supporting documentation associated with three of the following • Quality records/defects • Problem history/resolution • Resources/materials requisitions • Budgets • Equipment performance • Equipment maintenance • Equipment downtime/failure • Equipment utilisation • Health and safety • Staff development and training • Department procedures/work instructions • Tests and trials • Regulatory compliance			
		1.16	Report and evaluate the impact of improvement activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Complete the relevant documentation to include one from the following: • Job cards • Company-specific production recording system			
		1.18	Produce and maintain departmental competency skills matrix of team members			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to lead electrical/electronic product manufacturing or testing activities	2.1	Explain the health and safety requirements of the area in which the electrical/electronic manufacturing/testing activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain the information systems that are in use within their organisation, and how to record data to the system			
		2.3	Explain how to obtain and interpret legislative and regulatory documentation			
		2.4	Explain how to obtain and interpret company policies and procedures			
		2.5	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.6	Explain the process to be followed to develop and gain agreement on departmental budgets			
		2.7	Explain the importance of regularly monitoring departmental budgets and the implications for the business if this is not carried out			
		2.8	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.9	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to manufacture/test the equipment to the required standards			
		2.10	Explain how to access training and development programmes once a training need has been identified			
		2.11	Explain the specific health and safety precautions to be applied during the manufacturing/testing process, and their effects on others			
		2.12	Explain the procedure for completing and reviewing risk assessments			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain the hazards associated with carrying out activities in the department and how to minimise these and reduce any risks			
		2.14	Explain the importance of ensuring employees wear protective clothing and other appropriate safety equipment during manufacturing/testing process			
		2.15	Explain the importance of having access to up to date data and information such as drawings, specifications, manufacturers' manuals and other documents needed in the manufacturing/testing process			
		2.16	Explain how to interpret drawings, charts, specifications, information, data, reports, manuals and other documents needed to understand the requirements of the manufacturing/testing activity			
		2.17	Explain how interpret changes to the requirements for the manufacturing/testing activities			
		2.18	Explain who to contact for clarification of the manufacturing/testing requirements			
		2.19	Explain who should be involved in authorising any changes required to manufacturing/testing activities			
		2.20	Explain the operating principles and processes of the manufacturing/testing equipment used in their area of responsibility.			
		2.21	Explain the manufacturing/testing methods that could be used for different types of processes or activity			
		2.22	Explain the different types of equipment, and how they should be used for various manufacturing/testing methods			
		2.23	Explain how to determine the resources that are required for the manufacturing/testing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.24	Explain the methods used to calculate how long it should take to complete specific work outputs			
		2.25	Explain the procedure for purchasing/obtaining materials and other consumables necessary for the manufacturing/testing activities			
		2.26	Explain the company policy on repair/replacement of equipment required to manufacture/test products efficiently and effectively			
		2.27	Explain the importance of keeping up to date with new technologies, manufacturing/testing processes and systems			
		2.28	Explain the common problems associated with the manufacturing/testing activity			
		2.29	Explain the quality criteria that must be used for the different products or process			
		2.30	Explain the quality assurance and control methods that are used in the department			
		2.31	Explain the personnel involved to ensure that the quality of product outcomes are fit for purpose and their responsibilities to ensure this is achieved			
		2.32	Explain the tools and equipment used to ensure the products meet the customers quality requirements			
		2.33	Explain the process and procedures to be followed when defective products are identified both during production/on completion of the manufacturing/testing process			
		2.34	Explain the organisational procedure(s) to be adopted for the safe disposal of all types of waste materials			
		2.35	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.36	Explain how to use “root cause” problem solving analysis using the 5 whys/how technique			
		2.37	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.38	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.39	Explain how to create, review and modify Standard Operating Procedures (SOP's) and correlate work activities into them			
		2.40	Explain the techniques required to communicate information using visual control systems (such as card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.41	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 58: Carry Out the Testing and Calibration of Instrumentation Control Equipment and Circuits

Unit reference number: L/505/0970

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out the testing and calibration of instrumentation control equipment and circuits. 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 Engineering 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 the testing and calibration of instrumentation control equipment and circuits	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Carry out all of the following during the testing and calibration activities: • Obtain and use the correct issue of company and/or manufacturers' drawings and testing/calibration documentation • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Where appropriate, ensure the insertion of any relevant system trip defeats (such as fire extinguishant, emergency shutdown) • Ensure the safe isolation of instruments (such as process, electrical, hydraulic, pneumatic, mechanical) • Ensure that test equipment used is appropriate for the tests being carried out, is within current calibration dates and is used within its specified range • Provide and maintain safe access and working arrangements for the testing and calibration area • Carry out the testing and calibration activities, using appropriate techniques and procedures • Where applicable, take electrostatic discharge (ESD) precautions when handling sensitive components and circuit boards • Re-connect and return the equipment to service on completion of the testing and calibration activities • Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Lead a team by carrying out all the following: • Communicate the testing/calibration activities to the team • Involve the team in planning how the testing/calibration activities will be undertaken • Allocate specific testing/calibration activities to each team member • Involve the team in identifying improvements that could be made to the testing/calibration process and/or procedures • Encourage the team and/or individuals to take the lead where appropriate			
		1.4	Produce and update relevant testing/calibration schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Review and update procedures and plans to include three the following: • Preventive testing/calibration (routine inspections, and adjustments) • Corrective testing/calibration (activities identified from preventative maintenance activities) • Predictive testing/calibration (analysis of the equipment's condition) • Reactive testing/calibration (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development) Plus supporting documentation associated with two of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Testing/calibration processes • Operator manuals/working instructions • Regulatory compliance			
		1.6	Lead testing/calibration activities within the limits of their personal authority			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Carry out tests and calibration on four of the following types of instrumentation control equipment and circuits: • Pressure (such as absolute, gauge, vacuum) • Flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement) • Level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity) • Temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging) • Weight (such as mechanical systems, load cells/strain gauges, transducers) • Fiscal metering (such as gas, electricity, water, fuel) • Detection and alarm (such as smoke, heat, gas, chemical, water, metal) • Speed measurement (such as mechanical, electrical, stroboscopic) • Emergency shutdown • Speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems, stepper motors, invertors) • Vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors) • Nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter, ionising radiation monitors)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	...continued • Analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density) • Recorders and indicators • Telemetry systems (such as master station, outstation, stand alone systems) • Valves and valve mechanisms (such as control valves, valve actuators and positioners) • Other specific instrumentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Carry out tests and calibration using a range of tools and test equipment, to include six of the following: • Multimeter • Insulation testers • Temperature baths • Signal sources • Standard test gauges • Calibrated weights • Current injection devices • Pressure sources • Comparators • Analogue and digital meters • Digital pressure indicators • Dead weight tester • Logic probes • Calibrated flow meters • Special purpose test equipment • Workshop potentiometers			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Carry out all of the following during the testing/calibrating activities: • Obtaining calibration parameters from data records • Installing alarm defeat keys or program overrides (where appropriate) • Connecting up supplies, test and calibration equipment • Carrying out the tests and calibration to manufacturers' procedures • Setting, adjusting and calibrating the equipment and control circuit to the required specification parameters • Recording the test and calibration results in the appropriate formats/documentation • Dealing with instruments and control circuits that do not meet specification requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Carry out six of the following tests and calibrations: • Visual inspection of the instrument for completeness and freedom from damage or foreign objects • Standard serviceability test/calibration • Equipment self-diagnostics • Leak/pressure test • Signal injection tests • Soak test • Special-to-type tests • Signal measurement and transmission • Operational/function checks • Five point calibration • Unit substitution			
		1.11	Test and calibrate instrumentation control equipment and circuits, in compliance with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.12	Carry out the testing/calibration activities in the specified sequence and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Report any instances where the testing/calibration activities cannot be fully met or where there are identified defects outside the planned schedule			
		1.14	Complete relevant testing/calibration documentation accurately			
		1.15	Complete the relevant testing/calibration documentation to include one from the following: • Job cards • Testing/calibration log or report • Company-specific recording system			
		1.16	Dispose of waste materials in accordance with safe working practices and approved procedures			
		1.17	Identify and lead on making improvements to testing/calibration processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Identify and implement improvements in the services provided by the team to include two of the following: • Equipment downtime during testing and calibration • Equipment performance monitoring systems • Overall equipment effectiveness (OEE) • Testing and calibration procedures • Testing/calibration processes • Operator instructions • Visual management systems/documentation • Resource planning • Costs • Staff development and training • Health and safety • Procurement • Other (to be specified)			
		1.19	Update management information and systems to support the activities of the department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to carry out the testing and calibration of instrumentation control equipment and circuits	2.1	Explain the health and safety requirements of the area in which the testing/calibration activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.3	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.4	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to test and calibrate equipment to the required standards			
		2.5	Explain how to complete a skills audit of team members			
		2.6	Explain how teams can access the appropriate training and development programmes once a need training need has been identified			
		2.7	Explain the isolation and lock-off procedure or permit-to-work procedure that applies to the system and instruments being worked on, and how to check that any stored energy in pipework and instruments has been released			
		2.8	Explain the specific safety precautions to be taken when carrying out instrument and circuit testing and calibration activities			
		2.9	Explain hazards associated with carrying out testing and calibrating activities on instrumentation and control systems (such as stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down testing and calibration procedures) and how to minimise them and reduce any risks			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain the importance of wearing protective clothing and other appropriate safety equipment, during the testing and calibrating activities			
		2.11	Explain how the testing and calibrating activities may affect the work of others and the procedure for informing them of the work to be carried out			
		2.12	Explain the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD)			
		2.13	Explain how to obtain and interpret circuit drawings, calibration data, instrument specifications, manufacturers' manuals, history/maintenance reports, symbols used on instrumentation and control documents, and other documents needed in the testing and calibration process			
		2.14	Explain the basic principles of operation of the instrumentation and control equipment being tested/calibrated, how the system functions, its operating sequence, the working purpose of individual units/components and how they interact			
		2.15	Explain the reasons for making sure that control systems are isolated or put into manual control, and appropriate trip locks or keys are inserted, before removing any sensors or instruments from the system			
		2.16	Explain the identification of instrument sensors (including how to identify their markings, calibration information, component values, operating parameters and working range)			
		2.17	Explain methods of checking and calibrating instruments, and the type and range of equipment that can be used			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Explain how to set up and apply the appropriate test and calibration equipment (such as pressure testing in incremental stages)			
		2.19	Explain how to check that the test and calibration equipment is free from damage or defects, is in a safe and usable condition, and is configured correctly for the intended purpose			
		2.20	Explain how to analyse the test and calibration results, and how to use comparison and sequential techniques			
		2.21	Explain the environmental control requirements and company operating procedures relating to the testing and calibrating activities			
		2.22	Explain the documentation required, and the procedures to be followed, at the conclusion of the testing and calibrating			
		2.23	Explain the documentation required, and the procedures to be followed, at the conclusion of the testing and calibrating			
		2.24	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.25	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.26	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.27	Explain how to create or update Standard Operating Procedures (SOP's), testing and calibration schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.28	Explain the techniques required to communicate information using visual control systems (such as card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.29	Explain the extent of their own authority and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 59: Carry Out Maintenance Activities on Mechanical Equipment

Unit reference number: R/505/0971

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on mechanical equipment. 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 Engineering 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 maintenance activities on mechanical equipment	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Carry out all of the following during the maintenance activity: • Obtain and use the correct issue of company and/or manufacturer's drawings and maintenance documentation • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids) • Provide and maintain safe access and working arrangements for the maintenance area • Carry out the maintenance activities using appropriate techniques and procedures • Re-connect and return the system to service on completion of activities • Dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Lead a maintenance team by carrying out all the following: • Communicate the maintenance activities to the team • Involve the team in planning how the maintenance activities will be undertaken • Allocate specific maintenance activities to each team member • Involve the team in identifying improvements that could be made to the maintenance process and/or procedures • Encourage the team and/or individuals to take the lead where appropriate			
		1.4	Produce and update relevant maintenance schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Review and update maintenance procedures and plans to include three the following: • Preventive maintenance (routine inspections, and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development) Plus supporting documentation associated with two of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Operator manuals/working instructions • Regulatory compliance			
		1.6	Lead maintenance activities within the limits of their personal authority			
		1.7	Carry out the maintenance activities in the specified sequence and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Collect evidence regarding the fault from three of the following sources: • Person or operator who reported the fault • Sensory input (such as sight, sound, smell, touch) • Monitoring equipment or gauges • Plant/machinery records • Recording devices • Condition of end product			
		1.9	Use a range of fault diagnostic techniques, to include two of the following: • Half-split technique • Emergent sequence • Unit substitution • Input/output • Function/performance testing • Six point technique • Injection and sampling • Equipment self diagnostics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Use a variety of diagnostic aids and equipment, to include two of the following: • Manufacturer's manual • Physical layout diagrams • Algorithms • Flow charts • Probability charts/reports • Fault analysis charts (such as fault trees) • Equipment self diagnostics • Trouble shooting guides			
		1.11	Apply two of the following monitoring or testing procedures to help in the fault diagnosis: • Alignment checks • Force/pressure checks (such as spring pressure, hydraulic or pneumatic pressures) • Leakage • Vibration • Thermal checks (such as bearings, friction surfaces) • Movement checks (such as travel, clearance, levers, links)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Use two of the following types of test equipment to aid fault diagnosis: • Measuring instruments/devices • Thermal indicators • Dial test indicators • Audio test devices • Torque measuring devices • Self-diagnostic equipment • Other specific test equipment			
		1.13	Find faults that have resulted in two of the following breakdown categories: • Intermittent problem • Partial failure/out-of-specification output • Complete breakdowns			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Carry out maintenance activities on three of the following types of equipment: • Gearboxes • Machine tools • Lifting and handling equipment • Processing plant • Production plant • Engines • Pumps • Process control valves • Compressors • Transfer equipment • Mechanical structures • Workholding devices • Company-specific equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out six of the following maintenance techniques, as applicable to the equipment being maintained: • Dismantling equipment to unit/sub-assembly level • Dismantling units to component level • Proof marking/labelling of components • Checking components for serviceability • Replacing all lifed items (such as seals, bearings, gaskets) • Replacing damaged/defective components • Setting, aligning and adjusting replaced components • Tightening fastenings to the required torque • Making 'off-load' checks before starting up • Replenishing oils and greases • Safety system checks • Functionally testing the completed system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Replace/refit a range of mechanical components, to include ten of the following: • Shafts • Couplings • Gears • Clutches • Valves and seats • Pistons • Splined components • Brakes • Bearing and seals • Fitting keys • Springs • Diaphragms • Cams and followers • Chains & sprockets • Pulleys and belts • Levers and links • Slides • Rollers • Tooling • Fluid storage units • Fabricated components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	...continued • Wire ropes/cables • Housings • Actuating mechanisms • Structural/operational components • Locking & retaining devices (such as circlips, pins, lock nuts) • Covers and casings • Integrated modules • Other specific components			
		1.17	Maintain mechanical equipment which complies with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.18	Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule			
		1.19	Complete relevant maintenance documentation accurately			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.20	Complete the relevant maintenance documentation to include one from the following: • Job cards • Permit to work/formal risk assessment and/or sign-on/off procedures • Maintenance log or report • Company-specific recording system			
		1.21	Dispose of waste materials in accordance with safe working practices and approved procedures			
		1.22	Identify and lead on making improvements to maintenance processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.23	Identify and implement improvements in the services provided by the maintenance team to include two of the following: • Equipment downtime during maintenance • Equipment performance monitoring systems • Overall equipment effectiveness (OEE) • Maintenance procedures • Operator instructions • Visual management systems/documentation • Resource planning • Costs • Staff development and training • Health and safety • Procurement • Other (to be specified)			
		1.24	Update management information and systems to support the activities of the maintenance department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to carry out maintenance activities on mechanical equipment	2.1	Explain the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.3	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.4	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards			
		2.5	Explain how to complete a skills audit of team members			
		2.6	Explain how maintenance teams can access the appropriate training and development programmes once a need training need has been identified			
		2.7	Explain the isolation and lock-off procedures or permit-to-work procedure that applies			
		2.8	Explain the specific health and safety precautions to be applied during the maintenance procedure and their effects on others			
		2.9	Explain the hazards associated with carrying out mechanical maintenance activities (such as handling oils, greases, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise these and reduce any risks			
		2.10	Explain the importance of wearing protective clothing and other appropriate safety equipment during maintenance process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process			
		2.12	Explain the procedure to be adopted to establish the background of the fault			
		2.13	Explain how to evaluate various types of information available for fault diagnosis (such as operator reports, monitoring equipment, sensory information, machinery history records and condition of end product)			
		2.14	Explain the various fault finding techniques that can be used, and how they are applied (such as half-split, input/output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques, and equipment self diagnostics)			
		2.15	Explain how to use a range of fault diagnostic equipment to investigate the problem (such as measuring devices, torque and run-out devices)			
		2.16	Explain how to use various items of test equipment, and how to calibrate it and check that it is free from damage and defects			
		2.17	Explain how to evaluate sensory information (sight, sound, smell, touch)			
		2.18	Explain the procedure(s) to be followed for investigating the faults, and how to deal with intermittent faults			
		2.19	Explain how to analyse and evaluate possible characteristics and causes of specific faults/problems			
		2.20	Explain how to relate previous reports/records of similar fault conditions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Explain how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on health and safety, and on the overall process or system			
		2.22	Explain the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities			
		2.23	Explain the company policy on repair/replacement of components during the maintenance process			
		2.24	Explain the sequence to be adopted for the dismantling/re-assembly of various types of assemblies			
		2.25	Explain the methods and techniques used to dismantle/assemble mechanical equipment (such as release of pressures/force, proof marking, extraction, pressing, alignment)			
		2.26	Explain the methods of checking components are fit for purpose, and how to identify defects and wear characteristics			
		2.27	Explain the basic principles of how the equipment functions, operation sequence, the working purpose of individual units/components and how they interact			
		2.28	Explain the identification, application, fitting and removal of different types of bearings (such as roller, ring, thrust)			
		2.29	Explain the methods and techniques of fitting keys and splined components			
		2.30	Explain the identification, application, fitting and removal of different types of gears			
		2.31	Explain how to correctly tension belts and chains			
		2.32	Explain the identification and application of different types of locking devices			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.33	Explain the methods of checking that removed components are fit for purpose, and the need to replace `lifed' items (such as seals, gaskets, belts)			
		2.34	Explain the uses of measuring equipment (such as micrometers, verniers, run-out devices, other measuring devices)			
		2.35	Explain how to make adjustments to components/assemblies to ensure they function correctly (such as setting working clearance, setting travel, setting backlash in gears, preloading bearings)			
		2.36	Explain the importance of making `off-load' checks before running the equipment under power			
		2.37	Explain how to check tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for the intended purpose			
		2.38	Explain the importance of maintenance documentation and/or reports following the maintenance activity, and how to generate them			
		2.39	Explain the equipment operating and control procedures to be applied during the maintenance activity			
		2.40	Explain how to use lifting and handling equipment in the maintenance activity			
		2.41	Explain the problems associated with the maintenance activity, and how they can be overcome			
		2.42	Explain the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials			
		2.43	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.44	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.45	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.46	Explain how to create or update Standard Operating Procedures (SOP's) maintenance schedules and plans			
		2.47	Explain the techniques required to communicate information using visual control systems (such as, card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.48	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 60: Carry Out Maintenance Activities on Electrical Equipment

Unit reference number: Y/505/0972

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on electrical equipment. 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 Engineering 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 maintenance activities on electrical equipment	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Lead a maintenance team by carrying out all the following: • Communicate the maintenance activities to the team • Involve the team in planning how the maintenance activities will be undertaken • Allocate specific maintenance activities to each team member • Involve the team in identifying improvements that could be made to the maintenance process and/or procedures • Encourage the team and/or individuals to take the lead where appropriate			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out all of the following during the maintenance activity: • Obtain and use the correct issue of company and/or manufacturer's drawings and maintenance documentation • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids) • Provide and maintain safe access and working arrangements for the maintenance area • Carry out the maintenance activities using appropriate techniques and procedures • Re-connect and return the system to service on completion of activities • Dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition			
		1.4	Produce and update relevant maintenance schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Review and update maintenance procedures and plans to include three of the following: • Preventive maintenance (routine inspections, and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development) Plus supporting documentation associated with two of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Operator manuals/working instructions • Regulatory compliance			
		1.6	Lead maintenance activities within the limits of their personal authority			
		1.7	Carry out the maintenance activities in the specified sequence and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Collect fault diagnostic evidence from four of the following sources: • The person or operator who reported the fault • Recording devices • Test instrument measurements (such as watt meters, multimeter, earth-loop impedance testers) • Sensory input (sight, sound, smell, touch) • Plant/equipment records • Circuit meters (such as voltmeter, power factor meter, ammeter) • Condition of end product • Equipment self-diagnostics			
		1.9	Use a range of fault diagnostic techniques, to include two of the following: • Half-split technique • Input/output technique • Emergent sequence • Injection and sampling • Unit substitution • Six point technique • Function/performance testing • Equipment self-diagnostics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Use a variety of diagnostic aids and equipment to include two of the following: • Logic diagrams • Equipment self-diagnosis • Trouble shooting guides • Flow charts or algorithms • Fault analysis charts (such as fault trees) • Electronic aids • Manufacturers' manuals			
		1.11	Use all of the following fault diagnosis procedures: • Inspection (such as breakages, wear/deterioration, signs of overheating, missing parts, loose fittings) • Operation (such as manual switching off and on, RCD test buttons, automatic switching/timing/sequencing, desired outputs) • Measurement (such as voltage, current, continuity, power, temperature, luminescence)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Use three of the following types of test equipment to aid fault diagnosis: • Multimeter • Watt meter • Voltmeter • Ammeter • Earth-loop impedance tester • Insulation resistance tester • Portable appliance tester • Light meter • Other specific test equipment			
		1.13	Find faults that have resulted in two of the following breakdown categories: • Intermittent problem • Partial failure/out-of-specification output • Complete breakdowns			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Carry out maintenance activities on six of the following types of electrical equipment: • Single-phase power supplies • Control systems and components • Three-phase power supplies • Electrical plant • Direct current power supplies • Wiring enclosures • Motors and starters • Luminaires • Switchgear and distribution panels • Other specific electrical equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out eight of the following maintenance activities as applicable to the equipment being maintained: • Isolating and locking-off equipment • Removing and replacing damaged wires and cables • Disconnecting and reconnecting wires and cables • Attaching suitable cable identification markers • Removing and replacing wiring enclosures • Removing electrical units/components • Setting and adjusting replaced components • Checking components for serviceability • Making `off-load' checks before powering up • Replacing damaged/defective components • Functionally testing the completed system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Replace/refit a range of electrical components, to include ten of the following groups of components: • Cables and connectors • Capacitors • Lighting fixtures • Contactors • Rectifiers • Batteries • Relay components • Encoders or resolvers • Switches and sensors • Overload protection devices • Inverter and servo controllers • Solenoids • Locking and retaining devices (cable ties, clips, proprietary fasteners) • Circuit boards • Transformers • Thermistors or thermocouples • Other specific components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Maintain electrical equipment which complies with one of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.18	Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule			
		1.19	Complete relevant maintenance documentation accurately			
		1.20	Complete the relevant maintenance documentation to include one from the following: • Job cards • Permit to work/formal risk assessment and/or sign-on/off procedures • Maintenance log or report • Company-specific recording system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.21	Dispose of waste materials in accordance with safe working practices and approved procedures			
		1.22	Identify and lead on making improvements to maintenance processes and procedures			
		1.23	Update management information and systems to support the activities of the maintenance department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to carry out maintenance activities on electrical equipment	2.1	Explain the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.3	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.4	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards			
		2.5	Explain how to complete a skills audit of team members			
		2.6	Explain how maintenance teams can access the appropriate training and development programmes once a need training need has been identified			
		2.7	Explain the isolation and lock-off procedure or permit-to-work procedure that applies to maintenance activities (such as electrical isolation, locking off switchgear, removal of fuses, placing of maintenance warning notices, proving the isolation has been achieved and secured)			
		2.8	Explain how to recognise and deal with victims of electric shock			
		2.9	Explain the hazards associated with carrying out electrical maintenance activities (such as contact with live electrical components, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise these and reduce any risk			
		2.10	Explain the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, wiring regulations, and other documents needed for the maintenance activities			
		2.12	Explain the procedure to be adopted to establish the background of the fault			
		2.13	Explain how to evaluate the various types of information available for fault diagnosis			
		2.14	Explain how to use the various aids and reports available for fault diagnosis			
		2.15	Explain how to use various items of fault diagnostic equipment to investigate the problem			
		2.16	Explain the various fault finding techniques that can be used, and how they are applied (such as half-split, input-to-output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques and equipment self-diagnostics)			
		2.17	Explain how to evaluate sensory information (sight, sound, smell, touch)			
		2.18	Explain how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems			
		2.19	Explain how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on health and safety, and on the overall process or system			
		2.20	Explain how to relate previous reports/records of similar fault conditions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Explain the care, handling and application of electrical test instruments (such as multimeters, insulation resistance testers)			
		2.22	Explain how to calibrate electrical test instruments and check that they are free from damage and defects			
		2.23	Explain the purpose of the components which have been replaced/maintained			
		2.24	Explain the different types of cabling and their application (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables)			
		2.25	Explain the application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units)			
		2.26	Explain the different types of wiring enclosures that are used (to include conduit, trunking and traywork systems)			
		2.27	Explain the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments			
		2.28	Explain the company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities			
		2.29	Explain how to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range, frequency)			
		2.30	Explain the techniques used to dismantle/assemble electrical equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.31	Explain the methods of removing and replacing cables and wires in wiring enclosures without causing damage to existing cables			
		2.32	Explain the use of wiring regulations, and other, regulations when selecting wires and cables and when carrying out tests on systems			
		2.33	Explain the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly			
		2.34	Explain the tools and equipment used in the maintenance activities (including the use of cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools)			
		2.35	Explain the methods of checking that components are fit for purpose, and the need to replace `lifed' items (such as motor brushes, seals and gaskets overload protection devices)			
		2.36	Explain how to make adjustments to components/assemblies to ensure they function correctly			
		2.37	Explain how to check tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for the intended purpose			
		2.38	Explain the importance of making `off-load' checks before proving the equipment with the electrical supply on			
		2.39	Explain the generation of maintenance documentation and/or reports following the maintenance activity			
		2.40	Explain the equipment operating and control procedures to be applied during the maintenance activity			
		2.41	Explain how to use appropriate lifting and handling equipment in the maintenance activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.42	Explain the problems that can occur during the electrical maintenance activity, and how they can be overcome			
		2.43	Explain the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials			
		2.44	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.45	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.46	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.47	Explain how to create or update Standard Operating Procedures (SOP's) maintenance schedules and plans			
		2.48	Explain the techniques required to communicate information using visual control systems (such as, card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.49	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 61: Carry Out Maintenance Activities on Fluid Power Equipment

Unit reference number: D/505/0973

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on fluid power equipment. 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 Engineering 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 maintenance activities on fluid power equipment	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Lead a maintenance team by carrying out all the following: • Communicate the maintenance activities to the team • Involve the team in planning how the maintenance activities will be undertaken • Allocate specific maintenance activities to each team member • Involve the team in identifying improvements that could be made to the maintenance process and/or procedures • Encourage the team and/or individuals to take the lead where appropriate			
		1.3	Produce and update relevant maintenance schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Review and update maintenance procedures and plans to include three the following: • Preventive maintenance (routine inspections, and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development) Plus supporting documentation associated with two of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Operator manuals/working instructions • Regulatory compliance			
		1.5	Lead maintenance activities within the limits of their personal authority			
		1.6	Carry out the maintenance activities in the specified sequence and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Collect fault diagnosis evidence from three of the following sources: • The person or operator who reported the fault • Sensory input (such as sight, sound, smell, touch) • test instrument/rig measurements (such as pressure, flow, sequence) • Plant/machinery records • Monitoring equipment or gauges • Condition of the end product • Recording devices			
		1.8	Use a range of fault diagnostic techniques, to include two of the following: • Half-split technique • Input/output • Emergent sequence • Injection and sampling • Unit substitution • Six point technique • Functional/performance testing • Equipment self-diagnostics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Use a variety of diagnostic aids and equipment, to include two of the following: • Manufacturer's manual • Physical layout diagrams • Algorithms • Flow charts • Probability charts/reports • Fault analysis charts (such as fault trees) • Equipment self-diagnostics • Troubleshooting guides • Sequence charts • Function diagrams			
		1.10	Use all of the following diagnostic procedures: • Inspection (for leaks, loose fittings, breakages, wear/deterioration, damage to pipes/hoses, alignment) • Operation (such as manual operation, timing, sequencing) • Measurement (such as pressure, flow, timing, sequence, movement)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Use two of the following types of test equipment to aid fault diagnosis: • Measuring devices/meters • Flow indicators • Pressure indicators • Thermal indicators • Test rigs • Self-diagnostic equipment • Contamination monitoring and analysing devices			
		1.12	Find faults that have resulted in two of the following breakdown categories: • Intermittent problem • Partial failure/out-of-specification output • Complete breakdowns			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Carry out all of the following during the maintenance activity: • Obtain and use the correct issue of company and/or manufacturer's drawings and maintenance documentation • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids) • Provide and maintain safe access and working arrangements for the maintenance area • Carry out the maintenance activities using appropriate techniques and procedures • Re-connect and return the system to service on completion of activities • Dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition			
		1.14	Carry out maintenance activities on two of the following types of fluid power equipment: • Pneumatic • Hydraulic • Vacuum			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out all of the following maintenance activities, as applicable to the equipment being maintained: • Chocking/supporting actuators/rams/component • Releasing stored pressure • Draining, removing and replacing oil/fluids (as applicable) • Replacing damaged/defective components • Removing and replacing units/components (such as pumps, valves, actuators) • Disconnecting/removing hoses, pipes and tubing • Replacing all `lifed' items (such as seals, filters, gaskets, hoses) • Proof marking/labelling of removed components • Checking components for serviceability • Tightening fastenings to the required torque • Setting, aligning and adjusting replaced components • Making `off-load' checks before re-pressurising the system • Functional/performance testing of the maintained system • Priming and bleeding the system (where applicable)			
		1.16	Carry out maintenance activities to component level on all of the following fluid power components: • Pumps • Valves • Cylinders • Actuators			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Replace/refit a range of fluid power components, to include ten of the following: • Pumps • Motors • Compressors • Sensors • Pistons • Bearings • Receivers • Lubricators/filters • Spools • Reservoirs • Gaskets and seals • Regulators • Valves • Accumulators • Pipework, hoses/tubing • Valve solenoid • Actuators/cylinders • Pressure intensifiers • Switches • Other specific components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Maintain equipment which complies with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.19	Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule			
		1.20	Complete relevant maintenance documentation accurately			
		1.21	Complete the relevant maintenance documentation to include one from the following: • Job cards • Permit to work/formal risk assessment and/or sign-on/off procedures • Maintenance log or report • Company-specific recording system			
		1.22	Dispose of waste materials in accordance with safe working practices and approved procedures			
		1.23	Identify and lead on making improvements to maintenance processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.24	Identify and implement improvements in the services provided by the maintenance team to include two of the following: • Equipment downtime during maintenance • Equipment performance monitoring systems • Overall equipment effectiveness (OEE) • Maintenance procedures • Operator instructions • Visual management systems/documentation • Resource planning • Costs • Staff development and training • Health and safety • Procurement • Other (to be specified)			
		1.25	Update management information and systems to support the activities of the maintenance department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to carry out maintenance activities on fluid power equipment	2.1	Explain the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.3	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.4	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards			
		2.5	Explain how to complete a skills audit of team members			
		2.6	Explain how maintenance teams can access the appropriate training and development programmes once a need training need has been identified			
		2.7	Explain the isolation and lock-off procedures or permit-to-work procedure that applies			
		2.8	Explain the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others			
		2.9	Explain hazards associated with carrying out mechanical maintenance activities (such as handling oils, greases, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks			
		2.10	Explain the importance of wearing protective clothing and other appropriate safety equipment during maintenance process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process			
		2.12	Explain the various fault finding techniques that can be used, and how they are applied (such as half-split, input/output, emergent problem sequence, six point technique, functional testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)			
		2.13	Explain the procedure to be adopted to establish the background of the fault			
		2.14	Explain how to evaluate the various types of information available for fault diagnosis			
		2.15	Explain how to use the various aids and reports available for fault diagnosis			
		2.16	Explain how to evaluate sensory information from sight, sound, smell, touch			
		2.17	Explain how to use a range of fault diagnostic equipment to investigate the problem (such as measuring devices, pressure and flow testing devices)			
		2.18	Explain the importance of checking that test equipment is within current calibration dates, and the procedure to get the test instruments correctly calibrated			
		2.19	Explain how to use the test equipment, and how to connect it into the circuit at the appropriate points			
		2.20	Explain how to relate previous reports/records of similar fault conditions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Explain how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on health and safety, and on the overall process or system			
		2.22	Explain the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities			
		2.23	Explain principles and theories associated with fluid power equipment (such as cascading and truth tables, logic/ladder diagrams)			
		2.24	Explain the basic principles of operation of the equipment to be maintained			
		2.25	Explain company policy on repair/replacement of components during maintenance process			
		2.26	Explain how to construct and apply ladder logic, sequential charts/tables or functional diagrams			
		2.27	Explain dry and lubricated systems, and their application			
		2.28	Explain the selection, types and characteristics of fluids for the system			
		2.29	Explain the effects of pressure and flow on the performance of the system			
		2.30	Explain the identification of different compressors (such as screw, piston, rotary, vane)			
		2.31	Explain the identification of different hydraulic pumps and motors (such as piston, gear, vane)			
		2.32	Explain how to determine pressure settings and their effect on the system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.33	Explain the different types of pipework, fittings and manifolds, and their application			
		2.34	Explain the identification, application, function and operation of different types of valves, sensors, actuators, cylinders and pumps			
		2.35	Explain the application and fitting of static and dynamic seals			
		2.36	Explain the recognition of contaminants and the problems they can create, and the effects and likely symptoms of contamination in the system			
		2.37	Explain the techniques used to dismantle/assemble fluid power equipment (release of pressures/force, proof marking, extraction)			
		2.38	Explain the methods of checking that components are fit for purpose			
		2.39	Explain how to make adjustments to components/assemblies to ensure that they function correctly			
		2.40	Explain the identification and working purpose of individual components, and how they interact			
		2.41	Explain how to check that tools and equipment are free from damage or defect, are in a safe and usable condition, and are configured correctly for the intended purpose			
		2.42	Explain the generation of maintenance documentation and/or reports following the maintenance activity			
		2.43	Explain the equipment operating and control procedures to be applied during the maintenance activity			
		2.44	Explain how to use lifting and handling equipment safely and correctly in the maintenance activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.45	Explain the problems associated with the maintenance activity, and how they can be overcome			
		2.46	Explain the procedure to be adopted for the safe disposal of waste of all types of materials			
		2.47	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.48	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.49	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.50	Explain how to create or update Standard Operating Procedures (SOP's) maintenance schedules and plans			
		2.51	Explain the techniques required to communicate information using visual control systems (such as, card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.52	Explain the limit of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 62: Carry Out Maintenance Activities on Instrumentation and Control Equipment

Unit reference number: H/505/0974

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on instrumentation and control equipment. 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 Engineering 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 maintenance activities on instrumentation and control equipment	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Lead a maintenance team by carrying out all the following: • Communicate the maintenance activities to the team • Involve the team in planning how the maintenance activities will be undertaken • Allocate specific maintenance activities to each team member • Involve the team in identifying improvements that could be made to the maintenance process and/or procedures • Encourage the team and/or individuals to take the lead where appropriate			
		1.3	Produce and update relevant maintenance schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Review and update maintenance procedures and plans to include three the following: • Preventive maintenance (routine inspections, and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development) Plus supporting documentation associated with two of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Operator manuals/working instructions • Regulatory compliance			
		1.5	Lead maintenance activities within the limits of their personal authority			
		1.6	Carry out the maintenance activities in the specified sequence and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Collect fault diagnostic evidence from four of the following sources: • The person or operator who reported the fault • Equipment self-diagnosis • Test instrument measurements (such as multimeter, oscilloscope, logic probe, signal tracer, signal generator) • Recording devices • Plant/equipment records • Circuit outputs/computer display (such as pressure, flow, temperature) • Equipment outputs • Sensory input (sight, sound, smell, touch)			
		1.8	Use a range of fault diagnostic techniques, to include two of the following: • Half-split technique • Input/output technique • Injection and sampling • Six point technique • Emergent sequence • Unit substitution • Function/performance testing • Equipment self-diagnostics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Use a variety of diagnostic aids, to include two of the following: • Logic diagrams • Fault analysis charts (such as fault trees) • Flow charts or algorithms • Manufacturers' manuals • Probability charts/reports • Troubleshooting guides • Computer-aided test equipment • Electronic aids			
		1.10	Use all of the following fault diagnostic procedures: • Inspection (such as breakages, wear/deterioration, signs of overheating, loose connections/fittings) • Operation (such as manual switching off and on, automatic switching/timing/sequencing, outputs) • Measurement (such as voltage, current, continuity, logic state, noise, frequency, signal shape, level)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Use four of the following types of test equipment to aid fault diagnosis: • Multimeter • Pressure sources • Oscilloscope • Digital pressure indicators • Signal sources/generator • Standard test gauges • Current injection devices • Special purpose test equipment • Logic probe • Signal tracer • Other specific test equipment			
		1.12	Find faults that have resulted in two of the following breakdown categories: • Intermittent problem • Partial failure/out-of-specification output • Complete breakdowns			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Carry out all of the following during the maintenance activity: • Obtain and use the correct issue of company and/or manufacturer's drawings and maintenance documentation • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids) • Provide and maintain safe access and working arrangements for the maintenance area • Carry out the maintenance activities using appropriate techniques and procedures • Re-connect and return the system to service on completion of activities • Dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Carry out maintenance activities on three of the following types of instrumentation and control equipment: • Pressure (such as absolute, gauge, vacuum) • Flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement) • Level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity) • Temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging) • Weight (such as mechanical systems, load cells/strain gauges, transducers) • Fiscal metering (such as gas, electricity, water, fuel) • Detection and alarm (such as smoke, heat, gas, chemical, water, metal) • Speed measurement (such as mechanical, electrical, stroboscopic) • Emergency shutdown • Speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems, stepper motors, invertors) • Vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors) • Nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter) • Analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	...continued • Recorders and indicators • Telemetry systems (such as master station, outstation, stand alone systems) • Valves and valve mechanisms (such as control valves, valve actuators and positioners) • Other specific instrumentation			
		1.15	Carry out ten of the following maintenance activities, as appropriate to the equipment being maintained: • Disconnecting electrical/pneumatic supply • Replacing mechanical components • Disconnecting signal transmission • Replacing electrical components • Disconnecting process pipework • Replacing complete instruments • Removing instruments from the system • Tightening fastenings to the required torque • Replacing peripherals (such as sensors, actuators, relays, switches) • Replacing `lifed' items (such as seals, gaskets, batteries) • Proof marking/labelling of removed wires or components • Taking electrostatic discharge (ESD) precautions when handling components and circuit boards • Setting, aligning and adjusting replaced instruments			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Use four of the following types of test equipment: • Analogue or digital meters • Oscilloscope • Signal sources/generator • Standard test gauges • Current injection devices • Pressure sources • Logic probes • Digital pressure indicators • Signal tracer • Special purpose test equipment			
		1.17	Return instruments and systems to service, to include carrying out all of the following: • Connecting up process impulse pipework • Connecting up electrical/pneumatic supply • Connecting up signal transmission (such as electrical, electronic, pneumatic, mechanical) • Confirming that signal measurement and transmission are satisfactory • Final re-commissioning of the system and removal of any trip defeats			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Maintain equipment which complies with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.19	Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule			
		1.20	Complete relevant maintenance documentation accurately			
		1.21	Complete the relevant maintenance documentation to include one from the following: • Job cards • Permit to work/formal risk assessment and/or sign-on/off procedures • Maintenance log or report • Company-specific recording system			
		1.22	Dispose of waste materials in accordance with safe working practices and approved procedures			
		1.23	Identify and lead on making improvements to maintenance processes and procedures			
		1.24	Update management information and systems to support the activities of the maintenance department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to carry out maintenance activities on instrumentation and control equipment	2.1	Explain the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.3	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.4	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards			
		2.5	Explain how to complete a skills audit of team members			
		2.6	Explain how maintenance teams can access the appropriate training and development programmes once a need training need has been identified			
		2.7	Explain the isolation and lock-off procedures or permit-to-work procedure that applies			
		2.8	Explain the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others			
		2.9	Explain the hazards associated with carrying out mechanical maintenance activities (such as handling oils, greases, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks			
		2.10	Explain the importance of wearing protective clothing and other appropriate safety equipment during maintenance process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process			
		2.12	Explain the procedure to be adopted to establish the background of the fault			
		2.13	Explain how to evaluate the various types of information available for fault diagnosis			
		2.14	Explain how to use the various aids and reports available for fault diagnosis			
		2.15	Explain how to use various types of fault diagnostic equipment needed to investigate the problem			
		2.16	Explain the various fault finding techniques that can be used (such as half-split, input-to-output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques and equipment self-diagnostics) and how they are applied			
		2.17	Explain how to evaluate sensory conditions (by sight, sound, smell, touch)			
		2.18	Explain how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems			
		2.19	Explain how to relate previous reports/records of similar fault conditions			
		2.20	Explain how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on health and safety, and on the overall process or system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Explain the care, handling and application of instrumentation test instruments (such as multimeters, logic probes, oscilloscopes, signal tracers, signal generators)			
		2.22	Explain how to check that test instruments are within current calibration dates, and that they are free from damage and defects			
		2.23	Explain the precautions to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components			
		2.24	Explain the basic principles of operation of the instrumentation and control equipment being maintained, how the system functions, its operating sequence, the working purpose of individual units/components and how they interact			
		2.25	Explain the reasons for making sure that control systems are isolated or put into manual control, and appropriate trip locks, keys or program overrides are inserted, before removing any sensors or instruments from the system			
		2.26	Explain the identification and selection of instrument sensors (including how to identify their markings, calibration information, component values, operating parameters and working range)			
		2.27	Explain the correct way of fitting instruments to avoid faulty readings (caused by head correction, poor flow past sensor, blockages, incorrect wiring, poor insulation or incorrect materials)			
		2.28	Explain the correct and tidy installation and connection of external wiring and components, to avoid electronic interference or mechanical damage			
		2.29	Explain how to carry out visual checks of the instruments (such as checking for leaks, security of joints and physical damage)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.30	Explain the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process			
		2.31	Explain company policy on the repair/replacement of components during the maintenance process			
		2.32	Explain the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proof marking to aid reassembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)			
		2.33	Explain the methods of attaching identification marks/labels to removed components or cables, to assist with reassembly			
		2.34	Explain the methods of checking that components are fit for purpose, and the need to replace electronic modules, sensors, transmitters, transducers, electronic boards and other failed items			
		2.35	Explain how to check that tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for their intended purpose			
		2.36	Explain the generation of appropriate documentation and/or reports following the maintenance activity			
		2.37	Explain the equipment operating and control procedures to be applied during the maintenance activity			
		2.38	Explain the problems that can occur during the maintenance of the instrumentation and control system, and how they can be overcome			
		2.39	Explain the organisational procedure to be adopted for the safe disposal of waste of all types of material			
		2.40	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.41	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.42	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.43	Explain how to create or update Standard Operating Procedures (SOP's) maintenance schedules and plans			
		2.44	Explain the techniques required to communicate information using visual control systems (such as card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.45	Explain the limit of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 63: Carry Out Maintenance Activities on Mechanical Equipment Within an Engineered System

Unit reference number: K/505/0975

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on mechanical equipment within an engineered 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 Engineering 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 maintenance activities on mechanical equipment within an engineered system	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Lead a maintenance team by carrying out all the following: • Communicate the maintenance activities to the team • Involve the team in planning how the maintenance activities will be undertaken • Allocate specific maintenance activities to each team member • Involve the team in identifying improvements that could be made to the maintenance process and/or procedures • Encourage the team and/or individuals to take the lead where appropriate			
		1.3	Produce and update relevant maintenance schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Review and update maintenance procedures and plans to include three the following: • Preventive maintenance (routine inspections, and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development) Plus supporting documentation associated with two of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Operator manuals/working instructions • Regulatory compliance			
		1.5	Lead maintenance activities within the limits of their personal authority			
		1.6	Carry out the maintenance activities in the specified sequence and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Collect evidence regarding the fault from three of the following sources: • Person or operator who reported the fault • Sensory input (such as sight, sound, smell, touch) • Monitoring equipment or gauges • Plant/machinery records • Recording devices • Condition of end product			
		1.8	Use a range of fault diagnostic techniques, to include two of the following: • Half-split technique • Emergent sequence • Unit substitution • Input/output • Function/performance testing • Six point technique • Injection and sampling • Equipment self diagnostics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Use a variety of diagnostic aids and equipment, to include two of the following: • Manufacturer's manual • Physical layout diagrams • Algorithms • Flow charts • Probability charts/reports • Fault analysis charts (such as fault trees) • Equipment self diagnostics • Trouble shooting guides			
		1.10	Use two of the following types of test equipment to help in the fault diagnosis: • Mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments) • Electrical/electronic measuring instruments (such as multimeters, logic probes) • Fluid power test equipment (such as test rigs, flow meters, pressure gauges)			
		1.11	Find faults that have resulted in two of the following breakdown categories: • Intermittent problem • Partial failure/out-of-specification output • Complete breakdowns			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Carry out all of the following during the maintenance activity as applicable to the equipment being maintained: • Plan and communicate the maintenance activities to cause minimal disruption to normal working • Obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids) • Provide and maintain safe access and working arrangements for the maintenance area • Carry out the maintenance activities using appropriate techniques and procedures • Reconnect and return the system to service on completion of the maintenance activities • Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Use appropriate dismantling and re-assembly techniques to deal with two of the following groups: Fluid power components: • Releasing stored pressure • Chocking/supporting cylinders/rams/components • Disconnecting/removing hoses and pipes • Removing and replacing units/components (such as pumps, valves, actuators) Electrical components: • Isolating the power • Removing/replacing minor electrical components(such as relays, sensing devices, limit switches) • Disconnecting and reconnecting wires/cables • Removing and replacing major electrical components (such as motors, switch/control gear) • Removing and replacing wiring enclosures (such as conduit, trunking, traywork) Process controller components: • De-activating and resetting program controller • Disconnecting/reconnecting wires/cables • Re-loading programs and making minor amendments • Removing and replacing program logic peripherals • Removing and replacing input/output interfacing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Carry out maintenance activities on three of the following types of mechanical equipment: • Gearboxes • Processing plant • Production plant • Mechanical structures • Engines • Machine tools • Pumps • Conveyors/elevators • Lifting and handling equipment • Compressors • Process control valves • Workholding arrangements • Transfer equipment • Other specific equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out all of the following maintenance techniques, as applicable to the equipment being maintained: • Draining and removing fluids • Tightening fastenings to the required torque • Dismantling equipment to unit/sub-assembly level • Making `off-load' checks before powering up • Dismantling units to component level • Replenishing oils and greases • Proofmarking/labelling of components • Functionally testing the complete system • Setting, aligning and adjusting replaced components • Replacing damaged/defective components • Replacing all `lifed' items (such as seals, bearings, gaskets) • Checking components for serviceability			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Replace/refit a range of mechanical components, to include seven of the following: • Shafts • Valves and seats • Cams and followers • Pulleys and belts • Couplings • Brakes • Springs • Slides • Gears • Bearing and seals • Chains and sprockets • Levers and links • Clutches • Fitting keys • Locking and retaining devices (such as circlips, pins)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Ensure that the maintenance activities comply with one of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.18	Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule			
		1.19	Complete relevant maintenance documentation accurately			
		1.20	Complete the relevant paperwork from one of the following, and pass it to the appropriate people: • Job cards • Permits to work/formal risk assessment and/or sign on/off procedures • Maintenance log or report • Company-specific recording system			
		1.21	Dispose of waste materials in accordance with safe working practices and approved procedures			
		1.22	Identify and lead on making improvements to maintenance processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.23	Identify and implement improvements in the services provided by the maintenance team to include two of the following: • Equipment downtime during maintenance • Equipment performance monitoring systems • Overall equipment effectiveness (OEE) • Maintenance procedures • Operator instructions • Visual management systems/documentation • Resource planning • Costs • Staff development and training • Health and safety • Procurement • Other (to be specified)			
		1.24	Update management information and systems to support the activities of the maintenance department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to carry out maintenance activities on mechanical equipment within an engineered system	2.1	Explain the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain how to prioritise their own and the team's workload to ensure that targets are met			
		2.3	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.4	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards			
		2.5	Explain how to complete a skills audit of team members			
		2.6	Explain how maintenance teams can access the appropriate training and development programmes once a need training need has been identified			
		2.7	Explain the isolation and lock-off procedure or permit-to-work procedure that applies to the system			
		2.8	Explain the specific health and safety precautions to be applied during the maintenance activity, and their effects on others			
		2.9	Explain how to recognise and deal with victims of electric shock (to include methods of safely isolating the power source and methods of first aid resuscitation)			
		2.10	Explain the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain the hazards associated with carrying out maintenance activities on an integrated system (such as handling fluids, stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise these and reduce any risks			
		2.12	Explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports and other documents needed for the maintenance activities			
		2.13	Explain the basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact			
		2.14	Explain the various fault finding techniques that can be used, and how they are applied (such as half-split, input/output, emergent problem sequence, six point technique, functional testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)			
		2.15	Explain how to evaluate the various types of information available for fault diagnosis (such as operator reports, monitoring equipment, sensory inputs, machinery history records, and condition of the end product)			
		2.16	Explain how to evaluate sensory information from sight, sound, smell, touch			
		2.17	Explain the procedures to be followed to investigate faults, and how to deal with intermittent conditions			
		2.18	Explain how to use the various aids and reports available for fault diagnosis			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Explain the types of equipment that can be used to aid fault diagnosis (such as mechanical measuring instruments, electrical measuring instruments, test rigs, and pressure and flow devices), and how to check the equipment is calibrated or configured correctly for the intended use, and that it is free from damage and defects			
		2.20	Explain the application of specific fault finding methods and techniques that are best suited to the problem			
		2.21	Explain how to analyse and evaluate possible characteristics and causes of specific faults/problems			
		2.22	Explain how to make use of previous reports/records of similar fault conditions			
		2.23	Explain how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on the overall process			
		2.24	Explain the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance			
		2.25	Explain the company policy on repair/replacement of components during the maintenance activities			
		2.26	Explain the sequence to be adopted for dismantling and reassembling the equipment, to both sub-assembly and individual component level			
		2.27	Explain the methods of removing components that have interference fits (expansion, contraction or pressure)			
		2.28	Explain the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proof marking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.29	Explain the methods of attaching identification marks/labels to removed components or cables, to assist with re-assembly			
		2.30	Explain the methods of checking that components are fit for purpose, and the need to replace `lifed' items (such as seals, gaskets and bearings)			
		2.31	Explain how to make adjustments to components/assemblies, to ensure they function correctly			
		2.32	Explain how to check that tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for the intended purpose			
		2.33	Explain the importance of making `off-load' checks before proving the equipment with the electrical supply on			
		2.34	Explain the generation of maintenance documentation and/or reports on completion of the maintenance activity			
		2.35	Explain the equipment operating and control procedures to be applied during the maintenance activity			
		2.36	Explain how to use lifting and handling equipment safely and correctly in the maintenance activity			
		2.37	Explain the problems that can occur during the maintenance activity, and how they can be overcome			
		2.38	Explain the organisational procedure to be adopted for the safe disposal of waste of all types of material			
		2.39	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.40	Explain how to evaluate improvement ideas in order to select those that are to be pursued			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.41	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.42	Explain how to create or update Standard Operating Procedures (SOP's) maintenance schedules and plans			
		2.43	Explain the techniques required to communicate information using visual control systems (such as card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.44	Explain the extent of their authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 64: Carry Out Maintenance Activities on Electrical Equipment Within an Engineered System

Unit reference number: M/505/0976

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on electrical equipment within an engineered 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 Engineering 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 maintenance activities on electrical equipment within an engineered system	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Lead a maintenance team by carrying out all the following: • Communicate the maintenance activities to the team • Involve the team in planning how the maintenance activities will be undertaken • Allocate specific maintenance activities to each team member • Involve the team in identifying improvements that could be made to the maintenance process and/or procedures • Encourage the team and/or individuals to take the lead where appropriate			
		1.3	Produce and update relevant maintenance schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Review and update maintenance procedures and plans to include three the following: • Preventive maintenance (routine inspections, and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development) Plus supporting documentation associated with two of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Operator manuals/working instructions • Regulatory compliance			
		1.5	Lead maintenance activities within the limits of their personal authority			
		1.6	Carry out the maintenance activities in the specified sequence and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Collect evidence regarding the fault from three of the following sources: • Person or operator who reported the fault • Sensory input (such as sight, sound, smell, touch) • Monitoring equipment or gauges • Plant/machinery records • Recording devices • Condition of end product			
		1.8	Use a range of fault diagnostic techniques, to include two of the following: • Half-split technique • Emergent sequence • Unit substitution • Input/output • Function/performance testing • Six point technique • Injection and sampling • Equipment self diagnostics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Use a variety of diagnostic aids and equipment, to include two of the following: • Manufacturer's manual • Physical layout diagrams • Algorithms • Flow charts • Probability charts/reports • Fault analysis charts (such as fault trees) • Equipment self diagnostics • Trouble shooting guides			
		1.10	Use two of the following types of test equipment to help in the fault diagnosis: • Mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments) • Electrical/electronic measuring instruments (such as multimeters, logic probes) • Fluid power test equipment (such as test rigs, flow meters, pressure gauges)			
		1.11	Find faults that have resulted in two of the following breakdown categories: • Intermittent problem • Partial failure/out-of-specification output • Complete breakdowns			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Carry out all of the following during the maintenance activity as applicable to the equipment being maintained: • Plan and communicate the maintenance activities to cause minimal disruption to normal working • Obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • Ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids) • Provide and maintain safe access and working arrangements for the maintenance area • Carry out the maintenance activities using appropriate techniques and procedures • Reconnect and return the system to service on completion of the maintenance activities • Dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Use appropriate dismantling and re-assembly techniques to deal with two of the following groups: Fluid power components: • Releasing stored pressure • Chocking/supporting cylinders/rams/components • Disconnecting/removing hoses/pipes • Removing and replacing units/components (such as pumps, valves, actuators) Mechanical components: • Draining and replenishing fluids • Removing major mechanical units (such as gearboxes, pumps, workholding/transfer equipment) • Removing and refitting locking and retaining devices • Removing minor mechanical units/sub-assemblies (such as guards, structures) • Proofmarking components to aid reassembly • Setting, aligning and adjusting replaced units Process controller components: • De-activating and resetting program controller • Disconnecting/reconnecting wires/cables • Reloading programs and making minor amendments • Removing and replacing program logic peripherals • Removing and replacing input/output interfacing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Carry out maintenance activities on six of the following types of electrical equipment: • Single-phase power supplies • Control systems and components • Three-phase power supplies • Electrical plant • Direct current power supplies • Wiring enclosures • Motors and starters • Luminaires • Switchgear and distribution panels • Other specific electrical equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out all of the following maintenance activities, as applicable to the equipment being maintained: • Isolating and locking off equipment • Removing and replacing damaged wires/cables • Disconnecting / reconnecting wires and cables • Removing and replacing wiring enclosures • Attaching suitable cable identification markers • Setting and adjusting replaced components • Removing electrical units/components • Making `off-load' checks before powering up • Checking components for serviceability • Functionally testing completed system • Replacing damaged/defective components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Replace/refit a range of electrical components, to include eight of the following: • Cables and connectors • Switches and sensors • Invertors and servo controllers • Contactors • Solenoids • Circuit boards • Relay components • Capacitors • Starters • Lighting fixtures • Transformers • Rectifiers • Batteries • Overload protection devices • Encoders or resolvers • Locking and retaining devices (such as cable ties, clips, proprietary fasteners)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Ensure that maintenance activities comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.18	Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule			
		1.19	Complete relevant maintenance documentation accurately			
		1.20	Complete the relevant paperwork from one of the following, and pass it to the appropriate people: • Job cards • Maintenance log or report • Permits to work/formal risk assessment and/or sign-on/off procedures • Company-specific documentation			
		1.21	Dispose of waste materials in accordance with safe working practices and approved procedures			
		1.22	Identify and lead on making improvements to maintenance processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.23	Identify and implement improvements in the services provided by the maintenance team to include two of the following: • Equipment downtime during maintenance • Equipment performance monitoring systems • Overall equipment effectiveness (OEE) • Maintenance procedures • Operator instructions • Visual management systems/documentation • Resource planning • Costs • Staff development and training • Health and safety • Procurement • Other (to be specified)			
		1.24	Update management information and systems to support the activities of the maintenance department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to carry out maintenance activities on electrical equipment within an engineered system	2.1	Explain the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain how to prioritise their own and their team's workload to ensure that targets are met			
		2.3	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.4	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards			
		2.5	Explain how to complete a skills audit of team members			
		2.6	Explain how maintenance teams can access the appropriate training and development programmes once a need training need has been identified			
		2.7	Explain the isolation and lock-off procedure or permit-to-work procedure that applies to the system			
		2.8	Explain the specific health and safety precautions to be applied during the maintenance activity, and their effects on others			
		2.9	Explain how to recognise and deal with victims of electric shock (to include methods of safely isolating the power source and methods of first aid resuscitation)			
		2.10	Explain the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain the hazards associated with carrying out electrical maintenance activities on an integrated system (such as handling fluids, stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks			
		2.12	Explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, BS7671/IET wiring regulations and other documents needed for the maintenance activities			
		2.13	Explain the basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact			
		2.14	Explain the procedure to be adopted to establish the background of the fault			
		2.15	Explain how to evaluate the various types of information available for fault diagnosis			
		2.16	Explain how to use the various aids and reports available for fault diagnosis			
		2.17	Explain how to use various items of fault diagnostic equipment to investigate the problem			
		2.18	Explain the various fault finding techniques that can be used, and how they are applied (such as half-split, input-to-output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques and equipment self-diagnostics)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Explain how to evaluate sensory information (sight, sound, smell, touch)			
		2.20	Explain how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems			
		2.21	Explain how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on health and safety, and on the overall process or system			
		2.22	Explain how to relate previous reports/records of similar fault conditions			
		2.23	Explain the different types of cabling and their application (such as multi-core cables, single-core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables)			
		2.24	Explain the different types of electric motors and motor starters			
		2.25	Explain the different types of control systems and their various components			
		2.26	Explain the application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units)			
		2.27	Explain the various lighting systems used including tungsten, sodium, mercury vapour, LED, low energy and fluorescent			
		2.28	Explain the different types of wiring enclosures that are used (to include conduit, trunking and traywork systems)			
		2.29	Explain the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments			
		2.30	Explain the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.31	Explain the company policy on repair/replacement of components during the maintenance activities			
		2.32	Explain the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proof marking to aid re-assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)			
		2.33	Explain the methods of removing and replacing cables and wires in wiring enclosures, without causing damage to existing cables			
		2.34	Explain the use of BS7671/IET and other regulations when selecting wires and cables, and when carrying out tests on systems			
		2.35	Explain the methods of attaching identification marks/labels to removed components or cables, to assist with re-assembly			
		2.36	Explain the methods of checking that components are fit for purpose, and the need to replace `lifed' items (such as motor brushes, seals and gaskets, and overload protection devices)			
		2.37	Explain how to make adjustments to components/assemblies to ensure they function correctly			
		2.38	Explain how to check that tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for the intended purpose			
		2.39	Explain the importance of making `off-load' checks before proving the equipment with the electrical supply on			
		2.40	Explain the generation of maintenance documentation and/or reports on completion of the maintenance activity			
		2.41	Explain the equipment operating and control procedures to be applied during the maintenance activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.42	Explain how to use lifting and handling equipment in the maintenance activity			
		2.43	Explain the problems that can occur during the electrical maintenance activity, and how they can be overcome			
		2.44	Explain the organisational procedure to be adopted for the safe disposal of waste of all types of materials			
		2.45	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.46	Explain how to evaluate improvement ideas in order to select those that are to be pursued			
		2.47	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.48	Explain how to create or update Standard Operating Procedures (SOP's) maintenance schedules and plans			
		2.49	Explain the techniques required to communicate information using visual control systems (such as card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.50	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 65: Carry Out Maintenance Activities on Fluid Power Equipment Within an Engineered System

Unit reference number: A/505/0978

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on fluid power equipment within an engineered 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 Engineering 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 maintenance activities on fluid power equipment within an engineered system	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines			
		1.2	Lead a maintenance team by carrying out all the following: • Communicate the maintenance activities to the team • Involve the team in planning how the maintenance activities will be undertaken • Allocate specific maintenance activities to each team member • Involve the team in identifying improvements that could be made to the maintenance process and/or procedures • Encourage the team and/or individuals to take the lead where appropriate			
		1.3	Produce and update relevant maintenance schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Review and update maintenance procedures and plans to include three the following: • Preventive maintenance (routine inspections, and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development) Plus supporting documentation associated with two of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Operator manuals/working instructions • Regulatory compliance			
		1.5	Lead maintenance activities within the limits of their personal authority			
		1.6	Carry out the maintenance activities in the specified sequence and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Collect fault diagnosis evidence from three of the following sources: • The person or operator who reported the fault • Sensory input (such as sight, sound, smell, touch) • Test instrument/rig measurements (such as pressure, flow, sequence) • Plant/machinery records • Monitoring equipment or gauges • Condition of the end product • Recording devices			
		1.8	Use a range of fault diagnostic techniques, to include two of the following: • Half-split technique • Input/output • Emergent sequence • Injection and sampling • Unit substitution • Six point technique • Functional/performance testing • Equipment self-diagnostics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Use a variety of diagnostic aids and equipment, to include two of the following: • Manufacturer's manual • Physical layout diagrams • Algorithms • Flow charts • Probability charts/reports • Fault analysis charts (such as fault trees) • Equipment self-diagnostics • Troubleshooting guides • Sequence charts • Function diagrams			
		1.10	Use all of the following diagnostic procedures: • Inspection (for leaks, loose fittings, breakages, wear/deterioration, damage to pipes/hoses, alignment) • Operation (such as manual operation, timing, sequencing) • Measurement (such as pressure, flow, timing, sequence, movement)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Use two of the following types of test equipment to aid fault diagnosis: • Measuring devices/meters • Flow indicators • Pressure indicators • Thermal indicators • Test rigs • Self-diagnostic equipment • Contamination monitoring and analysing devices			
		1.12	Find faults that have resulted in two of the following breakdown categories: • Intermittent problem • Partial failure/out-of-specification output • Complete breakdowns			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Carry out all of the following during the maintenance activity: • Plan and communicate the maintenance activities to cause minimal disruption to normal working • Obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids) • Provide and maintain safe access and working arrangements for the maintenance area • Carry out the maintenance activities using appropriate techniques and procedures • Reconnect and return the system to service on completion of the maintenance activities • Dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Use appropriate dismantling and re-assembly techniques to deal with two of the following groups: Mechanical components: • Draining and replenishing fluids • Removing major mechanical units (gearboxes, pumps, workholding/transfer equipment) • Removing and refitting locking and retaining devices • Removing minor mechanical units/sub-assemblies(such as guards, structures) • Proofmarking components to aid re-assembly • Setting, aligning and adjusting replaced units Electrical components: • Isolating power supply • Removing / replacing minor electrical components (such as relays, sensing devices, limit switches) • Disconnecting and reconnecting wires/cables • Removing and replacing major electrical components (such as motors, switch/control gear) • Removing and replacing wiring enclosures (such as conduit, trunking, traywork, cable ways)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	...continued Programmable controller components: • De-activating and resetting program controller • Disconnecting/re d connecting wires/cables • Reloading programs and making minor amendments • Removing and replacing programming devices (such as laptop, programmer, PDA) • Removing and replacing input/output interfacing			
		1.15	Carry out maintenance activities on two of the following types of fluid power equipment: • Pneumatic • Hydraulic • Vacuum			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Carry out all of the following maintenance activities, as applicable to the equipment being maintained: • Chocking/supporting actuators/rams/component • Releasing stored pressure • Draining, removing and replacing oil/fluids (as applicable) • Replacing damaged/defective components • Disconnecting/removing hoses, pipes and tubing • Replacing all `lifed' items (such as seals, filters, gaskets, hoses) • Proofmarking/labelling of removed components • Checking components for serviceability • Tightening fastenings to the required torque • Removing and replacing units/components (such as pumps, cylinders, valves, actuators) • Setting, aligning and adjusting replaced components • Making `off-load' checks before re-pressurising system • Priming and bleeding the system (where applicable) • Functional/performance testing of the maintained system			
		1.17	Carry out maintenance activities to component level on one of the following fluid power components: • Pumps • Valves • Motors • Actuators/cylinders			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Replace/refit a range of fluid power components, to include seven of the following: • Pumps • Bearings • Compressors • Sensors • Pistons • Reservoirs • Receivers • Lubricators/filters • Spools • Accumulators • Gaskets and seals • Regulators • Valves • Pressure intensifiers • Pipework and hoses • Switches • Actuators/cylinders • Other specific components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	Ensure that maintenance activities comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.20	Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule			
		1.21	Complete relevant maintenance documentation accurately			
		1.22	Complete the relevant paperwork from one of the following, and pass it to the appropriate people: • Job cards • Maintenance log or report • Permit to work/formal risk assessment and/or sign on/off procedures • Company-specific documentation			
		1.23	Dispose of waste materials in accordance with safe working practices and approved procedures			
		1.24	Identify and lead on making improvements to maintenance processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.25	Identify and implement improvements in the services provided by the maintenance team to include two of the following: • Equipment downtime during maintenance • Equipment performance monitoring systems • Overall equipment effectiveness (OEE) • Maintenance procedures • Operator instructions • Visual management systems/documentation • Resource planning • Costs • Staff development and training • Health and safety • Procurement • Other (to be specified)			
		1.26	Update management information and systems to support the activities of the maintenance department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to carry out maintenance activities on fluid power equipment within an engineered system	2.1	Explain the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them			
		2.2	Explain how to prioritise their own and the team's workload to ensure that targets are met			
		2.3	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.4	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards			
		2.5	Explain how to complete a skills audit of team members			
		2.6	Explain how maintenance teams can access the appropriate training and development programmes once a need training need has been identified			
		2.7	Explain the isolation and lock-off procedure or permit-to-work procedure that applies to the system being worked on			
		2.8	Explain the specific health and safety precautions to be taken during the maintenance activities, and their effects on others			
		2.9	Explain the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities and where to obtain it			
		2.10	Explain the hazards associated with carrying out maintenance activities on an integrated system (such as handling fluids, stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain the regulations and codes of practice that apply to working with fluid power equipment			
		2.12	Explain how to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers' manuals, history/maintenance reports, symbols used in fluid power, and other documents needed for the maintenance activities			
		2.13	Explain the basic principles of operation of the equipment to be maintained			
		2.14	Explain the various fault finding techniques that can be used, and how they are applied (such as half-split, input/output, emergent problem sequence, six point technique, functional testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)			
		2.15	Explain how to evaluate the various types of information available for fault diagnosis (such as operator reports, monitoring equipment, sensory inputs, machinery history records, and condition of the end product)			
		2.16	Explain how to evaluate sensory information from sight, sound, smell, touch			
		2.17	Explain the procedures to be followed to investigate faults, and how to deal with intermittent conditions			
		2.18	Explain how to use the various aids and reports available for fault diagnosis			
		2.19	Explain the types of equipment that can be used to aid fault diagnosis (such as mechanical measuring instruments, electrical measuring instruments, test rigs, and pressure and flow devices), and how to check the equipment is calibrated or configured correctly for the intended use, and that it is free from damage and defects			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Explain the application of specific fault finding methods and techniques that are best suited to the problem			
		2.21	Explain how to analyse and evaluate possible characteristics and causes of specific faults/problems			
		2.22	Explain how to make use of previous reports/records of similar fault conditions			
		2.23	Explain how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on the overall process			
		2.24	Explain the importance of following the correct de-contamination procedures			
		2.25	Explain the principles and theories associated with fluid power equipment (such as cascading and truth tables, logic/ladder diagrams)			
		2.26	Explain how to construct and apply ladder logic, sequential charts/tables or functional diagrams			
		2.27	Explain dry and lubricated systems and their application			
		2.28	Explain the selection, types and characteristics of fluids for the system			
		2.29	Explain the effects of pressure and flow on the performance of the system			
		2.30	Explain the identification of different compressors (such as screw, piston, rotary, vane)			
		2.31	Explain the identification and application of different hydraulic pumps and motors (such as piston, gear, vane)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.32	Explain the effects, and likely symptoms, of contamination in the system			
		2.33	Explain the different types of pipework, fittings and manifolds, and their application			
		2.34	Explain the identification, application, function and operation of different types of valves (such as poppet, spool, piston, disc and slide)			
		2.35	Explain the identification, application function and operation of different types of sensors and actuators (such as rotary, linear, mechanical, electrical)			
		2.36	Explain the identification, application function and operation of different types of actuators/cylinders (such as single acting, double acting, linear and telescopic)			
		2.37	Explain the application and fitting of static and dynamic seals			
		2.38	Explain the company policy on repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities			
		2.39	Explain the sequence to be adopted for the dismantling and reassembling of the equipment, to both sub-assembly and individual component level			
		2.40	Explain the techniques used to dismantle/re-assemble integrated equipment (release of pressures/force, proofmarking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)			
		2.41	Explain the methods of attaching identification marks/labels to removed components or cables, to assist with re-assembly			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.42	Explain the methods of checking that components are fit for purpose, and the need to replace `lifed' items (such as seals, gaskets, filters, pistons, spools and bearings)			
		2.43	Explain how to make adjustments to components/assemblies, to ensure they function correctly			
		2.44	Explain how to check tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for the intended purpose			
		2.45	Explain the importance of making `off-load' checks before applying full pressure			
		2.46	Explain the generation of maintenance documentation and/or reports on completion of the maintenance activity			
		2.47	Explain the manufacturer's equipment operating and control procedures to be applied during the maintenance activity			
		2.48	Explain how to use lifting and handling equipment in the maintenance activity			
		2.49	Explain the problems that can occur during the maintenance activity, and how they can be overcome			
		2.50	Explain the organisational procedure to be adopted for the safe disposal of waste of all types of materials			
		2.51	Explain the organisational procedure to be adopted for the safe disposal of waste of all types of material			
		2.52	Explain how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement			
		2.53	Explain how to evaluate improvement ideas in order to select those that are to be pursued			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.54	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process			
		2.55	Explain how to create or update Standard Operating Procedures (SOP's) maintenance schedules and plans			
		2.56	Explain the techniques required to communicate information using visual control systems (such as, card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)			
		2.57	Explain the extent of their own authority and to whom they should report if they have a problem that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 66: Carry Out Maintenance Activities on Process Controller Equipment Within an Engineered System

Unit reference number: F/505/0979

QCF level: 4

Credit value: 16

Guided learning hours: 56

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on process controller equipment within an engineered 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 Engineering 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 maintenance activities on process controller equipment within an engineered system	1.1	Work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines.			
		1.2	Lead a maintenance team by carrying out all the following: • Communicate the maintenance activities to the team • Involve the team in planning how the maintenance activities will be undertaken • Allocate specific maintenance activities to each team member • Involve the team in identifying improvements that could be made to the maintenance process and/or procedures • Encourage the team and/or individuals to take the lead where appropriate			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out all of the following during the maintenance activities: • Plan and communicate the maintenance activities to cause minimal disruption to normal working • Obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids) • Provide and maintain safe access and working arrangements for the maintenance area • Carry out the maintenance activities using appropriate techniques and procedures • Reconnect and return the system to service on completion of the maintenance activities • Dispose of waste items in safe and environmentally acceptable manner and leave the work area in a safe condition			
		1.4	Produce and update relevant maintenance schedules and plans			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Review and update maintenance procedures and plans to include three the following: • Preventive maintenance (routine inspections and adjustments) • Corrective maintenance (activities identified from preventative maintenance activities) • Predictive maintenance (analysis of the equipment's condition) • Reactive maintenance (unexpected equipment/component failure) • Maintenance prevention (equipment/component design and development) Plus supporting documentation associated with two of the following: • Equipment performance • Equipment downtime/failure • Overall equipment effectiveness (OEE) • Maintenance costs • Health and safety • Staff development and training • Maintenance procedures/instructions • Operator manuals/working instructions • Regulatory compliance			
		1.6	Lead maintenance activities within the limits of their personal authority			
		1.7	Carry out the maintenance activities in the specified sequence and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Carry out fault diagnosis on two of the following types of interactive technologies, to sub-assembly or component level: • Mechanical • Electrical • Fluid power • Process controller			
		1.9	Collect information about the fault from four of the following sources: • The person or operator who reported the fault • Sensory (such as sight, sound, smell, touch) • Monitoring equipment or gauges • Plant or machinery records/history • Recording devices • Condition of the end product			
		1.10	Use a range of fault diagnostic techniques, to include two of the following: • Half-split technique • Emergent problem sequence • Functional/performance testing • Input/output • Six point technique • Injection and sampling • Unit substitution • Equipment self diagnostics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Use a variety of diagnostic aids, to include two of the following: • Manufacturer's manual • Logic diagrams • Algorithms • Flow charts • Probability charts/reports • Fault analysis charts (such as fault trees) • Equipment self diagnostics • Troubleshooting guides • Circuit diagrams/specifications			
		1.12	Use two of the following types of test equipment to help in the fault diagnosis: • Mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments) • Electrical/electronic measuring instruments (such as multimeters, logic probes) • Fluid power test equipment (such as test rigs, flow meters, pressure gauges)			
		1.13	Find faults that have resulted in two of the following breakdown categories: • Intermittent problem • Partial failure or reduced performance/out of specification product • Complete breakdown			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Use appropriate dismantling and re-assembly techniques to deal with two of the following groups: Mechanical components: • Draining and replenishing of fluids • Removing and refitting locking and retaining devices • Removing minor mechanical units/sub-assemblies (such as guards, structures) • Removing major mechanical units (such as gearboxes, pumps, mechanical handling, workholding/transfer equipment) • Proofmarking components to aid reassembly • Setting, aligning and adjusting replaced units Electrical components: • Isolating the power supply using correct lock-off communication procedure • Disconnecting and re-connecting wires/cables • Removing and replacing major electrical components (such as motors, switch/control gear) • Removing and replacing minor electrical components (such as relays, sensing devices, limit switches) • Removing and replacing wiring enclosures (such as conduit, trunking, cable traywork)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	...continued Fluid power components: • Releasing stored pressure • Chocking/supporting cylinders/rams/components • Disconnecting/removing hoses/pipes • Removing and replacing units/components (such as pumps, valves, actuators, cylinders)			
		1.15	Carry out maintenance activities on one of the following types of process controller equipment: • Unitary • Modular • Rack mount			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Carry out seven of the following program maintenance activities on the process controller system: • Select and use appropriate programming devices (such as terminals, handheld programmers and personal computers) • Use ladder logic, statement lists, or system flowcharts • Force contacts on and off • Edit, enter and remove contacts from lines of logic • Alter counter and timer settings • Use `on' and `off-line' programming use • Single-step mode of operation • Carry out on-line monitoring of programs • Programme by computer based authoring (to include sub-routines) • Load, read and save programs • Produce back-ups of completed programs			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Carry out all of the following during the maintenance activities: • Take electrostatic discharge (ESD) precautions when working on or close to sensitive components and circuit boards • Proofmark or label removed wires and components • Inspect and/or test components for serviceability • Use program full-run modes of operation • Change or add circuit boards/modules • Replace power supplies • Replace peripherals (such as sensors, actuators, relays, switches) • Replace process controller units • Replace back-up batteries (as appropriate) • Functionally test the system			
		1.18	Ensure maintenance activities comply with three of the following: • Organisational guidelines and procedures • Equipment manufacturer's operating specification/range • British, European or International standards or directives • Recognised compliance agency/body standards or directives • Health, safety and environmental requirements • Customer standards and requirements			
		1.19	Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule			
		1.20	Complete relevant maintenance documentation accurately			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.21	Complete the relevant paperwork from one of the following and pass it to the appropriate people: • Job cards • Maintenance log or report • Permits to work/formal risk assessment and/or sign on/off procedures • Company-specific documentation			
		1.22	Dispose of waste materials and components in accordance with safe working practices and approved procedures			
		1.23	Identify and lead on making improvements to maintenance processes and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.24	Identify and implement improvements in the services provided by the maintenance team to include two of the following: • Equipment downtime during maintenance • Equipment performance monitoring systems • Overall equipment effectiveness (OEE) • Maintenance procedures • Operator instructions • Visual management systems/documentation • Resource planning • Costs • Staff development and training • Health and safety • Procurement • Other specific improvement			
		1.25	Update management information and systems to support the activities of the maintenance department			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to carry out maintenance activities on process controller equipment within an engineered system	2.1	Explain the health, safety and environmental requirements of the area in which the maintenance activity is to take place and the responsibility these requirements place on them			
		2.2	Explain how to prioritise their own and the team's workload to ensure that targets are met			
		2.3	Explain how to communicate effectively, listen, question, support and coach others to work towards the departmental targets			
		2.4	Explain the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards			
		2.5	Explain how to complete a skills audit of team members			
		2.6	Explain how maintenance teams can access the appropriate training and development programmes once a need training need has been identified			
		2.7	Explain the isolation and lock-off procedure or permit-to-work procedure that applies to the system being worked on			
		2.8	Explain the isolation procedure which is specific to the process controller system being worked on			
		2.9	Explain the specific health and safety precautions that need to be applied during the maintenance activities and their effects on others			
		2.10	Explain how to recognise and deal with victims of electric shock (to include isolating the power source and methods of first aid resuscitation)			
		2.11	Explain the importance of wearing protective clothing (PPE) and other appropriate safety equipment during the maintenance activities and where this can be obtained			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.12	Explain the procedures and precautions to be adopted to eliminate electrostatic discharge hazards			
		2.13	Explain the hazards associated with carrying out maintenance activities on a process controlled integrated system (such as handling fluids, stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise these and reduce any risks			
		2.14	Explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports, symbols used on process controller documents and other documents needed for the maintenance activities			
		2.15	Explain the basic principles of how the system functions, its operation sequence, the working purpose of individual units/components and how they interact			
		2.16	Explain the various fault finding techniques that can be used and how they are applied (such as half-split, input/output, emergent problem sequence, six point technique, functional testing, unit substitution, injection and sampling techniques and equipment self-diagnostics)			
		2.17	Explain how to evaluate the various types of information available for fault diagnosis (such as operator reports, monitoring equipment, sensory inputs, machinery history records and condition of the end product)			
		2.18	Explain how to evaluate sensory information from sight, sound, smell, touch			
		2.19	Explain the procedures to be followed to investigate faults and how to deal with intermittent conditions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Explain how to use the various aids and reports available for fault diagnosis			
		2.21	Explain the types of equipment that can be used to aid fault diagnosis (such as mechanical measuring instruments, electrical measuring instruments, test rigs and pressure and flow devices) and how to check the equipment is calibrated or configured correctly for the intended use and that it is free from damage and defects			
		2.22	Explain the application of specific fault finding methods and techniques that are best suited to the problem			
		2.23	Explain how to analyse and evaluate possible characteristics and causes of specific faults/problems			
		2.24	Explain how to make use of previous reports/records of similar fault conditions			
		2.25	Explain how to evaluate the likely risk of running the equipment with the displayed fault and the effects the fault could have on the overall process			
		2.26	Explain the devices and systems for storing programmes			
		2.27	Explain the procedures to be applied to storage, location and method of backing up programmes			
		2.28	Explain the different types of interface cards and their application			
		2.29	Explain the application of computer-based authoring software for design and development			
		2.30	Explain the numbering system and codes used for identification of inputs and outputs			
		2.31	Explain how to search a programme within the process controller for specific elements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.32	Explain programming techniques and codes used (such as interlocking, timers, counters, sub-routines)			
		2.33	Explain the techniques involved in editing, entering and removing contacts from lines of logic and, where applicable, the procedure to be followed for `on' and `off-line' programming			
		2.34	Explain the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process			
		2.35	Explain the company policy on repair/replacement of components during the maintenance activities			
		2.36	Explain the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proofmarking to aid re-assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)			
		2.37	Explain the methods of attaching identification marks/labels to removed components or cables to assist with re-assembly			
		2.38	Explain the methods of checking that components are fit for purpose and the need to replace items such as batteries, boards and other failed items			
		2.39	Explain how to check that tools and equipment are free from damage or defects, are in a safe and usable condition and are configured correctly for the intended purpose			
		2.40	Explain the importance of making `off-load' checks before proving the equipment with the electrical supply on			
		2.41	Explain the generation of maintenance documentation and/or reports on completion of the maintenance activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.42	Explain the equipment operating and control procedures to be applied during the maintenance activity			
		2.43	Explain how to use lifting and handling equipment in the maintenance activity			
		2.44	Explain the problems that can occur during the maintenance of the process controller system and how they can be overcome			
		2.45	Explain the organisational procedure to be adopted for the safe disposal of waste of all types of materials			
		2.46	Explain the extent of their own authority and to whom they should report if they have a problem they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 67: Build, Support and Manage a Team

Unit reference number: F/600/9682

QCF level: 4

Credit value: 4

Guided learning hours: 20

Unit aim

This unit will enable learners to develop, manage and disband a team through a project cycle.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand the purpose and required attributes of a team and select those that match the team's requirements	1.1	Explain the role of a team in the achievement of a specific project or activity			
		1.2	Identify the attributes needed within the team to achieve its objectives			
		1.3	Analyse the skills and knowledge of potential and current team members against the identified needs			
		1.4	Identify individuals whose attributes most closely match the identified requirements			
2	Be able to induct team members and communicate their roles and responsibilities	2.1	Communicate project aims and objectives to team members			
		2.2	Explain how to introduce team members to each other and discuss each member's role and responsibilities			
3	Understand how to support team development	3.1	Identify the stages of team development			
		3.2	Explain how to resolve conflict between team members			
		3.3	Describe methods of encouraging team members to share knowledge and skills to achieve project objectives			
		3.4	Explain how to encourage open communication, trust and respect between team members			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
4	Be able to manage team performance and understand how to disband a team	4.1	Monitor and review the performance of a team against its purpose			
		4.2	Communicate project developments and to team members and support any change in roles or responsibilities			
		4.3	Communicate team and individual successes to the all team members			
5	Understand how to disband team	5.1	Explain how to prepare team members for project conclusion			
		5.2	Describe how team is disbanded			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 68: Develop, Maintain and Review Personal Networks

Unit reference number: R/600/9587

QCF level: 4

Credit value: 4

Guided learning hours: 25

Unit aim

This unit will help learners to develop, maintain and review networking relationships based on personal contacts.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand the benefits of networking and the need for data privacy	1.1	Evaluate the benefits of networking with individuals and organisations			
		1.2	Identify individuals and organisations that would provide benefits to own organisation and networks			
		1.3	Explain the need for confidentiality with networking contacts			
2	Be able to develop a personal network of contacts	2.1	Develop networks that will provide personal and organisational benefit			
		2.2	Develop guidelines for working with networks in line with organisational procedures			
3	Be able to review networking relationships	3.1	Assess the value own current personal network			
		3.2	Evaluate own experience with existing contacts and use these to inform future actions			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 69: Review Risk Management Processes in Own Area of Responsibility

Unit reference number: L/600/9622

QCF level: 4

Credit value: 3

Guided learning hours: 20

Unit aim

This unit will enable learners to monitor, evaluate and improve risk management processes within their own area of responsibility.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to monitor and evaluate risk management processes within own area of responsibility	1.1	Identify information from own area of responsibility to review the risk management process			
		1.2	Assess the effectiveness of the risk management process			
2	Be able to improve the risk management process	2.1	Implement changes to the risk management process where potential improvements have been identified			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 70: Provide Leadership and Direction for Own Area of Responsibility

Unit reference number: T/600/9601

QCF level: 4

Credit value: 5

Guided learning hours: 30

Unit aim

This unit will help learners to provide leadership and direction for their area of responsibility.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to lead in own area of responsibility	1.1	Identify own strengths and ability to lead in a leadership role			
		1.2	Evaluate strengths within own area of responsibility			
2	Be able to provide direction and set objectives in own area of responsibility	2.1	Outline direction for own area of responsibility			
		2.2	Implement objectives with colleagues that align with those of the organisation			
3	Be able to communicate the direction for own area of responsibility and collect feedback to inform improvement	3.1	Communicate the agreed direction to individuals within own area of responsibility			
		3.2	Collect feedback to inform improvement			
4	Be able to assess own leadership performance	4.1	Assess feedback on own leadership performance			
		4.2	Evaluate own leadership performance			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 71: Ensure Compliance with Legal, Regulatory, Ethical and Social Requirements

Unit reference number: H/600/9609

QCF level: 4

Credit value: 5

Guided learning hours: 25

Unit aim

This unit will help learners to identify and correct failures in compliance with legal, regulatory, ethical and social requirements relating to their own area of responsibility.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to monitor the operational compliance of procedures in meeting legal, regulatory, ethical and social requirements	1.1	Monitor the operational compliance of procedures in meeting legal, regulatory, ethical and social requirements			
2	Be able to identify and make recommendations on areas of non-compliance with procedures for legal, regulatory, ethical and social requirements relating to own area of responsibility	2.1	Identify areas of non-compliance with legal, regulatory, ethical and social procedures			
		2.2	Examine reasons for non-compliance with procedures			
		2.3	Make recommendations for corrections to ensure compliance with procedures			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 72: Implement Change in Own Area of Responsibility

Unit reference number: M/600/9659

QCF level: 4

Credit value: 6

Guided learning hours: 25

Unit aim

This unit will help learners to implement and evaluate a plan for change in their area of responsibility.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand how to implement change in own area of responsibility	1.1	Explain the main models and methods for managing change			
2	Be able to involve and support others through the change process	2.1	Communicate the benefits of and reasons for change and how they relate to business objectives			
		2.2	Implement and agree a plan to support change			
3	Be able to implement and monitor a plan for change in own area of responsibility	3.1	Apply SMART (Specific, Measurable, Achievable, Realistic and Time-bound) objectives with individuals and teams to plan for change			
		3.2	Assess opportunities and barriers to change			
		3.3	Review action plans and activities according to identified opportunities and barriers to change			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 73: Support Individuals to Develop and Take Responsibility for their Performance

Unit reference number: D/600/9690

QCF level: 4

Credit value: 4

Guided learning hours: 20

Unit aim

This unit will enable learners to support individuals in assessing and implementing a development plan. It will also enable learners to monitor an individual's progress and provide feedback.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to agree their performance development needs with an individual	1.1	Explain the standards of performance required for current or future role with an individual			
		1.2	Identify and agree the performance development needs for the individual			
2	Be able to understand how to help an individual create a development plan	2.1	Identify options available to support an individual in meeting desired standards of performance			
		2.2	Explain specific actions needed to achieve objectives			
		2.3	Explain the process for an individual to create a development plan			
3	Be able to support an individual in implementing their development plan	3.1	Describe the opportunities provided for an individual to improve performance			
		3.2	Explain the outcome to an individual for improved performance			
4	Be able to evaluate an individual's progress against a development plan and provide feedback for continual performance improvement	4.1	Monitor and evaluate an individual's progress against their development plan			
		4.2	Implement feedback to make development plan revisions			
		4.3	Explain how to encourage individuals to take responsibility for continuing their performance development			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 74: Know how to Follow Disciplinary Procedures

Unit reference number: H/600/9691

QCF level: 4

Credit value: 4

Guided learning hours: 20

Unit aim

This unit will ensure that learners understand how to follow disciplinary procedures and inform individuals of expected performance.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to understand performance expectations of an organisation	1.1	Explain an organisation's required standards of conduct and performance			
		1.2	Explain an organisation's formal disciplinary procedure			
2	Be able to identify and use communication methods to assess potential cases of misconduct or unsatisfactory performance	2.1	Explain how to identify when an individual's performance falls below organisational standards			
		2.2	Identify communication methods used to gather information on potential cases of misconduct or unsatisfactory performance			
3	Be able to know how to informally with cases of minor misconduct or unsatisfactory performance	3.1	Identify the differences between misconduct, gross misconduct and unsatisfactory performance, and how each should be handled			
		3.2	Evaluate whether a case of misconduct or unsatisfactory performance can be dealt with informally			
		3.3	Assess methods available to improve performance or behaviour			
		3.4	Explain the importance of recording informal disciplinary proceedings			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
4	Be able to follow an organisation's formal disciplinary procedure	4.1	Explain the importance of seeking advice and guidance from specialists prior to taking action			
		4.2	Explain when to follow formal disciplinary procedures			
		4.3	Assess the importance of communicating disciplinary procedures to individuals			
		4.4	Explain how to record and store information throughout the disciplinary process			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 75: Managing Grievance Procedures

Unit reference number:	**K/600/9692**
QCF level:	**4**
Credit value:	**3**
Guided learning hours:	**10**

Unit aim

This unit will ensure that learners can follow grievance procedures in their own organisation.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand how to prevent potential grievances	1.1	Identify situations that are likely to lead to grievances in an organisation			
		1.2	Explain how to prevent potential grievances			
2	Understand an organisation's grievance policy and procedure and deal with concerns raised by individuals informally	2.1	Explain an organisation's grievance policy and procedure			
		2.2	Identify the circumstances where a concern may be dealt with informally			
		2.3	Explain the methods used to deal informally with concerns			
3	Understand how to follow grievance procedures	3.1	Explain how to follow an organisation's written grievance procedure			
		3.2	Explain the importance of communicating grievance procedures			
		3.3	Identify how to seek advice and guidance from specialists or colleagues when dealing with grievances			
		3.4	Explain how to record and store information throughout the grievance process			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 76: Support the Management of Redundancies in Own Area of Responsibility

Unit reference number: M/600/9693

QCF level: 4

Credit value: 3

Guided learning hours: 15

Unit aim

This unit will ensure that learners can manage redundancies, follow organisational procedures, communicate and seek support in own area of responsibility.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand how to follow redundancy policy within own area of responsibility	1.1	Explain own organisation's redundancy policy, processes and any appeals procedures			
		1.2	Identify how to access support from colleagues or specialists when following redundancy processes			
2	Communicate information on redundancies to those affected	2.1	Explain how continuous communication with those affected by the redundancy policy			
		2.2	Explain the form of communication required to inform individuals selected for redundancy			
		2.3	Assess how to maintain the morale of remaining individuals			
3	Understand how to support those affected by redundancies	3.1	Identify where support from colleagues or specialists may be accessed by those affected by redundancies			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 77: Develop Working Relationships with Colleagues and Stakeholders

Unit reference number: K/600/9661

QCF level: 4

Credit value: 4

Guided learning hours: 20

Unit aim

This unit will help learners to develop effective working relationships with colleagues and stakeholders.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Know how to identify stakeholders and their relevance to an organisation	1.1	Identify an organisation's stakeholders			
		1.2	Evaluate the roles, responsibilities, interests and concerns of stakeholders			
		1.3	Assess the importance of identified stakeholders			
2	Understand how to establish working relationships with colleagues and stakeholders	2.1	Clarify how to agree a common sense of purpose with colleagues and stakeholders			
		2.2	Summarise how to create an environment of trust and mutual respect with colleagues and stakeholders			
3	Be able to create an environment of trust and mutual respect with colleagues and stakeholders	3.1	Review and revise the needs and motivations of colleagues and stakeholders			
		3.2	Demonstrate interaction with colleagues and stakeholders that allows respect for the views and actions of others			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 78: Support Learning and Development Within Own Area of Responsibility

Unit reference number: M/600/9676

QCF level: 4

Credit value: 5

Guided learning hours: 25

Unit aim

This unit will help learners to understand the importance of supporting learning and development within their own area of responsibility.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to identify the learning needs of colleagues in own area of responsibility	1.1	Identify gaps between requirements of colleagues' current or future work roles and their existing knowledge, understanding and skills			
		1.2	Prioritise learning needs of colleagues			
		1.3	Produce personal development plans for colleagues in own area of responsibility			
2	Understand how to develop a learning environment in own area of responsibility	2.1	Explain the benefits of continual learning and development.			
		2.2	Explain how learning opportunities can be provided for own area of responsibility			
3	Be able to support colleagues in learning and its application	3.1	Identify information, advice and guidance to support learning			
		3.2	Communicate to colleagues to take responsibility for their own learning			
		3.3	Explain to colleagues how to gain access to learning resources			
		3.4	Support colleagues to practise and reflect on what they have learned			
4	Be able to evaluate learning outcomes and future learning and development of colleagues	4.1	Examine with each colleague, whether the learning activities undertaken have achieved the desired outcomes			
		4.2	Support colleagues when updating their personal development plan			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 79: Address Performance Problems Affecting Team Members

Unit reference number: F/600/9679

QCF level: 4

Credit value: 3

Guided learning hours: 20

Unit aim

This unit will enable learners to identify, discuss, resolve and record team members' performance problems.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand legal requirements, industry regulations, organisational policies and professional codes concerning performance	1.1	Identify legal requirements, industry regulations, organisational policies and professional codes concerning performance			
		1.2	Explain limits of own authority relating to performance problems			
2	Be able to identify performance problems of team members	2.1	Assess team member's performance against performance criteria			
		2.2	Evaluate causes of identified performance problems			
3	Be able to discuss performance problems with team members	3.1	Identify performance problems to the attention of the team member concerned			
		3.2	Explain an organisation's policies for managing performance problems to the team member concerned			
		3.3	Develop a confidential record of discussions with team members about problems affecting their performance			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
4	Be able to set a course of action to deal with identified problems with team members	4.1	Explain and discuss alternative courses of action with the team member concerned			
		4.2	Identify the course of action with the team member concerned			
		4.3	Review and revise confidential records of discussions with team members about problems affecting their performance			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 80: Manage a Tendering Process

Unit reference number: H/600/9738

QCF level: 4

Credit value: 4

Guided learning hours: 20

Unit aim

This unit will enable learners to manage a tendering process, including developing product or service specifications and tender guidelines, evaluating tenders and selecting a supplier to deliver the required products or services.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand tendering processes	1.1	Explain the legal requirements of a tendering process			
		1.2	Explain organisational tendering policies and processes			
		1.3	Explain how to seek specialist support for the tendering process			
2	Be able to draw up a specification for required products or services	2.1	Consult with colleagues to identify and agree requirements for products or services			
		2.2	Draw up a specification that describes the products or services required			
3	Be able to write an invitation to tender document and communicate it to prospective suppliers	3.1	Write an invitation to tender outlining required specifications and organisational tendering processes			
		3.2	Communicate the invitation to tender to prospective suppliers			
4	Understand how to respond fairly to pre-tender queries	4.1	Explain how to respond to pre-tender queries in ways that ensure all prospective suppliers have the same information			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
5	Be able to evaluate received tenders	5.1	Establish criteria with which to evaluate received tenders			
		5.2	Receive, record and open tenders in line with stated tendering process			
		5.3	Seek clarification from prospective suppliers where necessary			
		5.4	Evaluate tenders against established criteria			
6	Be able to select a supplier and provide post-tender feedback	6.1	Offer a contract to the chosen supplier			
		6.2	Inform unsuccessful suppliers of the outcome and provide feedback			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 81: Develop and Implement a Risk Assessment Plan in Own Area of Responsibility

Unit reference number: L/600/9703

QCF level: 4

Credit value: 6

Guided learning hours: 20

Unit aim

This unit will help learners to promote, monitor and review health and safety in their own area of responsibility.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand the legal requirements and personal responsibilities for health and safety within an organisation	1.1	State the legal requirements that apply to own role in relation to health and safety			
		1.2	Consult with specialist advisor(s) on health and safety policy and procedures			
		1.3	Explain an organisation's health and safety responsibilities			
		1.4	Describe health and safety responsibilities in own area of responsibility			
2	Be able to promote the importance of health and safety practices	2.1	Communicate an organisation's written health and safety policy to individuals within own area of responsibility			
		2.2	Allocate sufficient resources to deal with health and safety issues in own area of responsibility			
3	Be able to ensure that hazards and risks are identified and managed in own area of responsibility	3.1	Consult with colleagues on health and safety hazards and risks in own area of responsibility			
		3.2	Assess health and safety hazards and risks in own area of responsibility			
		3.3	Identify hazards and risks that require action to be taken to ensure compliance with legal and organisational requirements			
		3.4	Develop and implement a plan in own area of responsibility			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
4	Be able to monitor and review health and safety performance and policy in own area of responsibility	4.1	Establish procedures that monitor health and safety performance in own area of responsibility			
		4.2	Review the health and safety performance of own area of responsibility			
		4.3	Review the health and safety policy in own area of responsibility			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 82: Manage Physical Resources

Unit reference number:	**K/600/9711**
QCF level:	**4**
Credit value:	**3**
Guided learning hours:	**25**

Unit aim

This unit will enable learners to identify, obtain, manage and review the use of physical resources. The unit will also teach learners about the environmental impact of resource use.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand the importance of sustainability when using physical resources	1.1	Explain the importance of using sustainable resources			
		1.2	Explain the potential impact of resource use on the environment			
		1.3	Explain how to use resources effectively and efficiently			
		1.4	Describe actions one can take to minimise any adverse environmental impact of using physical resources			
2	Be able to identify resource requirements for own area of responsibility	2.1	Consult with colleagues to identify their planned activities and corresponding resource needs			
		2.2	Evaluate past resource use to inform expected future demand			
		2.3	Identify resource requirements for own area of responsibility			
3	Be able to obtain required resources for own area of responsibility	3.1	Submit a business case to procure required resources			
		3.2	Review and agree required resources with relevant individuals			
		3.3	Explain an organisation's processes for procuring agreed resources			
4	Be able to monitor and review the quality and usage of resources in own area of responsibility	4.1	Monitor the quality of resources against required specifications			
		4.2	Identify differences between actual and planned use of resources and take corrective action			
		4.3	Analyse the effectiveness and efficiency of resource use in own area of responsibility			
		4.4	Make recommendations to improve the effectiveness and efficiency of resource use			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 83: Manage the Environmental Impact of Work Activities

Unit reference number: M/600/9712

QCF level: 4

Credit value: 5

Guided learning hours: 10

Unit aim

This unit will enable learners to assess the environmental impact of their work and operate in such a way as to reduce the impact on the environment.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand the legal requirements and environmental policies that impact on own area of responsibility	1.1	Explain the legal requirements that impact on own area of responsibility			
		1.2	Explain the environmental policies that impact on own area of responsibility			
2	Understand how to assess the impact of work activities on the environment and how this can be minimised	2.1	Explain what specialist advice is available to manage the environmental impact of work activities			
		2.2	Explain how to assess the impact of work activities and resources on the environment			
		2.3	Explain how to minimise the environmental impact of work activities			
3	Be able to assess and report on the environmental impact of work activities in own area of responsibility	3.1	Assess the environmental impact of work activities and resource use			
		3.2	Produce a report on the environmental impact of work activities and resource use, with recommendations for improvement			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
4	Be able to organise work activities and resource use to minimise environmental impact	4.1	Adapt the use of resources in own area of responsibility to reduce environmental impact			
		4.2	Organise activities in own area of responsibility to reduce environmental impact			
5	Be able to promote ongoing improvement in environmental performance	5.1	Establish means by which individuals can identify and report opportunities for improving environmental performance			
		5.2	Communicate environmental benefits resulting from changes to work activities			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 84: Prepare for and Support Quality Audits

Unit reference number:	**Y/600/9798**
QCF level:	**4**
Credit value:	**4**
Guided learning hours:	**20**

Unit aim

The unit will help learners understand the quality standards and are able to participate in a quality audit and take corrective action.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Understand the quality standards and procedures that apply to own area of responsibility	1.1	Describe the quality standards and procedures that apply to own area of responsibility			
2	Be able to monitor work in own area of responsibility against quality standards and procedures	2.1	Select and apply methods for monitoring work			
3	Be able to prepare for a quality audit in own area of responsibility	3.1	Prepare and organise records and documentation for the quality auditor			
		3.2	Review previous quality audits and ensure agreed recommendations have been implemented			
4	Be able to discuss quality audit findings with the auditor	4.1	Discuss with the auditor the results of the audit and identify any areas for improvement			
		4.2	Agree corrective actions to remedy any identified issues, and set a date for their implementation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
5	Be able to complete agreed actions following a quality audit	5.1	Take corrective action based on quality audit findings			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 85: Develop and Implement Marketing Plans

Unit reference number: K/600/9790

QCF level: 4

Credit value: 6

Guided learning hours: 25

Unit aim

This unit will enable learners to produce a marketing strategy, implement a plan and monitor and evaluate the plan to determine future marketing activites.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to identify and prioritise marketing objectives for own area of responsibility	1.1	Analyse the organisation's business plan to identify marketing objectives for own area of responsibility			
		1.2	Explain the organisation's culture, vision and values			
		1.3	Analyse and prioritise marketing objectives			
2	Be able to produce a marketing strategy in own area of responsibility	2.1	Describe and evaluate the target markets for own organisation's products or services			
		2.2	Identify and consult with marketing specialists if required			
		2.3	Identify marketing tools and models to develop a strategy			
		2.4	Develop a marketing strategy based on key success criteria for own area of responsibility			
3	Be able to produce and implement a marketing plan for own area of responsibility	3.1	Evaluate the resource requirements for the marketing plan			
		3.2	Produce a marketing plan based on the strategy			
		3.3	Agree roles and responsibilities of stakeholders			
		3.4	Communicate the marketing plan with key stakeholders			
4	Monitor and evaluate the marketing plan in own area of responsibility	4.1	Monitor progress of the marketing plan against business objectives			
		4.2	Assess and evaluate the impact of the marketing plan			
		4.3	Revise future marketing plans based on the impact evaluation			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 86: Analyse the Market in which your Organisation Operates

Unit reference number: M/600/9791

QCF level: 4

Credit value: 5

Guided learning hours: 25

Unit aim

This unit will enable learners to analyse an organisation's market position and trends. Learners will also learn how to analyse customer needs and communicate with key stakeholders.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to analyse customers' needs	1.1	Assess the economic environment in which your organisation operates			
		1.2	Evaluate your customers' needs and relate to own organisation			
		1.3	Analyse customer perception of own products/ services in comparison to competitors			
2	Be able to analyse the market using research tools and techniques	2.1	Identify and utilise market research specialists if necessary			
		2.2	Analyse current and future macro and micro economic trends in own sector			
		2.3	Use recognised research tools to assess market trends and opportunities for growth			
3	Be able to communicate research findings to inform managerial decisions	3.1	Produce a report based on research findings			
		3.2	Communicate the report to key individuals within own organisation			
		3.3	Evaluate feedback from key individuals			
		3.4	Revise and communicate updated report to key individuals			
		3.5	Monitor the economic environment and changes in customers' needs			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 87: Develop and Evaluate Operational Plans for Own Area of Responsibility

Unit reference number:	**Y/600/9588**
QCF level:	**5**
Credit value:	**6**
Guided learning hours:	**25**

Unit aim

This unit will help learners to develop, implement, monitor and review operational plans for their own area of responsibility.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to align objectives of own area of responsibility with those of own organisation	1.1	Identify operational objectives within own area of responsibility			
		1.2	Analyse objectives of own area of responsibility in relation to those of own organisation			
2	Be able to implement operational plans in own area of responsibility	2.1	Assess risks associated with operational plans and include contingency arrangements			
		2.2	Identify support from relevant stakeholders			
		2.3	Implement operational plan within own area of responsibility			
3	Be able to monitor and evaluate operational plans in own area of responsibility	3.1	Monitor procedures within the operational plan			
		3.2	Evaluate operational plans and implement any necessary actions			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 88: Manage the Achievement of Customer Satisfaction

Unit reference number: A/600/9793

QCF level: 4

Credit value: 5

Guided learning hours: 25

Unit aim

This unit will help learners to understand the importance of monitoring customer service satisfaction levels to manage the achievement of customer satisfaction.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to understand customer service standards required in own organisation	1.1	Explain customer service standards within own organisation			
		1.2	Describe customer service best practice in own sector using research techniques			
2	Be able to implement sustainable processes for customer satisfaction	2.1	Define sustainable processes taking into account environmental issues			
		2.2	Identify sustainable processes to support customer service standards			
		2.3	Produce a plan for implementation			
		2.4	State customer service standards with relevant key stakeholders			
		2.5	Ensure resources are provided to deliver agreed standards of customer service			
3	Be able to manage and support colleagues in delivering customer service standards	3.1	Communicate customer service roles and responsibilities with employees in own organisation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
4	Be able to manage and develop culture in own organisation to support customer service standards	4.1	Evaluate the culture in own organisation			
		4.2	Identify techniques for improving motivation amongst employees			
		4.3	Describe motivational strategies for improving customer service standards			
5	Be able to monitor customer service levels for continuous improvement	5.1	Describe methods of measuring customer satisfaction			
		5.2	Develop processes for monitoring customer satisfaction, including customer feedback mechanisms			
		5.3	Review employee performance to ensure customer service standards and organisational values are met			
		5.4	Analyse and monitor customer service			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 89: Plan, Allocate and Monitor Work in Own Area of Responsibility

Unit reference number: H/600/9674

QCF level: 4

Credit value: 5

Guided learning hours: 25

Unit aim

This unit will help learners to plan, allocate and monitor work in their own area of responsibility, and make any necessary changes to original work plans.

Unit assessment requirements/evidence requirements

There are no specific assessment requirements for this unit. Please refer to the overall Management Standards Centre assessment requirements/strategy in Annexe C.

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	Be able to produce a work plan for own area of responsibility	1.1	Explain the context in which work is to be undertaken			
		1.2	Identify the skills base and the resources available			
		1.3	Examine priorities and success criteria needed for the team			
		1.4	Produce a work plan for own area of responsibility			
2	Be able to allocate and agree responsibilities with team members	2.1	Identify team members' responsibilities for identified work activities			
		2.2	Agree responsibilities and SMART (Specific, Measurable, Achievable, Realistic and Time-bound) objectives with team members			
3	Be able to monitor the progress and quality of work in own area of responsibility and provide feedback	3.1	Identify ways to monitor progress and quality of work			
		3.2	Monitor and evaluate progress against agreed standards and provide feedback to team members			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
4	Be able to review and amend plans of work for own area of responsibility and communicate changes	4.1	Review and amend work plan where changes are needed			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 90: Manage Budgets

Unit reference number: T/601/2580
QCF level: 4
Credit value: 5
Guided learning hours: 29

Unit aim

This unit is about managing and monitoring a budget for a department or section within an organisation.

Unit assessment requirements/evidence requirements

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Please refer to the overall Council for Administration assessment requirements/strategy in Annexe D.

Learning outcomes	Assessment Criteria	Assessment Guidance
1	1.1 – 1.3	Evidence may be supplied via learner reports/reflective accounts, professional discussion and questioning
2	2.1 – 2.4	
3	3.1 – 3.3	

Learning outcomes	Assessment Criteria	Assessment Guidance
4	4.1	Evidence may be supplied via witness testimony, professional discussion, learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Budgets • Financial records
	4.2 – 4.4	Evidence may be supplied via witness testimony, professional discussion, learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Letters • Emails • Memos • Reports • Budgets • Financial records

Learning outcomes	Assessment Criteria	Assessment Guidance
5	5.1	Evidence may be supplied via learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Records • Budgets
	5.2	Evidence may be supplied via witness testimony, professional discussion, learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Information produced • Budgets
	5.3	Evidence may be supplied via learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Calculations • Budgets
	5.4	Evidence may be supplied via learner reports/reflective accounts and inspection of products, using evidence appropriate to the learners job role from the following sources: • Information produced • Budgets

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	Understand the purpose of budgets	1.1	Explain the purpose and benefits of managing financial resources effectively and efficiently			
		1.2	Identify legal, regulatory and organisational requirements for managing a budget			
		1.3	Describe different types of budgetary systems and their features			
2	Understand how to manage budgets	2.1	Describe methods for monitoring, controlling and recording income and expenditure			
		2.2	Describe ways in which costs may be minimised in own area of responsibility			
		2.3	Identify situations in which corrective action may be needed			
		2.4	Describe the scope of own authority for managing a budget and authorising expenditure			
3	Understand how to report performance against budgets	3.1	Explain the purpose and benefits of reporting information on performance against budget			
		3.2	Explain how to check the accuracy of budget calculations			
		3.3	Explain the purpose and benefits of recording information that will help with the future preparation of budgets			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
4	Be able to manage budgets	4.1	Control budget performance within limits and deadlines			
		4.2	Analyse and take action to minimise costs where possible			
		4.3	Take corrective action to make sure of best value for money			
		4.4	Authorise expenditure within the scope of own authority			
5	Be able to monitor budgets	5.1	Record transactions, as required			
		5.2	Produce information on performance against budget, when required			
		5.3	Make sure all calculations are accurate			
		5.4	Record information that will help with the preparation of future budgets			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 91: Agree a Budget

Unit reference number: J/601/2552
QCF level: 3
Credit value: 4
Guided learning hours: 25

Unit aim

This unit is about developing and agreeing a budget for a department or section within a business.

Unit assessment requirements/evidence requirements

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Please refer to the overall Council for Administration assessment requirements/strategy in Annexe D.

Learning outcomes	Assessment Criteria	Assessment Guidance
1	1.1 – 1.6	Evidence may be supplied via learner reports/reflective accounts, professional discussion and questioning

Learning outcomes	Assessment Criteria	Assessment Guidance
2	2.1 – 2.2	Evidence may be supplied via learner reports/reflective accounts
	2.3	Evidence may be supplied via learner reports/reflective accounts, professional discussion and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Draft budget
	2.4	Evidence may be supplied via witness testimony, professional discussion, learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Budget

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	Understand how to develop budgets	1.1	Explain how to use estimations when developing a draft budget			
		1.2	Explain how to identify priorities and financial resources needed when preparing a budget			
		1.3	Explain the purpose and benefits of identifying priorities when preparing a budget			
		1.4	Explain the purpose and benefits of evaluating and justifying estimated costs and income			
		1.5	Describe procedures for negotiating superseded budgets			
		1.6	Describe skills needed for agreeing budgets			
2	Be able to agree a budget	2.1	Identify financial resources needed to achieve goals and objectives for agreeing a budget			
		2.2	Evaluate and justify costs and risks			
		2.3	Prepare a draft budget			
		2.4	Negotiate and agree a budget			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 92: Make Decisions in a Business Environment

Unit reference number: H/601/2560

QCF level: 4

Credit value: 4

Guided learning hours: 24

Unit aim

This unit is about making decisions in a business environment at the level where there is no requirement for formal legal or organisational procedures to be followed.

Unit assessment requirements/evidence requirements

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Please refer to the overall Council for Administration assessment requirements/strategy in Annexe D.

Learning outcomes	Assessment Criteria	Assessment Guidance
1	1.1 - 1.2	Evidence may be supplied via learner reports/reflective accounts, professional discussion and questioning
2	2.1 – 2.4	
3	3.1 – 3.6	
4	4.1 – 4.2	

Learning outcomes	Assessment Criteria	Assessment Guidance
5	5.1	Evidence may be supplied via learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Information collected • Research carried out
	5.2	Evidence may be supplied via learner reports/reflective accounts
6	6.1 – 6.3	
	6.4 – 6.6, 6.8 – 6.10	Evidence may be supplied via observation of workplace activities, witness testimony, professional discussion, learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Letters • Emails • Memos • Reports • Presentations
	6.7	Evidence may be supplied via observation of workplace activities, witness testimony, professional discussion, learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role

Learning outcomes	Assessment Criteria	Assessment Guidance
7	7.1 – 7.2	Evidence may be supplied via learner reports/reflective accounts

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	Understand the purpose and process of decision-making	1.1	Evaluate situations where decision-making is required			
		1.2	Explain key stages in the decision-making process			
2	Understand how to prepare to make decisions	2.1	Explain the purpose of knowing the context in which a decision is being made			
		2.2	Justify possible limitations on a person making decisions			
		2.3	Explain how to research information to be used to inform and influence decision-making			
		2.4	Evaluate sources of information that can be used to inform and influence decision-making			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
3	Understand how to make decisions	3.1	Explain the purpose of meetings and other discussions where decisions are being made			
		3.2	Explain how to structure own ideas, information and recommendations to maximise their effectiveness			
		3.3	Explain the purpose and benefits of respecting other people's contributions to the decision-making process			
		3.4	Explain how to be proactive and engage with colleagues during the decision-making process			
		3.5	Justify the use of evidence, argument, questioning and assertiveness to influence outcomes			
		3.6	Explain the purpose of collective responsibility			
4	Understand how to assess decisions and their effects	4.1	Evaluate ways to monitor the effect of decisions and identify learning points			
		4.2	Explain how to review the decision-making process			
5	Be able to prepare background information to make decisions	5.1	Research and collect information to add value to the decision-making process			
		5.2	Evaluate sources of information needed			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
6	Be able to make decisions	6.1	Identify and agree criteria for making a decision			
		6.2	Review information provided in order to make a decision			
		6.3	Structure ideas, information and recommendations in a logical and meaningful way			
		6.4	Present rationale and conclusions to others using accurate and current information			
		6.5	Provide additional information to support conclusions			
		6.6	Respond as required when asked to supply information to help with decision-making			
		6.7	Respect other people's contributions to the decision-making process			
		6.8	Use evidence, argument, questioning and assertiveness to justify decision(s)			
		6.9	Listen to other people's feedback and record for future evaluation			
		6.10	Confirm support for the decision(s)			
7	Be able to assess contributions to decision-making	7.1	Assess contributions made to the decision-making process			
		7.2	Identify learning points to improve future decision-making			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 93: Negotiate in a Business Environment

Unit reference number: K/601/2561

QCF level: 4

Credit value: 7

Guided learning hours: 40

Unit aim

This unit is about preparing for, and carrying out, negotiations with other parties, in a business environment.

Unit assessment requirements/evidence requirements

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Please refer to the overall Council for Administration assessment requirements/strategy in Annexe D.

Learning outcomes	Assessment Criteria	Assessment Guidance
1	1.1 - 1.11	Evidence may be supplied via learner reports/reflective accounts, professional discussion and questioning.
2	2.1 – 2.5	
3	3.1 – 3.3	

Learning outcomes	Assessment Criteria	Assessment Guidance
4	4.1	Evidence may be supplied via learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Negotiating brief
	4.2 – 4.3, 4.5	Evidence may be supplied via learner reports/reflective accounts
	4.4	Evidence may be supplied via learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Research carried out
	4.6	Evidence may be supplied via witness testimony, professional discussion, learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Letters • Emails • Memos • Presentation • Reports

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	Understand how to prepare for negotiations	1.1	Explain the main principles of negotiation			
		1.2	Explain the process of negotiation and how it is used in business			
		1.3	Outline commercial and ethical frameworks that are important in negotiations			
		1.4	Analyse the purpose and benefits of different negotiation strategies and techniques			
		1.5	Explain the value of understanding the roles and levels of responsibility of other negotiators			
		1.6	Explain the purpose and benefits of understanding the objectives of the other negotiators			
		1.7	Explain the purpose of understanding own level of responsibility and authority in negotiations			
		1.8	Explain the purpose and benefits of research and preparation before negotiations			
		1.9	Analyse how differences in culture may impact on negotiations			
		1.10	Explain the purpose and benefits of having clear and realistic objectives for negotiations			
		1.11	Explain the purpose and benefits of having compromise positions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Understand how to conduct negotiations	2.1	Explain the purpose and benefits of being flexible during negotiations while seeking to achieve the main objectives			
		2.2	Explain the purpose of keeping to the brief during negotiations			
		2.3	Explain the purpose of keeping to own level of authority during negotiations			
		2.4	Explain the purpose of referring issues to others, where required			
		2.5	Explain the purpose and benefits of keeping goodwill during negotiations, and ways of doing so			
3	Understand how to complete negotiations	3.1	Explain the purpose and benefits of achieving a 'win-win' outcome			
		3.2	Explain the purpose of keeping an accurate record of negotiations, and agreeing the record			
		3.3	Explain the purpose of withdrawal from negotiations, where needed			
4	Be able to prepare for negotiation	4.1	Prepare a negotiating brief			
		4.2	Identify and prioritise objectives and compromise positions			
		4.3	Identify objectives other negotiators may have			
		4.4	Research and assess the strength of the other negotiators			
		4.5	Identify potential problems in negotiations and suggest solutions to overcome them			
		4.6	Make sure all involved in the negotiations are fully briefed and prepared			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
5	Be able to conduct negotiations	5.1	Carry out negotiations in line with the commercial and ethical frameworks of an organisation			
		5.2	Carry out negotiations within limits of own authority			
		5.3	Make proposals which meet personal / organisational objectives, and those of the people being negotiated with (where possible)			
		5.4	Adapt negotiation strategy to obtain results that meet minimum or agreed outcomes			
		5.5	Clarify other people's understanding, and respond to their queries and objections			
		5.6	Suggest solutions to deal with problems			
		5.7	Refer the negotiations when matters arise which require authorisation			
		5.8	Carry out negotiations in a way that creates goodwill and promotes a positive image of an organisation			
6	Be able to complete negotiations	6.1	Reach an agreement to the satisfaction of all those involved in the negotiations, where possible			
		6.2	Maintain clear and correct records of the negotiations and agree them with all involved			
		6.3	Withdraw from negotiations to re-consider current position, if necessary			
		6.4	Complete negotiations in a way that creates goodwill and promotes a positive image of an organisation			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 94: Prepare Specifications for Contracts

Unit reference number: F/601/2565
QCF level: 4
Credit value: 5
Guided learning hours: 30

Unit aim

This unit is about understanding and preparing the information that is needed to award a contract for work.

Unit assessment requirements/evidence requirements

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Please refer to the overall Council for Administration assessment requirements/strategy in Annexe D.

Learning outcomes	Assessment Criteria	Assessment Guidance
1	1.1 – 1.6	Evidence may be supplied via learner reports/reflective accounts, professional discussion and questioning.
2	2.1 – 2.2	
3	3.1 – 3.2	Evidence may be supplied via witness testimony, professional discussion, learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • Letters • Emails • Memos • Reports

Learning outcomes	Assessment Criteria	Assessment Guidance
4	4.1	Evidence may be supplied via learner reports/reflective accounts, professional discussion and inspection of products, using evidence appropriate to the learner's job role from the following sources: • List of criteria
	4.2	Evidence may be supplied via witness testimony, professional discussion, learner reports/reflective accounts and inspection of products, using evidence appropriate to the learner's job role from the following sources: • List of criteria • Letters • Emails • Memos • Reports

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	Understand work contracts	1.1	Explain the purpose and benefits of contracts and other forms of agreement			
		1.2	Describe different types of contracts and agreements			
		1.3	Evaluate different types of contract and agreement for their intended purpose			
		1.4	Explain the purpose of legal, regulatory and organisational requirements that may govern contracts			
		1.5	Identify a range of terminology used in contracts and explain its purpose			
		1.6	Explain the purpose and benefits of requirements and specifications in contracts			
2	Understand how to prepare for selection	2.1	Explain the purpose and benefits of prioritising requirements			
		2.2	Explain the purpose and value of developing objective selection criteria			
3	Be able to prepare specifications for work	3.1	Identify requirements for contractor(s), consulting with others where required			
		3.2	Prioritise requirements and prepare specifications for the products and services to be provided, consulting with others where required			
4	Be able to agree selection criteria	4.1	Prepare selection criteria			
		4.2	Agree selection criteria, where required			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 95: Leading Workplace Organisation Activities

Unit reference number: F/600/5406

QCF level: 4

Credit value: 10

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead workplace organisation 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead workplace organisation activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within the learner's area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Lead the activities that apply the principles and process of workplace organisation within the work areas, and establish the area scores			
		1.4	Set standards and guidelines for situations where information, resources or equipment is missing or is in surplus and where improvements can be made			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Lead the team activities that make improvements to workplace organisation			
		1.6	Lead the production and/or updating of standard operation procedures and visual controls that everyone works to within the area			
		1.7	Lead the production and/or updating of standard operation procedures which cover three of the following: • Cleaning of equipment/work area • Maintenance of equipment • Health and safety • Process procedures • Manufacturing operations/working processes • Quality systems • Regulatory compliance system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Lead the production and/or updating of changes to visual controls, which cover three of the following: • Producing shadow boards or an alternative (such a labelled racking and storage systems to standardise the storage and location of area resources and/or equipment • Colour coding • Line status systems (such as line, process system) • Skills matrix • Performance measures • Process control boards • Improvement systems • Planning systems			
		1.9	Make measurable improvements to the workplace organisation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead workplace organisation activities	2.1	Describe the health and safety requirements of the area in which they are leading the workplace organisation activity			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Describe the factors to be considered when selecting a work area for an activity (to include: cleanliness, health and safety, product quality, equipment and organisation)			
		2.4	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.5	Describe the procedure used to identify and address surplus or missing equipment or resources (such as carrying out a 'red tagging' exercise)			
		2.6	Explain how to arrange and label the necessary resources or equipment for rapid identification and access			
		2.7	Explain how to correlate information to create or update standard operating procedures or other approved documentation			
		2.8	Explain how to evaluate and prioritise the improvements required for the workplace			
		2.9	Explain how to score and audit the workplace organisation			
		2.10	Describe the techniques required to communicate information using visual control systems (such as shadow boards, performance charts, KPI's)			
		2.11	Describe the extent of the learner's own authority, and to whom they should report 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 96: Leading Continuous Improvement (Kaizen) Activities

Unit reference number: M/600/5420

QCF level: 4

Credit value: 14

Guided learning hours: 32

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead continuous improvement (Kaizen) 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead continuous improvement (Kaizen) activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within the learner's area of responsibility to include all of the following: • Set out and communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Approve the plan for the Kaizen process to the agreed work area/activity to include plan, do, check, act			
		1.4	Agree objectives and targets for the Kaizen activity			
		1.5	Lead the carrying out of the Kaizen activity within the chosen work area/activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Confirm waste, problems or conditions within the work area or activity and discuss and evaluate what improvements can be made			
		1.7	Confirm and lead improvements within the working area/activity which cover three of the following: • Reduction in cost • Improved health, safety and/or working environment • Improved quality • Improved regulatory compliance • Improvements to working practices • Reduction in lead time • Reduction in waste and/or energy usage • Improved customer service • Improved resource utilisation			
		1.8	Lead a structured waste elimination activity, based on the identified wastes, problems or conditions			
		1.9	Lead the production of and approve changes to standard operating procedures (SOPs), or other approved documentation that will sustain the improvements resulting from the Kaizen activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Confirm and lead improvements, which cover three of the following: • Cleaning of equipment or work area • Maintenance of equipment • Health and safety • Process procedures • Manufacturing operations or work area operations • Quality system • Regulatory compliance systems			
		1.11	Agree calculated measures of performance for quality, cost and delivery			
		1.12	Agree calculations for one of the following quality measures: • Not right first time (as a percentage or as parts per million (PPM)) • Company-specific quality measure			
		1.13	Agree calculations for one of the following measures: • Delivery schedule achievement • Company-specific delivery or service measure			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Agree calculations for one of the following cost measures: • Parts per operator hour (PPOH) • Production volume • Value added per person (VAPP) • Overall equipment effectiveness (OEE) • Stock turns • Floor space utilization (FSU) • Cost breakdown (such as labour, material, energy and overhead) • Company-specific cost measure			
		1.15	Approve the calculations and lead the development of a visual representation of the optimum resources required for a process based on customer demand			
		1.16	Evaluate comparisons of the agreed work area/activity before and after the kaizen activity to confirm improvements using key performance indicators			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Show business improvements, using one of the following key performance indicators: • Not right first time (as a percentage or as parts per million (PPM)) • Company-specific quality measure • Delivery schedule achievement • Company-specific delivery measure • Parts per operator hour (PPOH) • Production volume • Value added per person (VAPP) • Overall equipment effectiveness (OEE) • Stock turns • Floor space utilization (FSU) • Cost breakdown (such as labour, material, energy and overhead) • Company-specific cost measure			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead continuous improvement (Kaizen) activities	2.1	Describe the health and safety requirements of the area in which they are leading the Kaizen activity			
		2.2	Explain how a work area/activity is selected for the Kaizen activity			
		2.3	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.4	Describe the principles for the deployment of Kaizen (such as where a culture focuses on sustained continuous improvement, aiming at eliminating waste in all systems and processes in the organisation and supply chain)			
		2.5	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 them			
		2.6	Explain problem solving and root cause analysis			
		2.7	Describe the importance of understanding the process/activity under review, and how this will affect the quality of the problem solving			
		2.8	Describe the application of the Deming cycle (plan, do, check, act)			
		2.9	Explain how to carry out a Kaizen activity and establish measurable improvements			
		2.10	Explain how to distinguish facts from opinions in order to identify improvement actions			
		2.11	Explain how improvements to the process are achieved by engaging the knowledge and experience of the people involved in the process			
		2.12	Explain how to encourage people to identify potential improvements			
		2.13	Explain how to evaluate improvement ideas in order to select those that are to be pursued			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain how to set quantifiable targets and objectives			
		2.15	Explain how to produce/propose the creation of or changes to standard operating procedures (SOPs) or other approved documentation			
		2.16	Describe the techniques used to visually communicate the work of the Kaizen activity to participants and others			
		2.17	Describe the application of the business' key measures of competitiveness (such as the former DTI's seven measures: delivered right first time, delivery schedule achievement, people productivity, stock turns, overall equipment effectiveness, value added per person, floor space utilisation)			
		2.18	Explain how the cycle time of a process can be defined			
		2.19	How to calculate the required production rate for a process by using a calculation (such as Takt Time)			
		2.20	Explain how to calculate the optimal resources (such as people, equipment, facilities and materials) required for a process based on customer demand			
		2.21	Describe the techniques used to distribute work content to balance cycle times to the rate of customer demand, and how to visually represent it (e.g. line balance and process displays)			
		2.22	Describe the extent of the learner's own authority, and to 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 97: Leading the Development of Visual Management Systems

Unit reference number: M/600/5434

QCF level: 4

Credit value: 9

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead the development of visual management systems. 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead the development of visual management systems	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out and communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Consider and justify the appropriate parts of the process or work area that will have visual controls			
		1.4	Approve and lead the making of changes to visual management systems			
		1.5	Agree the key performance indicators that will be displayed in the work area			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Lead the production of and approve changes to standard operating procedures (SOPs), and visual controls that everyone works to within the area			
		1.7	Lead the creation and updating of visual management systems that promote six of the following: • Health and safety • Quality/zero defects • Process concerns or corrective actions • Performance measures • Standard operating procedures • Workplace organisation • Skills matrices • Autonomous maintenance worksheets • Parts/material control systems • Problem resolution (eg, Kaizen boards) • Shadow boards • Standard work-in-progress (WIP) locations and quantities • Planning systems • The delivery of effective meetings			
		1.8	Monitor the effectiveness of the visual management system and check the quality of information being displayed			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead the development of visual management systems	2.1	Describe the health and safety requirements of the work area in which they are leading the visual management activities			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Describe the factors to be considered when selecting a visual management			
		2.4	Explain where to find the information required to develop a local visual management system			
		2.5	Describe the visual management systems available to create 'the visual factory' (such as using Kanban systems, card systems, colour coding, floor footprints, graphs, team boards)			
		2.6	Explain how to differentiate between business performance measures and local performance measures			
		2.7	Describe the measures of performance in a lean business environment (such as health, safety and the environment, right first time, cost, delivery, responsiveness, process concerns and corrective actions, performance measures, workplace organisation)			
		2.8	Describe the application of measurement techniques required for communicating the visual management within an area and to others who may use the information (such as target versus actual, % right first time, Pareto analysis, bar charting, action plans, Paynter charts)			
		2.9	Describe the extent of the learner's own authority, and to whom they should report 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 98: Leading the Creation of Flexible Production and Manpower Systems

Unit reference number: K/600/5447

QCF level: 4

Credit value: 7

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead the creation of flexible production and manpower systems. 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead the creation of flexible production and manpower systems	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out and communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Lead the application of the principles and processes of creating flexible production and manpower systems to the chosen activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Lead the selection of three different parts or materials in the work area, and approve the calculations for the following: • Workload • Capacity of resource (equipment, people) • Takt time			
		1.5	Obtain and approve the schedule and batch size for the parts or materials in the work area			
		1.6	Lead the creation of level schedules for the parts in the work area			
		1.7	Direct the production of a visual communication of the schedule, which includes: • Workload • Resource capacity • Takt time for the work area			
		1.8	Identify and evaluate improvement opportunities, and waste which needs to be removed, in order to achieve Takt time and flow processing			
		1.9	Lead the production of a local workforce flexibility matrix (skills matrix)			
		1.10	Direct the production of a visual representation, identifying resources that do not meet the Takt time requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Implement the creation of a visually controlled system, based on the demand of subsequent processes for the chosen parts or materials, which includes four of the following: • Standard work in progress • Safety stocks • Part or material routers • Physical control signals • Rules and disciplines of the implemented control system			
		1.12	Implement a visually controlled system, based on the demand of subsequent processes for the chosen parts, and which improves the overall process effectiveness			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead the creation of flexible production and manpower systems	2.1	Describe the health and safety requirements of the work area in which they are leading the activity			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Describe the information required to create level schedules, load and capacity, Takt time and batch sizes			
		2.4	Describe the meaning of 'level schedules', and how to create them			
		2.5	Explain how to create a load and capacity diagram			
		2.6	Explain Takt time, and how this is calculated			
		2.7	Describe the application of standard work in progress			
		2.8	Describe the application of visually controlled systems and signals, based on the demand of subsequent processes			
		2.9	Describe the application of skills matrices			
		2.10	Describe the application of consignment stocking			
		2.11	Explain how to simplify working practices and reduce the human error risk			
		2.12	Describe the consequences of introducing a new improved part/process/material router			
		2.13	Explain problem solving and route cause analysis			
		2.14	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 them			
		2.15	Explain how to stabilise and then optimise equipment effectiveness			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.16	Explain how to conduct a review of asset care/best practice effectiveness, and establish a robust routine of asset care and correct operation			
		2.17	Describe the appropriate techniques that provides value to the customer (such as push-pull systems, single piece flow, just in time (JIT), Kanban, autonomation)			
		2.18	Describe the techniques used to visually communicate the work done (such as level schedules, load and capacity diagrams, revised batch sizes, and Takt time)			
		2.19	Explain how to lay out an effective workplace, utilising recognised techniques (such as cellular manufacturing incorporating parallel lines or U-shaped cells)			
		2.20	Describe the extent of their own authority, and to whom they should report 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 99: Leading Value Stream Mapping (VSM) Activities

Unit reference number: M/600/5563

QCF level: 4

Credit value: 13

Guided learning hours: 32

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead Value Stream Mapping (VSM) 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

Your ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead value stream mapping (VSM) activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within the learner's area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Approve the selection of appropriate parts or materials on which the activity is to be carried out			
		1.4	Lead the value stream mapping process on the chosen parts, using appropriate improvement tools and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Lead the creation of and approve a current state map for the parts or materials chosen to include all of the following: • Part or material flow through the process • Information flow • Inventory • Set-up and cycle times for each operation • Lead time for the part or material • Value-adding percentage of lead time • Delays which occur between each operation • Takt time and schedules for the chosen part • Customer and supplier ordering and delivery			
		1.6	Confirm problems or conditions within the current state map where improvements can be made			
		1.7	Confirm opportunities for improvements and waste that needs to be removed, in order to create a future state map covering three of the following: • Improved workflow • Improved lead time • Improved quality • Improved safety • Less inventory • Improved flexibility • Less waste/cost			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Lead the production of and approve a future state map to include all of the following: • Part or material flow through the process • Information flow • Inventory • Set-up and cycle times for each operation • Lead time for the part or material • Value-adding percentage of lead time • Delays which occur between each operation • Takt time and schedules for the chosen part • Customer and supplier ordering and delivery			
		1.9	Lead the implementation of the changes identified			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead value stream mapping (VSM) activities	2.1	Describe the health and safety requirements of the area in which they are leading the value stream mapping activity			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Explain how a part is selected for a value stream mapping activity			
		2.4	Explain from whom authority is gained for release of people and resources for the value stream mapping activity			
		2.5	Explain how to structure and run a value stream mapping event			
		2.6	Describe the principles and processes for the deployment of value stream mapping			
		2.7	Explain how improvements to the process can be achieved			
		2.8	Explain how to evaluate improvement ideas and select those that will give the greatest benefit for the least spend			
		2.9	Explain how to set quantifiable objectives and targets for the future state maps			
		2.10	Explain how to create standard operating procedures (SOPs)			
		2.11	Describe the techniques used to visually communicate the information and results of the process			
		2.12	Describe the techniques of problem solving and root cause analysis			
		2.13	Explain systems lead time, how they differ from actual lead time, and how both are constructed			
		2.14	Explain how to calculate Takt time			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Describe the principles of increasing process capacity			
		2.16	Explain what constitutes value adding and non-value adding activities			
		2.17	Describe the extent of their own authority, and to whom they should report 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 100: Leading Statistical Process Control (SPC) Activities

Unit reference number: J/600/5665

QCF level: 4

Credit value: 8

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead Statistical Process Control (SPC) 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead statistical process control (SPC) activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Work to, and ensure compliance with all the required process monitoring documentation and work instruction sheet			
		1.4	Approve the process on which the process analysis is to be carried out			
		1.5	Consult with relevant people and lead the gathering of the necessary data for analysis			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Lead the application of the principles and processes of statistical process control to the chosen process			
		1.7	Lead the performing of basic statistical process control, using appropriate tools and techniques			
		1.8	Lead the use of statistical and graphical methods to represent the process conditions			
		1.9	Approve the capability of the process, identifying: • Cp • Cpk			
		1.10	Lead the production of charts for process and control information, to include three from: • Simple run charts • Tally charts • Bar charts • Histograms • Box plots • Time series charts • Pareto diagrams • Stem and leaf plots • Run charts			
		1.11	Agree activities which will improve the process performance			
		1.12	Approve the production of an action plan to implement the improvements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead statistical process control (SPC) activities	2.1	Describe the health and safety requirements of the area in which they are leading the process control activities			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Explain where process control fits within a continuous improvement environment			
		2.4	Explain how process performance affects customer satisfaction and process costs			
		2.5	Explain where and why statistical process control is used, the benefits, and how it is applied			
		2.6	Describe the importance of standardisation within a process operation, and why process performance can only be determined when it is controlled			
		2.7	Explain how process control can improve process performance			
		2.8	Describe the benefits of prevention and detection			
		2.9	Describe the two types of variation within a process (common cause, special cause), and the impact they have within the process			
		2.10	Explain how to gather data and effectively analyse it; how the data can be used to communicate abnormalities within a process			
		2.11	Describe the main types of control charts used for SPC, their features and benefits, and how to construct and implement them			
		2.12	Describe the meaning of a 'population' and a 'sample'			
		2.13	Describe the measurements of central tendency and variability, and how they are calculated			
		2.14	Describe the properties of a normal curve of distribution			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Explain how to create charts or diagrams (such as run charts, histograms, box plots, time series charts, Pareto diagrams, and stem and leaf plots)			
		2.16	Explain how to explain the terms and calculate mean, median, mode, standard deviation, range and variance			
		2.17	Explain how to explain and calculate process capability (Cp and Cpk)			
		2.18	Describe the extent of their own authority, and to whom they should report 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 101: Leading Value Management (Value Engineering and Value Analysis) Activities

Unit reference number: A/600/5713

QCF level: 4

Credit value: 11

Guided learning hours: 32

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead value management (value engineering and value analysis) 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead value management (value engineering and value analysis) activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Lead the application of the principles and processes of value management (VM) to the chosen product or process			
		1.4	Confirm what the customer requires from the product or the process, and approve quantifiable objectives and targets for the value management activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Lead the analysis of the functions of the product or process being studied, and agree allocated costs to those functions			
		1.6	Lead the production of a total cost model and supply chain map for the product or process, which shows how cost are related to function			
		1.7	Confirm the non-value added activity within the product or process, and approve alternatives			
		1.8	Lead the development of these alternatives into detailed proposals that will improve the value of the product or process			
		1.9	Lead the production of detailed proposals of the findings of the value management activities which: • Identify the non-value added activities and indicate alternatives • Prioritise and rank the alternatives • Include a risk assessment of the alternatives • Identify the most appropriate alternatives • Provide costing recommendations for management approval • Identify expected benefits			
		1.10	Approve the new value added process, and manage the plan within agreed timescales			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead value management (value engineering and value analysis) activities	2.1	Describe the health and safety requirements of the work area in which they are leading the value management activities			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Explain how to select a product or process on which to carry out the value management activity			
		2.4	Explain how to structure and run a value management activity			
		2.5	Explain how to set quantifiable objectives and targets for the value management activity			
		2.6	Explain how to carry out a function analysis			
		2.7	Describe the performance related tools used to qualify customer wants and needs			
		2.8	Describe the 'cost of function' equation, and how to calculate the cost of function			
		2.9	Explain FAST diagramming and value trees			
		2.10	Explain decision making and creativity techniques (brainstorming)			
		2.11	Explain how value management relates to the overall business strategy and competitive positioning			
		2.12	Explain how to produce a total cost model and supply chain map for the product or process			
		2.13	Explain what constitutes value adding and non-value adding activities			
		2.14	Explain how to identify what a customer requires from a product or process			
		2.15	Explain how to prioritise and rank the alternatives			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.16	Explain how to complete a risk assessment of the alternatives			
		2.17	Explain how to prepare the findings into proposals			
		2.18	Explain how to monitor and track proposals to implementation			
		2.19	Describe the extent of their own authority, and to whom they should report 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 102: Leading Failure Modes and Effects Analysis (FMEA) Activities

Unit reference number: L/600/5733

QCF level: 4

Credit value: 9

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead Failure Modes and Effects Analysis (FMEA) 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead failure modes and effects analysis (FMEA) activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Agree the key features of failure modes and effects analysis required for the activity under investigation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Lead the carrying out of a failure modes and effects analysis on two of the following: • Concept • Product • Design • Process • System • Machine			
		1.5	Agree, for the activities analysed: • The potential failure modes • The potential effects from failure modes • The potential causes of failure modes			
		1.6	Co-ordinate the production of a failure modes and effects analysis			
		1.7	Check the recording of the information gathered in an appropriate format			
		1.8	Approve the score for all of the following: • The likely occurrence of a potential failure modes • The severity of the potential failure modes • The likelihood of detection of the potential failure modes			
		1.9	Consider and approve valid judgements about the activity using failure modes and effects analysis principles			
		1.10	Approve the risk priority numbers (RPNs) calculations, agree high RPNs, and agree actions to improve them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Check rating tables for all of the following: • Occurrence • Severity • Detection			
		1.12	Lead the reassessment of a failure modes and effects analysis once actions have been completed, and review the re-score of severity, occurrence and detection			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead failure modes and effects analysis (FMEA) activities	2.1	Describe the health and safety requirements of the area in which they are leading the failure modes and effects analysis.			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Describe the main features and benefits of carrying out a failure modes and effects analysis			
		2.4	Explain who should be part of a team that constructs and updates a failure modes and effects analysis			
		2.5	Explain system FMEA, concept FMEA, design FMEA and process FMEA - what they are, and where they should use them			
		2.6	Describe the meaning of failure mode, failure effect and failure cause			
		2.7	Describe the rating scale used in failure modes and effects analysis projects, to include the severity rating scale, the occurrence rating scale and the detection rating scale			
		2.8	Explain how to calculate a risk priority number (RPN)			
		2.9	Explain how to use the risk priority numbers			
		2.10	Explain how to apply a structured approach to risk reduction			
		2.11	Explain when to start a failure modes and effects analysis			
		2.12	Explain when to update a failure modes and effects analysis			
		2.13	Describe the roles and responsibilities of individuals within a failure modes and effects analysis team			
		2.14	Describe the extent of their own authority within the project, and to whom they should report 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 103: Leading Measurement Systems Analysis (MSA) Activities

Unit reference number: R/600/5748

QCF level: 4

Credit value: 9

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead Measurement Systems Analysis (MSA) 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead measurement systems analysis (MSA) activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Approve the selection of an appropriate measurement system on which to carry out the analysis			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Lead the carrying out of a measurement system analysis, which includes three from the following: • Completing a calibration study on a gauge • Conducting a gauge linearity study • Completing either an attribute or a variable gauge repeatability and reproducibility study • Conducting a metrology study on a measurement system which includes either a variable or attribute gauge repeatability and reproducibility study			
		1.5	Obtain and approve all the necessary data in order to carry out the measurement systems analysis			
		1.6	Lead the carrying out of the analysis, using the appropriate techniques			
		1.7	Agree the type of measurement system variation, to include two of the following: • Bias • Linearity • Stability • Accuracy • Repeatability • Reproducibility			
		1.8	Confirm the recording of the results of the analysis in the appropriate format			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Agree the percentage gauge repeatability and reproducibility of the measurement system under study, and approve ways of improving the measurement system			
		1.10	Lead the production of a measurement systems analysis report, detailing ways of improving the measurement system under study			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead measurement systems analysis (MSA) activities	2.1	Describe the health and safety requirements of the area in which they are leading the measurement systems analysis			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Explain why we should study our measurement systems			
		2.4	Explain how to select a measurement system for analysis			
		2.5	Describe the possible sources of measurement systems variation			
		2.6	Describe the use of measurement systems analysis, and how it can be used in a Six Sigma improvement project			
		2.7	Explain how to conduct a variable and a attribute repeatability and reproducibility study			
		2.8	Describe the terminology used in measurement system analysis (such as bias, linearity, stability, accuracy, repeatability, discrimination, resolution, reproducibility)			
		2.9	Explain how to conduct a measurement systems analysis study			
		2.10	Explain how to calculate gauge repeatability and reproducibility			
		2.11	Explain how to calculate gauge precision and tolerance			
		2.12	Explain industry rules for repeatability and reproducibility results			
		2.13	Describe the extent of their own authority within the project, and to whom they should report 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 104: Carrying Out Design of Experiments (DOE)

Unit reference number: L/600/5862

QCF level: 4

Credit value: 9

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out Design of Experiments (DOE). 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

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 design of experiments (DOE)	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			
		1.2	Select an appropriate process on which to carry out the design of experiment and obtain all the necessary data			
		1.3	Determine the scope/parameters of the experiment			
		1.4	Utilise sample size selection to ensure the statistical validity of the experiment and calculate the correct sample size required for the experiment			
		1.5	Estimate the resources and expected benefits for the design of experiment undertaken			
		1.6	Document the resources required to include: • Financial • Time scales • Manpower • Plant/equipment • Materials			
		1.7	Identify a suitable sampling plan to reduce systematic errors			
		1.8	Carry out a design of experiment within an improvement project utilising the appropriate tools and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	For the experiment undertaken identify: • A suitable Alpha risk level • A suitable Delta that needs to be observed • A suitable Beta level			
		1.10	Determine the correct experimental design to use from one of the following: • Full factorial • 2k factorial • Fractional factorial			
		1.11	Record the results of the design of experiment in the appropriate format			
		1.12	Analyse the data gathered and identify areas where improvements to the process can be made			
		1.13	Calculate and produce graphs for the following: • Main effects • Interactions			
		1.14	Produce a design of experiment report which includes an action plan to ensure the improvements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to carry out design of experiments (DOE)	2.1	Describe the health and safety requirements of the area in which they are carrying out an experiment			
		2.2	Explain why we need to use design of experiments and how this benefits an improvement project			
		2.3	Explain how to determine the scope of an experiment			
		2.4	Explain how to carry out a design of experiment project and the tools and techniques used			
		2.5	Explain where to obtain the data required to carry out the design of experiment			
		2.6	Explain how to calculate the sample size to be used in the design of experiment			
		2.7	Explain what is meant by Alpha risk and Beta risk			
		2.8	Explain how to use the data obtained to calculate: mean, median, mode, standard deviation, range and variance			
		2.9	Explain how to calculate and graphically display main effects and interactions			
		2.10	Explain what is the meaning of a population and a sample in terms of the design of experiment			
		2.11	Explain how to design a suitable array for the designs to include full factorial, 2k factorial and fractional			
		2.12	Explain how to design an array to assess the selected interactions from the designs to include full factorial, 2k factorial and fractional			
		2.13	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 105: Leading Mistake/Error Proofing (POKA YOKE) Activities

Unit reference number: K/600/5867

QCF level: 4

Credit value: 9

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead mistake/error proofing (POKA YOKE) 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead mistake/error proofing (Poka Yoke) activities	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Use information and data to approve the selection of a suitable process on which the mistake/error proofing activity is to be carried out			
		1.4	Lead the application of the mistake/error proofing process to the chosen activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Use appropriate techniques to analyse the data received, and confirm valid conclusions			
		1.6	Evaluate recommendations and lead the production of worksheets for the activity that identify the problem and actions to be taken			
		1.7	Lead the creation of a worksheet of the mistake/error proofing activity, identifying: • The description of the mistake/error identified • The containment action taken • The root cause of the mistake/error • The permanent corrective action to be taken			
		1.8	Agree suitable solutions, and manage the carrying out of agreed trials to measure the effectiveness of the solution			
		1.9	Approve suitable solutions and determine their: • Effectiveness • Cost • Complexity			
		1.10	Confirm and co-ordinate the implementation of the optimum solution			
		1.11	Lead the measurement and documentation of the results			
		1.12	Identify the benefits of mistake/error proofing in terms of: • Improved quality/compliance (such as ISO9001) • Reduced costs • Delivery or service			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead mistake/error proofing (Poka Yoke) activities	2.1	Explain how to define a mistake/error proofing activity, and the benefits of carrying this out			
		2.2	Describe the difference and benefits between mistake/error proofing and prevention and detection			
		2.3	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.4	Describe the selection criteria used to determine a suitable product or process on which to carry out the mistake/error proofing activity			
		2.5	Explain how mistake/error proofing can lead to zero defects			
		2.6	Describe the relationship between errors and defects			
		2.7	Describe the different types and range of mistakes			
		2.8	Explain how defects originate in products or processes			
		2.9	Explain how the role of source inspection contributes to the reduction of defects			
		2.10	Describe the application of mistake/error proofing (Poka Yoke) tools (such as 'cause and effect', and the 5 'why's)			
		2.11	Describe the type of mistake/error proofing documentation, and the information it should contain			
		2.12	Describe the analysis and charting methodology used for mistake/error proofing			
		2.13	Describe the financial implications of mistake/error proofing projects			
		2.14	Describe the relationship between mistake/error proofing and other continuous improvement processes (such as workplace organisation 5S/5C, quick changeovers, cellular manufacturing, total productive maintenance, structured problem solving and visual management)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Explain how to undertake trials and measure the effectiveness of mistake/error proofing projects			
		2.16	Describe the different types and range of mistake proofing devices used			
		2.17	Describe the roles and responsibilities of individuals within a mistake/error proofing team (including facilitator, timekeeper, scribe)			
		2.18	Describe the extent of their own authority within the activity, and to whom they should report 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 106: Applying Quality Function Deployment (QFD)

Unit reference number: J/600/5875

QCF level: 4

Credit value: 9

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to apply Quality Function Deployment (QFD). 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

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	Apply quality function deployment (QFD)	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			
		1.2	Identify the customer requirement of a product or process using quality function deployment			
		1.3	Obtain all the required information necessary to perform the quality function deployment study			
		1.4	Produce a matrix for a quality function deployment project which identifies the four phases as follows: • Pre-planning • Design deployment • Process and production planning • Managing deployment			
		1.5	Determine the customer requirements within the project in terms of: • Needs and expectations • Functions • Features			
		1.6	Carry out the quality function deployment project			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Identify within the quality function deployment project the: • Necessary inputs and how to acquire them • The outputs from each of the four phases and their execution • Customer rankings • Substitute quality characteristics			
		1.8	Analyse the information gathered and draw conclusions as to the appropriate course of action			
		1.9	Record the results of the analysis in the appropriate format			
		1.10	Produce and score matrices for three of the following: • Relationships • Technical requirements • Correlations • Planning • Specifications			
		1.11	Produce a report outlining the findings and the recommended solutions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to apply quality function deployment (QFD)	2.1	Describe the health and safety requirements of the area in which they are carrying out the quality function deployment activity			
		2.2	Describe the advantages of using quality function deployment			
		2.3	Describe the 'quality lever' and how quality function deployment fits this model			
		2.4	Describe the terms 'house of quality' and 'voice of the customer'			
		2.5	Explain how quality function deployment relates to potential failure modes and effects analysis, design of experiments, value analysis, control plans, Pugh concept diagrams			
		2.6	Explain how to carry out a quality function deployment activity, and the tools and techniques used			
		2.7	Describe the four phases of quality function deployment (pre-planning, design deployment, process and production planning, managing deployment)			
		2.8	Explain how to identify the necessary inputs and outputs for each of the phases			
		2.9	Explain what are the customer's requirements within the project, in terms of needs and expectations, features and functions			
		2.10	Explain how to produce matrices for relationships, specifications, technical requirements and planning			
		2.11	Explain how to score the matrices within the quality function deployment			
		2.12	Describe the extent of their own authority within the project and whom they should report to, in the event of problems they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 107: Leading the Creation of Standard Operating Procedures (SOP)

Unit reference number: F/600/5888

QCF level: 4

Credit value: 8

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead the creation of Standard Operating Procedures (SOP). 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead the creation of standard operating procedures (SOP)	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out and communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Lead the production of a standard operating procedure for two of the following: • Cleaning of equipment • Maintenance of equipment • Health, safety and environmental practices and procedures • Process procedures • Manufacturing operations • Quality improvements • Improvements to customer satisfaction			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Lead the production of standard operating procedures that include all of the following: • Operation/process to be performed • Part/product number and part/product description/operation reference • Operation/process number • Preparation activities prior to starting the operation/process • Description of the full operation/process, broken down into appropriate tasks/activities • Quality standards, health and safety requirements, environmental issues/requirements • Tooling/fixtures/gauges/equipment required • Sketches/photographs/drawings that assist completion of the operation/process • Date of first issue • Originator of the document • Latest revision date			
		1.5	Lead the gathering of information of the current operation or process to identify the optimum and safest method			
		1.6	Agree what tools, equipment, fixtures, documentation and standards are required			
		1.7	Ensure that all team members performing the operation or process have the opportunity to contribute, and agree the method identified			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Lead the production of standard operating procedures in an agreed format and monitor their accuracy against the operation or process requirements			
		1.9	Lead the production of standard operating procedures that minimise all of the following: • Time • Effort • Waste			
		1.10	Arrange for the supply of standard operating procedures at their point of use, and the storage of copies and master copies in accordance with company requirements			
		1.11	Lead the revision of standard operating procedures, as appropriate, to ensure their effectiveness in the workplace			
		1.12	Establish confirmation that the method defined will meet quality, productivity, health, safety and environmental requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead the creation of standard operating procedures (SOP)	2.1	Describe the health and safety requirements of the area for which they are leading the creation of standard operating procedures (SOP)			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Describe the various formats used in creating SOP			
		2.4	Explain where to find the SOP document format to be used in their business			
		2.5	Describe the information that will be required to create a SOP			
		2.6	Explain how SOP are structured, and the importance of their use			
		2.7	Explain methods of communicating/facilitating to ensure that all the required information for the SOP is captured			
		2.8	Describe the operation/process to be captured in the SOP			
		2.9	Explain why SOP are the basis for quality and continuous Improvement			
		2.10	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 them			
		2.11	Explain how to simplify work done, eliminating waste and potential for human error			
		2.12	Explain Takt time, and the relationship with achieving flow in a process			
		2.13	Describe the extent of their own authority, and to whom they should report 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 108: Leading the Application of Six Sigma Methodology to a Project

Unit reference number: D/600/5896

QCF level: 4

Credit value: 14

Guided learning hours: 32

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead the application of Six Sigma methodology to a project. 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead the application of Six Sigma methodology to a project	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Lead the application of the structured Six Sigma methodology and approach to the selected project			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Lead and participate in Six Sigma projects which cover two the following: • Manufacturing • Quality level • Administration			
		1.5	Lead the utilisation of the five phases of Six Sigma within the project: • Define • Measure • Analyse • Improve • Control			
		1.6	Approve the Six Sigma organisational infrastructure, roles and responsibilities and business-specific metrics that would apply			
		1.7	Lead the production of a diagram (family tree) of the Six Sigma organisational infrastructure and the roles of: • Champion • Mentor • Yellow Belt • Green Belt • Black Belt • Master Black Belt			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Lead the production of a metric chart for the Six Sigma projects undertaken: • Financial • Quality • Process			
		1.9	Agree areas where the Six Sigma tools, techniques and activities can be applied, and direct the need to measure those factors that are critical to quality characteristic (CTQC) for the customer, business and process			
		1.10	Identify the critical to quality characteristic (CTQC) of the projects, to include: • Cost • Quality • Delivery			
		1.11	Contribute to the identification of the cost of poor quality, by agreeing the defects per million opportunities (DPMO)			
		1.12	Establish defects per million opportunities to the sigma score, and determine the gap to Six Sigma performance			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead the application of Six Sigma methodology to a project	2.1	Describe the Six Sigma methodology, and how it is applied to a project			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Describe the Six Sigma infrastructure and philosophy			
		2.4	Describe the benefits that will arise from a Six Sigma project			
		2.5	Describe the 'parts per million opportunities' goal of Six Sigma			
		2.6	Describe the calculation of defects per million opportunities (DPMO)			
		2.7	Describe the five phases of Six Sigma that are applied to a project			
		2.8	Explain how to define a critical to quality characteristic (CTQC)			
		2.9	Explain how non-value added activity can serve as a roadblock for achieving Zero Defect			
		2.10	Explain how to define an 'opportunity for defect'			
		2.11	Describe the roles and responsibilities of the key players in the Six Sigma process (Champion, Mentor, Master Black Belt, Black Belt, Green Belt and Yellow Belt)			
		2.12	Describe the relationship between key process input variables (KPIV) and key process output variables (KPOV) (using the equation Y=(f)x)			
		2.13	Describe the extent of their own authority, and to whom they should report 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 109: Leading the Carrying Out of Six Sigma Process Mapping

Unit reference number: T/600/5905

QCF level: 4

Credit value: 14

Guided learning hours: 32

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead the carrying out of Six Sigma process mapping. 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead the carrying out of Six Sigma process mapping	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines.			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Approve the selection of a suitable process on which to carry out the process mapping activity			
		1.4	Agree the key stages that form the overall process under investigation			
		1.5	Lead the collection of the data necessary to construct the Six Sigma process map			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Lead the construction of the process map for the Six Sigma project			
		1.7	Lead the production of a process map, which identifies: • The key process input variables • The key process output variables			
		1.8	Confirm both the key process input variables and the key process output variables as one or more of the following: • Controllable • Critical • Noise • Standard operating procedure			
		1.9	Confirm the value added and non-value added steps in a process			
		1.10	Identify and agree improvements to the process as a result of the information gathered in the Six Sigma mapping activity			
		1.11	Agree and have included on the process map the specifications of both the: • Key process input variables • Key process output variables			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead the carrying out of Six Sigma process mapping	2.1	Describe the health and safety requirements of the area in which they are leading the process mapping activity			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Describe the benefits of carrying out Six Sigma process mapping			
		2.4	Explain what a Six Sigma process map is and how it is constructed			
		2.5	Explain how the Six Sigma process map integrates within a Six Sigma project			
		2.6	Describe what is meant by key process input variables (KPIVs) and key process output variables (KPOVs)			
		2.7	Describe the data collection point for the key process input variables and key process output variables (such as gauges, forms and samples)			
		2.8	Explain what the main types of key process input variables and key process output variables are in terms of being controllable, critical, noise, or standard operating procedures			
		2.9	Explain who should create a Six Sigma process map			
		2.10	Describe the difference between a value added activity and a non-value added activity			
		2.11	Describe the roles and responsibilities of individuals within a process mapping team			
		2.12	Describe the extent of their own authority within the project, and to whom they should report 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 110: Leading the Application of Basic Statistical Analysis

Unit reference number: T/600/5919

QCF level: 4

Credit value: 10

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead the application of basic statistical analysis. 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead the application of basic statistical analysis	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Consult with appropriate people and lead the gathering of the relevant data for statistical analysis			
		1.4	Direct the production of data gathering forms or charts to gather information to enable statistical and graphical analysis to take place			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Lead the recording of the collected data, utilising three of the following methods: • Bar charts • Histograms • Pareto diagrams • Stem and leaf diagrams • Box plots • Time series charts			
		1.6	Lead the use of statistical and graphical analysis on a Six Sigma project			
		1.7	Lead the production of descriptive statistics of data, to include all of the following: • Mean • Median • Mode • Standard deviation • Range and variance			
		1.8	Lead the production of a normal distribution to assess a population from the representative sample			
		1.9	Interpret the statistical data collected, in order to validate and approve the pre-determined courses of action			
		1.10	Approve the production of an action plan as a result of the statistical and graphical analysis undertaken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead the application of basic statistical analysis	2.1	Describe the health and safety requirements of the area in which they are leading the collecting of data			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Describe the meaning of 'variation', how this can be detected with statistics, and how this variation can affect a process			
		2.4	Describe the number of data points needed to draw a statistically valid conclusion			
		2.5	Explain why we need to use basic statistics			
		2.6	Describe the meaning of the terms 'population' and 'sample' when applied to basic statistics			
		2.7	Explain distribution curves and the properties of a normal curve			
		2.8	Explain how to create and use charts and diagrams (such as histograms, box plots, time series charts, Pareto diagrams, stem and leaf diagrams)			
		2.9	Explain how to calculate mean, median, mode, standard deviation, range and variance			
		2.10	Describe the difference between descriptive and inferential statistics			
		2.11	Describe the extent of their own authority within the project, and to whom they should report 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 111: Leading the Application of Six Sigma Metrics to a Project

Unit reference number: Y/600/5931

QCF level: 4

Credit value: 9

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead the application of Six Sigma metrics to a project. 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead the application of Six Sigma metrics to a project	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Lead Six Sigma metrics activities on both: • Products • Processes			
		1.4	Consult with appropriate personnel and lead the gathering of the necessary data to produce a metric graph			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	For the selected activity, lead the application of Six Sigma metrics to monitor the process and justify improvements			
		1.6	Confirm, for each of the activities covered: • Defects per million opportunities • Defects per unit • Rolled through put yield (Yrt) • The sigma score			
		1.7	Confirm and approve metrics, which are: • Long-term • Short-term • Variable or attribute			
		1.8	Approve both primary and secondary metrics for the Six Sigma project			
		1.9	Agree where appropriate to transform variable data to attribute data			
		1.10	Direct the use of the data collected to complete a primary metric graph			
		1.11	Use the graph produced to identify and approve where improvements to metrics can be made			
		1.12	Approve an action plan that will bring about the improvements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead the application of Six Sigma metrics to a project	2.1	Describe the health and safety requirements of the area in which they are leading the Six Sigma metrics activity			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Describe the main features and benefits of carrying out a Six Sigma metrics activity			
		2.4	Describe the importance of using metrics to drive a Six Sigma project			
		2.5	Explain how to calculate defects per million opportunities, defects per unit and rolled throughput yield			
		2.6	Explain how to utilise Z tables to calculate the sigma score			
		2.7	Describe the time period necessary to calculate a meaningful baseline			
		2.8	Explain how to set realistic objectives and targets for the Six Sigma metrics activity			
		2.9	Explain how to gather the data required for inclusion in a metric chart			
		2.10	Explain how to construct a Six Sigma metric chart			
		2.11	Describe the relationship between 'parts per million', 'defects per million opportunities', Yrt and the sigma score			
		2.12	Describe the difference between variable and attribute data			
		2.13	Explain why it is advantageous to transform attribute data into variable data			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Explain how to transform attribute data into variable data			
		2.15	Describe the significance of the 1.5 S shift, and how it can be utilised to infer long-term metric values			
		2.16	Describe the extent of their own authority within the project, and to whom they should report in the event of problems that you cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 112: Leading the Production of a Characteristic Selection Matrix

Unit reference number: R/600/5944

QCF level: 4

Credit value: 9

Guided learning hours: 25

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead the production of a characteristic selection matrix. 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead the production of a characteristic selection matrix	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Work with the customer to agree the customer requirements and manage the application of a characteristic selection matrix to the Six Sigma project			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Lead the production of a characteristic selection matrix for two of the following: • Concept • Product • Design • Process • System • Machine			
		1.5	Lead the five-step process for generating a characteristic selection matrix: • List the customer key process output variable • Score the key process output variables • List the key process input variables that impact the customer key process output variables • Numerically rate the interaction between key process input variables and customer key process output variables • Use ranking to prioritise future team focus			
		1.6	Lead the collection of all the required data necessary to create the matrix			
		1.7	Lead the production of a characteristic selection matrix for the chosen activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Use the characteristic selection matrix produced to agree scoring parameters for: • Customers • Team members			
		1.9	Use the matrix produced to identify and approve activities in the process where improvements can be made			
		1.10	Lead the preparation of and approve an action plan that will bring about the improvements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead the production of a characteristic selection matrix	2.1	Describe the health and safety requirements of the area in which they are leading the characteristic selection matrix activity			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Explain what is a characteristic selection matrix; why we need to produce them; who should create a characteristic selection matrix			
		2.4	Explain how to generate a characteristic selection matrix using the five-step process			
		2.5	Explain what is meant by the term 'customer' when producing a characteristic selection matrix			
		2.6	Explain what are key process output variables and key process input variables			
		2.7	Explain where in the quality function deployment matrix does the characteristic selection matrix appear			
		2.8	Describe the inter-relationship between a characteristic selection matrix and a potential failure modes and effects analysis			
		2.9	Describe the inter-relationship between Six Sigma process mapping and a characteristic selection matrix			
		2.10	Explain how to score a characteristic selection matrix			
		2.11	Explain how a process map links into a characteristic selection matrix			
		2.12	Explain how a characteristic selection matrix links into a potential failure modes and effects analysis			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain how to utilise the results of a characteristic selection matrix			
		2.14	Explain how to prioritise a Six Sigma project teams focus			
		2.15	Describe the extent of their own authority within the project 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 113: Leading the Carrying Out of Capability Studies

Unit reference number: L/600/5957

QCF level: 4

Credit value: 14

Guided learning hours: 32

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to lead the carrying out of capability studies. 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 Business Improvement Techniques Level 4 unit assessment strategy in Annexe E.

Unit specific additional assessment requirements:

The word lead is used throughout this unit. This means that although the outcomes of this unit may be carried out and achieved as part of a team, it is necessary for the learner to demonstrate a level of overriding management and direction of the activities as a whole. This may be in the form of coordinating multiple activities, using company strategies and objectives to determine activity focus and managing projects involving improvement initiatives. The learner will have a leading role in controlling activity focus and planning.

Specific quantifiable and auditable personal contributions in the achievement of this unit are also required to fulfil this unit.

Competence in all the areas covered by the standard is required.

The learner's ability to combine the performance statements specified when applying the principles and processes of this unit must be demonstrated.

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	Lead the carrying out of capability studies	1.1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.2	Lead the activities within their area of responsibility to include all of the following: • Set out an communicate the purpose of the improvement activities • Involve the team in planning how the improvement activity will be achieved • Ensure each team member has individual objectives and understands how these objectives contribute to the overall improvement objective • Provide advice and support the team to achieve both team and individual improvement objectives • Motivate the team to present their own improvement ideas • Encourage the team and/or individuals to take the lead where appropriate • Agree the implementation of the improvement ideas • Negotiate any physical and/or financial resources required to implement the improvement activity (where appropriate) • Monitor the progress of improvement activities • Deal with any organisational problems identified during the improvement activity			
		1.3	Lead a capability study, which covers both: • The short term • The long term			
		1.4	Obtain and approve all the necessary data needed to carry out the capability study analysis			
		1.5	Agree the appropriate sample size using statistical based techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Determine whether rational sub-grouping is appropriate			
		1.7	Lead the process capability study and confirm relevant statistics			
		1.8	Confirm the calculation of the following statistics: • Mean • Median • Mode • Standard deviation • Range • Variance			
		1.9	Confirm the calculation of the following from the above statistics: • The capability indices Cp and Cpk for the process • The sigma score (Z) from the Cpk • The parts per million outside upper and lower specification limits for the processes studied			
		1.10	Lead the production of a histogram to represent the Cp and Cpk graphically			
		1.11	Obtain and approve the information gained and agree activities to improve the process capability			
		1.12	Lead the production of and approve a process capability report highlighting the improvements to be made and the actions to be taken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to lead the carrying out of capability studies	2.1	Describe the health and safety requirements of the area in which they are leading the capability studies			
		2.2	Explain how to plan the resources and time needed to carry out the agreed activity			
		2.3	Explain why we need to assess process capability and how this affects a Six Sigma project			
		2.4	Explain what is meant by the term Sigma Score (Z)			
		2.5	Explain how to calculate the Sigma Score (Z) and use this to estimate the percentage outside of specification			
		2.6	Explain what are Cp and Cpk and how are they calculated			
		2.7	Explain how to calculate long-term capability from short term data			
		2.8	Explain how many samples are needed for a statistically valid short term capability study			
		2.9	Explain what is a population and what is a sample			
		2.10	Explain how to select appropriate sample sizes			
		2.11	Explain how to calculate parts per million			
		2.12	Explain how to calculate mean, median, mode, standard deviation, range, and variance			
		2.13	Explain how to perform rational sub-grouping			
		2.14	Describe the extent of their own authority within the project 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 114: Producing Mechanical Engineering Drawings Using a CAD System

Unit reference number: F/504/6348

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 mechanical 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 F.

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 mechanical engineering 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: • 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, line types, 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, etc)			
		1.3	Plan the drawing activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Use appropriate sources to obtain the required information for the drawing to be created			
		1.5	Use three of the following to obtain the necessary data to produce the required drawings: • Drawing brief • Drawing change or modification request • Manuals • Calculations • Sketches • Specifications • Regulations • Sample component • Existing drawings/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 design features, as appropriate to the drawing being produced: • Function • Quality • Manufacturing method • Ergonomics • Materials • Cost • Life of the product • Tolerances • Clearance • Aesthetics • Physical space • Operating environment • Interfaces • Safety			
		1.7	Carry out all of the following before producing the engineering drawing: • Ensure that the data and information they have is complete and accurate • Review the data and information to identify the drawing requirements • Recognise and deal with problems (such as information-based and technical)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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			
		1.10	Interpret and produce drawings, using two of the following methods of projection: • First angle orthographic projections • Isometric/oblique projections • Third angle orthographic projections			
		1.11	Produce two of the following types of drawing: • Detail drawings • General arrangement drawings • Sub-assembly drawings • Installation drawings			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Produce mechanical drawings which include ten of the following: • Straight lines • Dimensions • Angled lines • Text • Insertion of standard components • Symbols and abbreviations • Curved/contour lines • Circles or ellipses • Geometrical tolerancing • Hidden detail • Sectional detail • Parts lists • Other specific detail			
		1.13	Use codes and other references that follow the required conventions			
		1.14	Produce drawings which comply with the following: • BS and ISO standards Plus one more from the following: • Organisational guidelines • Statutory regulations and codes of practice • CAD software standards • Other international standard			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Make sure that drawings are checked and approved by the appropriate person			
		1.16	Save the drawings in the appropriate medium and location to include all of the following: • Ensure that their drawing has been checked and approved by their supervisor • Check that the drawing is correctly titled and referenced • Save the drawing to an appropriate storage medium (such as hard drive, CD/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) • Record and store any changes to the drawings in the company information system (where appropriate)			
		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 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)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 115: Producing Components Using Hand Fitting Techniques

Unit reference number: J/504/6349

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce components using hand fitting techniques. 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 F.

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 components using hand fitting techniques	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 hand fitting activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, assembly drawings and procedures • Ensure that all power tool cables, extension leads or air supply hoses are in a serviceable condition • Check that all measuring equipment is within calibration date • Ensure that the components used are free from foreign objects, dirt or other contamination • Return all tools and equipment to the correct location on completion of the fitting activities			
		1.3	Plan the fitting activities before they start them			
		1.4	Obtain the appropriate tools and equipment for the hand fitting operations, and check that they are in a safe and usable condition			
		1.5	Mark out the components for the required operations, using appropriate tools and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Mark out a range of material forms, to include two of the following: • Square/rectangular (such as bar stock, sheet material, machined components) • Circular/cylindrical (such as bar stock, tubes, turned components, flat discs) • Sections (such as angles, channel, tee section, joists, extrusions) • Irregular shapes (such as castings, forgings, odd shaped components)			
		1.7	Use marking out methods and techniques, to include: • Direct marking using instruments Plus one more of the following: • Use of templates • Tracing/transfer methods			
		1.8	Use a range of marking out equipment, to include all of the following: • Rules/tapes • Dividers/trammels • Scribers • Punches • Scribing blocks • Squares • Protractor • Vernier instruments			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Mark out workpieces which include all of the following features: • Datum/centre lines • Square/rectangular profiles • Circles • Radial profiles • Linear hole positions Plus one more from the following: • Angles/angular profiles • Radial hole positions • Allowances for bending • Simple pattern development			
		1.10	Cut and shape the materials to the required specification, using appropriate tools and techniques			
		1.11	Cut and shape two different types of material from the following: • Low carbon/mild steel • High carbon steel • Cast iron • Stainless steel • Aluminium/aluminium alloys • Brass/brass alloys • Plastic/nylon/synthetic • Composite • Other specific material			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Use both of the following hand fitting activities: • Filing • Hand sawing Plus one more from the following: • Power sawing • Offhand grinding • Scraping • Chiselling • Lapping			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce components which combine different operations and have features that cover all of the following: • Flat datum faces • Faces which are square to each other • Curved profiles • Drilled through holes • Reamed holes • Internal threads • External threads Plus three more from the following: • Faces that are parallel to each other • Faces angled to each other • Holes drilled to a depth • Chamfers and radii • Counterbore, countersink, or spot face • Sliding or mating parts			
		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	Use all of the following measuring equipment during the hand fitting and checking activities: • External micrometers • Vernier calliper • Surface finish equipment (such as comparison plates, machines) Plus four more of the following: • Rules • squares • Callipers • 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
		1.16	Carry out the necessary checks for accuracy, to include all of the following: • Linear dimensions • Flatness • Squareness • Angles • Profiles • Hole position • Hole size/fit • Depths • Thread size and fit • Surface finish			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Produce components to all of the following standards, as applicable to the process: • Components to be free from false tool cuts, burrs and sharp edges • General dimensional tolerance +/- 0.25mm or +/- 0.010” • There must be one or more specific dimensional tolerances within +/- 0.1mm or +/- 0.004” • Flatness and squareness 0.05mm per 25mm or 0.002" per inch • Angles within +/- 1 degree • Screw threads to BS Medium fit • Reamed and bored holes within H8 • Surface finish 63 µin 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 fitting activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce components using hand fitting techniques	2.1	Describe the health and safety requirements and safe working practices and procedures required for the hand fitting activities undertaken			
		2.2	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy			
		2.3	Describe the hazards associated with the hand fitting 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), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	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			
		2.6	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.7	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)			
		2.8	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
		2.9	Describe the methods of holding and supporting the workpiece during the marking out activities, and equipment that can be used (such as surface plates, angle plates, vee blocks and clamps, parallel bars, screw jacks)			
		2.10	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 which are linearly positioned, boxed and on pitch circles)			
		2.11	Describe the ways of laying out the marking out shapes or patterns to maximise use of materials			
		2.12	Describe the need for clear and dimensional accuracy in marking out to specification and drawing requirements			
		2.13	Explain how to set and adjust tools (such as squares, protractors and Verniers)			
		2.14	Describe the importance of using tools only for the purpose intended; the care that is required when using the equipment and tools; the proper way of storing tools and equipment between operations			
		2.15	Describe the cutting and shaping methods to be used, and the sequence in which the operations are to be carried out			
		2.16	Describe the various types of file that are available, and the cut of files for different applications			
		2.17	Describe the importance of ensuring that file handles are secure and free from embedded foreign bodies or splits			
		2.18	Explain how to prepare the components for the filing operations (cleaning, de-burring, marking out)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Describe the use of vice jaw plates to protect the workpiece from damage			
		2.20	Explain how to file flat, square and curved surfaces, and how to achieve a smooth surface finish (such as by draw filing, the use of abrasive cloth, lapping using abrasive pastes)			
		2.21	Explain how to select saw blades for different materials, and how to set the saw blades for different operations (such as cutting externally and internally)			
		2.22	Explain how to cut external threads using hand dies, and the method of fixing and adjusting the dies to give the correct thread fit			
		2.23	Explain how to determine the drill size for tapped holes, and the importance of using the taps in the correct sequence			
		2.24	Explain how to prepare drilling machines for operations (such as adjustment of table height and position; mounting and securing drills, reamers, countersink and counterbore tools in chucks or Morse taper sockets; setting and adjusting spindle speeds; setting and adjusting guards/safety devices)			
		2.25	Explain how to mount the workpiece (such as in a machine vice, clamped to table, clamped to angle brackets); techniques of positioning drills to marking out, use of centre drills and taking trial cuts and checking accuracy, and how to correct holes which are off centre			
		2.26	Explain how to produce a sliding or mating fit using filing, scraping and lapping techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.27	Describe the problems that can occur with the hand fitting activities, and how these can be overcome (such as defects caused by incorrectly ground drills, inappropriate speeds, damage by workholding devices)			
		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 in a safe and clean condition on completion of the fitting activities (such as removing and storing power leads, isolating machines, removing and returning drills, cleaning the equipment and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 116: Producing Mechanical Assemblies

Unit reference number: F/504/6351

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce mechanical assemblies. 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 F.

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 mechanical assemblies	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 assembly activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, assembly drawings and procedures • Ensure that all power tool cables, extension leads or air supply hoses are in a safe and serviceable condition • Check that tools and measuring instruments to be used are within calibration date • Use lifting and slinging equipment in accordance with health and safety guidelines and procedures (where appropriate) • Ensure that the components used are free from foreign objects, dirt or other contamination • Return all tools and equipment to the correct locations on completion of the assembly activities			
		1.3	Plan the assembly activities before they start them			
		1.4	Obtain and prepare the appropriate components, tools and equipment			
		1.5	Use the appropriate methods and techniques to assemble the components in their correct positions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Produce assemblies using six of the following methods and techniques: • Assembling of components by expansion/contraction • Fitting (such as filing, scraping, lapping or polishing) • Securing by using mechanical fasteners/threaded devices • Applying sealants/adhesives • Electrical bonding of components • Assembling of products by pressure • Setting and adjusting • Drilling • Reaming • Balancing components • Applying bolt locking methods • Shimming and packing • Blue-bedding of components • Aligning components • Riveting • Pinning • Torque setting			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Assemble products to meet the required specification, using nine of the following types of component: • Assembly structure (framework, support, casings, panels) • Pre-machined components • Fabricated components • Bearings • Seals • Bushes • Shafts • Chains • Couplings • Sprockets • Cams and followers • Levers/linkages • Keys • Pulleys • Gears • Pipework/hoses • Springs • Belts • Gaskets • Other specific component			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Assemble products using two of the following assembly aids and equipment: • Workholding devices • Lifting and moving equipment • Specialised assembly tools/equipment • Jigs and fixtures • Shims and packing • Rollers or wedges • Supporting equipment			
		1.9	Secure the components using the specified connectors and securing devices			
		1.10	Secure the components using both of the following categories of fastening devices: • Threaded fasteners (such as nuts, bolts, machine screws, cap screws) • Locking and retaining devices (such as tab washers, locking nuts, wire locks, special purpose types) Plus one more from the following: • Pins (such as parallel/dowels, hollow/roll, tapered, split) • Spring clips (such as external circlips, internal circlips, special clips) • Rivets (such as countersunk, roundhead, blind, special purpose types)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Check the completed assembly to ensure that all operations have been completed and that the finished assembly meets the required specification			
		1.12	Carry out the required quality checks, to include eight from the following, using appropriate equipment: • Positional accuracy • Freedom of movement • Component security • Completeness • Dimensions • Orientation • Alignment • Function • Bearing/shaft end float • Operating/working clearances • Freedom from damage or foreign objects • Torque settings			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce mechanical assemblies which comply with all of the following: • All components are correctly assembled and aligned in accordance with the specification • Moving parts are correctly adjusted and have appropriate clearances • Where appropriate, assemblies meet required geometric tolerances (such as square, straight, angles free from twists) • All fastenings have appropriate washers and are tightened to the required torque • Where appropriate, bolt locking methods are applied			
		1.14	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			
		1.15	Leave the work area in a safe and tidy condition on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce mechanical assemblies	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the assembly activities undertaken			
		2.2	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy			
		2.3	Describe the hazards associated with the assembly activities (such as use of power tools, trailing leads or air hoses, damaged or badly maintained tools and equipment, lifting and handling heavy items), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	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			
		2.6	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.7	Explain how to prepare the components in readiness for the assembly activities (such as visually checking for defects, cleaning the components, removing burrs and sharp edges)			
		2.8	Describe the general principles of mechanical assembly, and the purpose and function of the components and materials used (including component identification systems such as codes and component orientation indicators)			
		2.9	Describe the assembly/joining methods, techniques and procedures to be used, and the importance of adhering to these procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how the components are to be aligned, adjusted and positioned prior to securing, and the tools and equipment to be used for this			
		2.11	Describe the various mechanical fastening devices that are used (such as nuts, bolts, machine screws, cap screws, clips, pins, locking and retaining devices)			
		2.12	Describe the importance of using the specified components and joining devices for the assembly, and why they must not use substitutes			
		2.13	Explain where appropriate, the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them			
		2.14	Explain how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the assembly (such as checking for correct operation where the assembly has moving parts, checking the torque figures to which critical fastenings have been tightened, checking the end float on shafts, checking operating clearance on actuating mechanisms)			
		2.15	Explain how to detect assembly defects, and what to do to rectify them (such as ineffective joining techniques, foreign objects, component damage)			
		2.16	Describe the methods and equipment used to transport, lift and handle components and assemblies			
		2.17	Explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition			
		2.18	Describe the importance of ensuring that all tools are used correctly and within their permitted operating range			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities			
		2.20	Describe the problems that could occur with the assembly operations, and the importance of informing appropriate people of non-conformances			
		2.21	Explain when to act on their own initiative and when to seek help and advice from others			
		2.22	Explain how to Leave the work area in a safe and clean condition on completion of the assembly activities (such as removing and storing power leads, returning hand tools and 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 117: Forming and Assembling Pipework Systems

Unit reference number: L/504/6353

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to form and assemble pipework systems. 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 F.

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	Form and assemble pipework systems	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 pipe bending, forming and fitting activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, assembly drawings and procedures • Check that the bending and forming equipment is in a safe and usable condition • Return all tools and equipment to the correct location on completion of the pipe fitting activities • Apply safe working practices at all times			
		1.3	Plan the pipe fitting activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Produce pipework assemblies using two of the following types of pipe: • Carbon steel • Stainless steel • Copper • Brass • Aluminium • Plastic			
		1.5	Mark out pipework, using the following method: • Direct marking using tapes and markers Plus one more from the following: • Set-outs of pipework using templates • Producing set wires • Set-outs of pipework onto floor			
		1.6	Cut the pipes to the appropriate lengths making allowances for bending and attachment of fittings			
		1.7	Cut and prepare the pipes for forming and assembly, to include carrying out all of the following: • Cutting pipes to length with appropriate allowance for fittings • Removing all external and internal burrs • Cleaning pipe ends for soldering or cementing (where appropriate) • Cutting threads on pipe ends to the appropriate length (where appropriate) • Checking that prepared pipes are the correct length			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Cut and prepare pipework using the following: • Saws (hand or power) Plus two more from the following: • Pipe/tube cutter • De-burring reamers • Abrasive cloth • Wire pipe cleaners			
		1.9	Bend and form the pipes using the appropriate tools and equipment for the types and sizes of pipe			
		1.10	Bend and form pipe using the following method: • Hand operated pipe bender Plus one more of the following: • Bending springs • Hydraulic pipe bending equipment • Pipe expander • Heating methods • Swaging kit • Fillers			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce pipework bends/forms that include both of the following: • Angular bends • Offsets Plus one more from the following: • Bridge sets • Expansion loops • Radii • External swaged ends • Internal swaged ends			
		1.12	Assemble and secure the pipework, using the correct fittings and joining techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce pipework assemblies which combine a range of different fittings, covering all of the following: • Straight couplings • Elbows • Tee pieces Plus three more from the following: • Flanges • Unions • Reduction pieces • Valves • Drain/bleeding devices • Blanking caps • Screwed fittings (such as tank, tap, pump, gauges)			
		1.14	Assemble pipes using three of the following methods: • Compression fittings • Snap-on/push fittings • Screwed connections • Soldered fittings • Brazed fittings • Cemented fittings • Welded joints			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Assemble pipework using all of the following methods and techniques: • Securing pipework supports to structures • Fitting pipework supports • Connecting pipe-to-pipe • Connecting pipe-to-equipment • Using gaskets, seals/sealing tapes or jointing compounds • Alignment/levelling equipment			
		1.16	Produce pipework assemblies which comply with all of the following: • Pipes are bent to the appropriate shape/form and position • All pipe bends are free from buckling or deformation • Appropriate fittings are used, and are secure and leak free • Soldered and cemented fittings are free from excessive residues • The completed assembly meets the specific system requirements			
		1.17	Check the completed assembly to ensure that all operations have been completed and that the finished pipe assembly meets the required specification			
		1.18	Test the completed pipe assembly, using the appropriate techniques, tools and equipment			
		1.19	Carry out tests on the assembled pipework, to include one of the following: • Hydraulic pressure testing • Gas/air leakage test • Water leakage testing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.20	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			
		1.21	Leave the work area in a safe and tidy condition on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to form and assemble pipework systems	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the pipe fitting 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 the pipe fitting activities (such as handling long pipe lengths, using damaged or badly maintained tools and equipment, using pipe bending equipment, using heating and soldering equipment, using adhesives), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	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			
		2.6	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.7	Describe the principles and methods of marking out pipework, and the type of equipment used (such as direct marking, use of templates, use of set wires)			
		2.8	Explain how to prepare the pipes in readiness for the marking out activities (visually checking for defects, cleaning the materials, removing burrs and sharp edges)			
		2.9	Explain how to determine the overall length of the pipework required, taking into account allowances for pipe fittings and (where appropriate) screwed connections			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Describe the tools and equipment used in the cutting and preparing the pipes (such as saws, pipe and tube cutters)			
		2.11	Describe the characteristics of the various materials that are to be used with regard to the bending operations, and why some materials may require the addition of heat/hot air to aid the bending process			
		2.12	Describe the methods used to hand bend and form the pipe (including the use of bending springs, hand bending machines, fillers, heating methods)			
		2.13	Explain how to produce the various bends required (such as angled bends, dog-leg sets, bridge sets and expansion loops)			
		2.14	Describe the reasons for incorporating expansion loops in a system, and where they should be positioned			
		2.15	Explain how to prepare pipework and fittings for the assembly operation (such as checking for damage, removing foreign objects, dirt and swarf from bore of pipe, removing burrs)			
		2.16	Describe the range of pipe fittings that can be used, and how to identify them (such as straight connectors, elbows, tee pieces, reduction pieces, flanged fittings, valves, blanking pieces/cap ends)			
		2.17	Describe the different types of fittings available, such as screwed fittings, soldered fittings, compression fittings, push fit fittings and glued/cemented fittings			
		2.18	Explain how to produce screw threads on the pipe ends, and the tools and equipment that can be used (such as stocks and dies, pipe threading machines)			
		2.19	Describe the methods used to seal screwed joints (such as tapes and sealing compounds)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Describe the use of flanges to connect pipes; use of gaskets; and torque loading of flange bolts			
		2.21	Describe the methods used to prepare pipe ends and fittings for soldering or brazing, and why it is necessary to ensure that these preparations are carried out			
		2.22	Describe the various types of soldered connectors available (such as solder ring types and capillary fittings)			
		2.23	Describe the methods used to solder the joints, and how to recognise when the fitting is correctly soldered			
		2.24	Describe the precautions to be taken when using gas torches to form the joint, and the effect of overheating the joint			
		2.25	Describe the methods used to prepare pipe ends and fittings when using adhesives, and why it is necessary to ensure that these preparations are carried out			
		2.26	Describe the methods used to cement the joints, and how to recognise when the fitting is correctly secured			
		2.27	Describe the various adhesives and sealing compounds that are used on non-metallic pipework			
		2.28	Describe the precautions to be taken when using the adhesives, cements and sealing compounds (such as adequate ventilation, fume extraction, away from naked flames, avoiding skin contact)			
		2.29	Describe the use of compression fittings; how the pipes are sealed; and the effects of over tightening the fittings			
		2.30	Describe the use of push-fit connectors, and their advantages and disadvantages			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.31	Explain how to identify the correct orientation of fittings with regard to flow, and the consequences of incorrect orientation			
		2.32	Describe the supporting methods that are used when assembling pipework, and the type of fittings that are used			
		2.33	Describe the methods of testing pipework systems for leaks (using air, water or hydraulic testing methods)			
		2.34	Describe the extent of their own responsibility and whom they should report to if they have problems that they cannot resolve			
		2.35	Describe the importance of leaving the work area in a safe and clean condition on completion of the pipework assembly activities (such as removing and storing power leads, returning hand tools and equipment to is 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 118: Carrying Out Aircraft Detail Fitting Activities

Unit reference number: R/504/6354

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out aircraft detail fitting 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 F.

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 aircraft detail fitting activities	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 aircraft detail fitting activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Check that all measuring equipment is within calibration date • Ensure that all power tool cables, extension leads or air supply hoses are in a serviceable condition and PAT tested • Return all tools and equipment to the correct location on completion of the detail fitting activities			
		1.3	Plan the aircraft detail fitting activities before they start them			
		1.4	Obtain the appropriate tools and equipment for the aircraft detail fitting operations, and check that they are in a safe and usable condition			
		1.5	Mark out the components for the required operations, using appropriate tools and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Mark out a range of material forms, to include three from: • Square/rectangular (such as bar stock, sheet material, machined components) • Circular/cylindrical (such as bar stock, tubes, turned components, flat discs, rolled cylinders/cones) • Sections (such as angle, channel, tee section, joists, extrusions) • Irregular shapes (such as castings, forgings, odd shaped components) • Detail assemblies			
		1.7	Use two types of material from: • Aluminium • Titanium • Stainless steel • Composite material • Other specific material			
		1.8	Use marking out methods and techniques which include the following: • Direct marking using instruments Plus one more from the following: • Use of templates • Tracing/transfer methods • Other specific method			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Use a range of marking out equipment, to include all of the following: • Marking tools • Rules/tapes • Squares • Protractors • Vernier instruments • Dividers/compass			
		1.10	Mark out workpieces, to include all of the following features: • Datum/centre lines • Square/rectangular profiles • Circles and radial profiles • Linear hole positions Plus two more from the following: • Angles/angular profiles • Radial hole positions • Allowances for bending • Simple pattern development			
		1.11	Cut and shape the materials to the required specification, using appropriate tools and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Cut and shape the materials, using four of the following: • Saws (hand or mechanical) • Guillotines • Bench knives • Tin snips • Drills and hole saws • Nibblers • Cropping machines • Files • Abrasive discs			
		1.13	Bend and form the materials, using the appropriate tools and equipment			
		1.14	Bend and form materials using four of the following: • Bench folding machines • Box pan folding machines • Pinch or pyramid rolling machines • Presses • Hand tools • Heating techniques • Shrinking techniques • Stretching techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Produce components which combine different operations and have features that cover all of the following: • Edges/faces that are square to each other • Edges/faces that are parallel • Curved or circular forms • Holes linearly pitched Plus two more of the following: • Edges/faces that are angled • Internal profiles • External profiles • • Holes radially pitched			
		1.16	Produce a range of components with features that cover five of the following: • Right angled bends • Angled bends • Square flanges • Tray sections and channels • Curved/circular flanges • Curved profile • Cylindrical shape • Conical shape • Dished profile			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Assemble and secure the components, using the correct fastening devices and joining techniques			
		1.18	Measure and check that all dimensional and geometrical aspects of the component are to the specification			
		1.19	Produce components to all of the following standards, as applicable to the process: • Components to be free from false tool cuts, burrs and sharp edges • Finished components meet the required shape/geometry (to the template profile) • Completed components are free from excessive tooling marks, deformation or cracking • Dimensional tolerance +/- 0.25mm or +/- 0.010” • Flatness and squareness 0.05mm per 25mm or 0.002" per inch • Angles within +/- 0.5 degree • Screw threads to BS Medium fit • Reamed and bored holes within H8 • Surface finish 63 µin or 1.6 µm			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.20	Use both of the following types of measuring equipment during the detail fitting and checking activities: • External micrometers • Vernier calliper Plus four more of the following: • Rules • Squares • Callipers (external and internal) • Vernier protractors • Depth micrometers • Depth Verniers • Slip gauges • Feeler gauges • Bore/hole gauges • Radius/profile gauges • Thread gauges • Dial test indicators (DTI) • Surface finish equipment (such as comparison plates, machines) • Coordinate measuring machine (CMM)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.21	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			
		1.22	Leave the work area in a safe and tidy condition on completion of the fitting activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to carry out aircraft detail fitting activities	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the aircraft detail fitting 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 the aircraft detail fitting activities (such as use of power tools, trailing leads or hoses, damaged or badly maintained tools and equipment, use of forming and bending equipment, using hand shears and guillotines), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	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			
		2.6	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.7	Explain how to identify the materials to be used; material identification systems; codes used and grain flow indicators			
		2.8	Describe the principles of marking out, and the equipment used in the aerospace industry			
		2.9	Explain how to clean and prepare the surfaces to be marked out ensuring, where appropriate, that grain flow is taken into account			
		2.10	Explain how to calculate bending allowances when marking out			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain how to select and establish suitable datums; the importance of ensuring that marking out is undertaken from the selected datums, and the possible effects of working from different datums			
		2.12	Explain how to mark out the workpiece (including datums; cutting guidelines; square and rectangular profiles; circular and radial profiles; angles; holes which are linearly positioned, boxed and on pitch circles)			
		2.13	Describe the various methods of pattern development that can be used (such as parallel line; radial line; triangulation), and typical applications of each method			
		2.14	Describe the ways of laying out the marking-out shapes or patterns to maximise use of materials			
		2.15	Describe the need for clear and dimensional accuracy in marking out to specification and drawing requirements			
		2.16	Describe the importance of using tools only for the purpose intended; the care that is required when using the equipment and tools; the proper way of storing tools and equipment between operations			
		2.17	Describe the shaping methods and techniques that can be used to produce a range of shapes/profiles on the various section materials (such as sawing, shearing, drilling, filing, abrading), and the sequence in which the operations will need to be carried out			
		2.18	Explain how to select saw blades for different applications and materials, and methods of setting saw blades for cutting externally and internally (such as hand saws, mechanical saws, band saws)			
		2.19	Describe the various shearing methods that can be used (such as tin snips, bench shears, guillotines, cropping machines and nibbling machines)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Describe the range of hand tools and associated equipment that is used to produce a variety of shapes, bends, curved surfaces, dished profiles			
		2.21	Describe the range of bending and forming machines to be used (such as fly presses, bending machines, rolling machines, flanging machines)			
		2.22	Explain how to set up a bending machine to produce a range of forms (such as right-angled bends, angled bends, tray sections, channel sections)			
		2.23	Explain how to set up pinch/pyramid forming rolls to produce a variety of forms (such as curved profiles, cylinders, cones)			
		2.24	Explain how to produce flanges on curved/cylindrical components (using machines and hand tools)			
		2.25	Describe the methods of drilling and finishing holes in sheet and stock materials (such as drills, reamers, countersinks, hole saws)			
		2.26	Describe the various types of files that are available; the cut of files for different applications; the importance of ensuring that file handles are safe and free from embedded foreign bodies			
		2.27	Describe the preparations and or treatments that may need to be carried out on the materials before and after the cutting and shaping operations			
		2.28	Describe the purpose and use of joint sealing agents and anti-electrolysis barriers, and the precautions to be taken when using them			
		2.29	Explain how to conduct any necessary checks to ensure the accuracy and quality of the components produced			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.30	Describe the problems that can occur with the cutting, shaping and forming operations, and how these can be overcome			
		2.31	Explain when to act on their own initiative and when to seek help and advice from others			
		2.32	Describe the importance of leaving the work area in a safe and clean condition on completion of the aircraft detail fitting activities (such as removing and storing power leads, isolating machines, removing and returning drills, cleaning the equipment and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 119: Installing Aircraft Mechanical Fasteners

Unit reference number: L/504/6367

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 install aircraft mechanical fasteners. 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 F.

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	Install aircraft mechanical fasteners	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 activities during the installation of the mechanical fasteners: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Check that all measuring equipment is within calibration date • Ensure that all power tool cables, extension leads or air supply hoses are in a serviceable condition and PAT tested • Return all tools and equipment to the correct location on completion of the installation activities			
		1.3	Plan the installation of the mechanical fasteners before they start the activity			
		1.4	Obtain the appropriate tools and equipment for the installation operations, and check that they are in a safe and usable condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Use both of the following types of equipment: • Riveting guns (appropriate to rivet type) • Gripping pins and location dowels Plus two more from the following: • Gauges for intrusions • Drills and tools with attachments • Redline templates • Jigs • Clamps			
		1.6	Assemble and secure the components, using the correct fastening devices and joining techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Install a range of mechanical fasteners, to include all of the following: • Hollow rivets • Solid rivets • threaded fasteners • Quick release fasteners Plus two more from the following: • Collared fasteners • Anchor nuts • Split pins • Rivnuts • NAPPY pins • Pin clips • PIP/PIT pins • Wire locks • Other locking devices			
		1.8	Use all of the following installation methods and techniques: • Countersinking • Milling rivets • Solid riveting (single and double handed) • Wire locking • Through-hole • Blind riveting			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Make three types of connection from: • Wet assembly • Dry assembly • Panels • Skins • Structures • Repairs			
		1.10	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
		1.11	Use four of the following to carry out appropriate checks during, and on completion of, the installation activities: • Rules • Squares • Callipers • Protractors • Micrometers • Verniers • Slip gauges • Feeler gauges • Bore/hole gauges • Radius/profile gauges • Dial test indicators (DTI) • Torque wrenches/gauges • Rivet intrusion gauges			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Install aircraft mechanical fasteners to comply with all of the following requirements: • All components are correctly assembled and aligned, in accordance with the specification • Overall dimensions are within specification tolerances • Assemblies meet appropriate geometric tolerances (such as square, straight, angles free from twists) • Where appropriate, pitches of rivets/fasteners meet specification requirements • Completed assemblies have secure and firm joints, and are clean and free from burrs/flash, deformation or cracking			
		1.13	Check that the installation is complete, and that all components are free from damage			
		1.14	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			
		1.15	Leave the work area in a safe and tidy condition on completion of the fitting activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to install aircraft mechanical fasteners	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the installation of the aircraft mechanical fasteners			
		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 installing aircraft mechanical fasteners, and with the tools and equipment used (such as use of power tools, trailing leads or hoses, damaged or badly maintained tools and equipment), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	Describe the importance of working to the installation instructions and appropriate specifications			
		2.6	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			
		2.7	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.8	Describe the process for the control of materials, and the need for component control and quarantine			
		2.9	Explain how to identify the mechanical fasteners to be used; material identification systems; codes used and grain flow indicators			
		2.10	Explain why they must obtain design approval before removing and replacing faulty fasteners			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Describe the purpose and use of joint sealing agents and anti-electrolysis barriers, and the precautions to be taken when using them			
		2.12	Describe the regulations concerning electrical bonding and anti-electrolysis barriers			
		2.13	Describe the various types and range of screwed fasteners used on aircraft fittings, and the methods of installing them			
		2.14	Describe the types and applications of aircraft rivets, and the advantages of hollow rivets over solid rivets			
		2.15	Describe the reasons for using screw fastenings rather than rivets			
		2.16	Describe the purpose and use of a countersink cage			
		2.17	Describe the various locking devices used with fastenings			
		2.18	Describe the purpose and use of locating dowels, gripping pins and gauges, when carrying out fastening operations			
		2.19	Describe the procedures to be adopted when removing rivets and other fasteners			
		2.20	Describe the term 'quilting', its occurrence and avoidance			
		2.21	Describe bolt break-offs, and where they occur			
		2.22	Explain how to check that riveting guns, power tools and attachments are in a safe and usable condition, and the action to be taken in the event of identifying defective equipment			
		2.23	Describe the types of gauges used to measure angles, depths, countersinks and torque			
		2.24	Explain how and why tools are calibrated, and how to check that the tools they are using are within calibration dates			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.25	Explain how to conduct any necessary checks to ensure the accuracy and quality of the installations produced			
		2.26	Describe the problems that can occur with the installation of the mechanical fasteners, and how these can be overcome			
		2.27	Explain when to act on their own initiative and when to seek help and advice from others			
		2.28	Describe the importance of leaving the work area in a safe and clean condition on completion of the activities (such as removing and storing power leads, isolating machines, removing and returning drills, cleaning the equipment and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 120: Producing Aircraft Detail Assemblies

Unit reference number: L/504/6370

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce aircraft detail assemblies. 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 F.

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 aircraft detail assemblies	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 activities during assembly: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Check that all tools, test and measuring equipment are within calibration date and PAT tested • Ensure that all power tool cables, extension leads or air supply hoses are in a serviceable condition • Return all tools and equipment to the correct location on completion of the assembly activities			
		1.3	Plan the aircraft detail assembly activities before they start them			
		1.4	Obtain the appropriate tools and equipment for the aircraft detail assembly operations, and check that they are in a safe and usable condition			
		1.5	Obtain the specified components and check that they are in a usable condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Produce aircraft detail assemblies, which includes seven of the following components: • Skins • Stringers • Cleats • Tanks • Frames • Ribs • Panels • Brackets • Trays • Angles • Pipes, unions and joints • Jumper braids, bonding clips, earthing straps • Aircraft general supplies • Other small assemblies, as applicable			
		1.7	Use the appropriate methods and techniques to assemble the components in their correct positions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Apply all of the following assembly methods and techniques: • Drilling and riveting • Ensuring that correct part numbers are used • Applying sealants/adhesives • Electrical bonding of components • Ensuring that correct hand of components is used (left or right handed) • Positioning and aligning components for cosmetic appearance and skin lines • Securing components using mechanical fasteners and threaded devices • Applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts)			
		1.9	Secure the components using the specified connectors and securing devices			
		1.10	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
		1.11	Produce assemblies which comply with all of the following: • All components are correctly assembled and aligned in accordance with the specification • Overall dimensions are within specification tolerances • Assemblies meet appropriate geometric tolerances (such as square, straight, angles free from twists) • Where appropriate, pitches of rivets/fasteners meet specification requirements • Completed assemblies have secure and firm joints, and are clean and free from burrs/flash, deformation or cracking			
		1.12	Check the completed assembly to ensure that all operations have been completed and that the finished assembly meets the required specification			
		1.13	Carry out quality and accuracy checks which include three from the following: • Cosmetic appearance • Accuracy of skin lines • Freedom from damage • Torque loading checks • Electrical bonding and continuity			
		1.14	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			
		1.15	Leave the work area in a safe and tidy condition on completion of the fitting activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce aircraft detail assemblies	2.1	Describe the specific safety precautions to be taken whilst carrying out the detail assembly operations (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)			
		2.2	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy			
		2.3	Describe the hazards associated with producing aircraft detail assemblies, and with the tools and equipment used (such as use of power tools, trailing leads or hoses, damaged or badly maintained tools and equipment), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	Describe the importance of working to the assembly instructions and appropriate specifications			
		2.6	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			
		2.7	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.8	Explain how to identify the components to be used; component identification systems; codes used and component orientation indicators			
		2.9	Describe the preparations to be undertaken on the components prior to fitting them into the assembly			
		2.10	Describe the assembly methods and procedures to be used, and the importance of adhering to these procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain how the components are to be aligned and positioned, and the tools and equipment that are used (including jigs and fixtures)			
		2.12	Describe the methods used to hold the components in their correct position prior to securing them with the appropriate fasteners			
		2.13	Describe the various mechanical fasteners that will be used, and their method of installation (including open and blind rivets, threaded fasteners, special securing devices)			
		2.14	Describe the importance of using the specified fasteners for the particular assembly, and why they must not use substitutes			
		2.15	Explain what to do if the components or fastening devices are not assembled correctly, are damaged, or have other faults			
		2.16	Explain why they must obtain design approval before removing and replacing faulty fasteners			
		2.17	Describe the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with the various adhesives and sealants			
		2.18	Describe the purpose and use of joint sealing agents and anti-electrolysis barriers, and the precautions to be taken when using them			
		2.19	Describe the quality control procedures to be followed during the assembly operations			
		2.20	Explain how to conduct any necessary checks to ensure the accuracy and quality of the assemblies produced			
		2.21	Explain how and why tools are calibrated, and how to check that the tools they are using are within calibration dates			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.22	Describe the importance of using all tools in the correct manner and within their permitted operating range			
		2.23	Describe the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects			
		2.24	Describe the problems that can occur with the detail assembly operations, and how these can be overcome			
		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 in a safe and clean condition on completion of the aircraft detail assembly activities (such as removing and storing power leads, isolating machines, removing and returning drills, cleaning the equipment and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 121: Preparing and Using Lathes for Turning Operations

Unit reference number: Y/504/6372

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use lathes for turning operations. 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 F.

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	Prepare and use lathes for turning operations	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices at all times during the turning activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Machine guards are in place and are correctly adjusted • Components are held securely (without damage or distortion) • Cutting tools are maintained in a suitable/safe condition • Make sure the work area is maintained and left in a safe and tidy condition			
		1.3	Plan the machining activities before they start them			
		1.4	Obtain and prepare the appropriate materials, tools and equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Machine components made from two of the following types of material: • Low carbon/mild steel • High carbon steel • Aluminium/aluminium alloys • Cast iron • Brass/brass alloys • Plastic/nylon/composite • Other specific material			
		1.6	Mount and set the required workholding devices, workpiece and cutting tools			
		1.7	Mount, secure and machine components using three of the following workholding devices: • Three-jaw chucks with hard jaws • Three-jaw chucks with soft jaws • Four-jaw chucks • Collet chucks • Drive plate and centres • Fixtures • Faceplates • Magnetic or pneumatic devices • Fixed steadies or travelling steadies • Special purpose workholding devices (such as wax chucks)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Mount and use eight of the following types of tool: • Turning • Facing • Boring • Knurling • Parting off • Forming • Recessing/grooving • Chamfering • Centre drills • Twist/core drills • Reamers • Taps • Thread forming tools • Dies			
		1.9	Set and adjust the machine tool speeds and feeds to achieve the component specification			
		1.10	Use the machine tool controls safely and correctly, in line with operational procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce machined components which combine different operations and have features that cover all of the following: • Flat faces • Parallel diameters • Stepped diameters • Tapered diameters • Drilled holes • Reamed holes • Chamfers • Grooves/undercuts Plus four more of the following: • Bored holes • Profile forms • Internal threads • External threads • Eccentric diameters • Parting off • Knurls or special finishes			
		1.12	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
		1.13	Carry out the necessary checks for accuracy, to include all of the following: • External diameters • Parallelism • Bore/hole size/fit • Angle/taper • Surface finish • Linear dimensions (such as lengths, depths) • Grooves/undercuts (such as position, width, depth) Plus two more of the following: • Internal diameters • Concentricity • Eccentricity • Ovality • Thread fit			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Use all of the following measuring equipment during the machining and checking activities: • External micrometers • Vernier/digital/dial callipers • Dial test indicators (DTI) • Surface finish equipment (such as comparison plates, machines) Plus four more of the following: • Rules • Internal micrometers • Depth micrometers • Depth Verniers • Slip gauges • Bore/hole gauges • Thread gauges (such as ring, plug, profile) • Plug gauges • Radius/profile gauges • Protractors • Coordinate measuring machine (CMM)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Produce components to all of the following quality and accuracy standards, as applicable to the operation: • Components to be free from false tool cuts, burrs and sharp edges • General dimensional tolerance +/- 0.25mm or +/- 0.010” • There must be one or more specific dimensional tolerances within +/- 0.1mm or +/- 0.004” • Surface finish 63 µin or 1.6µm • Reamed holes within H8 • Screw threads BS medium fit • Angles within +/- 0.5 degree			
		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	Shut down the equipment to a safe condition on completion of the machining activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use lathes for turning operations	2.1	Describe the safe working practices and procedures to be followed when preparing and using lathes (such as ensuring the correct isolation of the machine before mounting workholding devices; fitting and adjusting machine guards, ensuring that the workpiece is secure and that tooling is free from the workpiece before starting the machine)			
		2.2	Describe the hazards associated with the turning operations (such as revolving/moving parts of machinery, airborne and hot metal particles, sharp cutting tools and burrs and sharp edges on component), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be worn for the turning activities (such as correctly fitting overalls and safety glasses; ensuring that, if they have long hair, it is tied back or netted; and removing any jewellery or other items that can become entangled in the machinery)			
		2.4	Describe the safety mechanisms on the machine (such as emergency stop buttons, emergency treadle brakes), and the procedure for checking that they function correctly			
		2.5	Describe the correct operation of the machine controls in both hand and power modes, how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency			
		2.6	Explain how to plan and prepare to carry out the machining operations (such as obtaining the component drawing, determining the machines required, selecting materials, selecting workholding methods and devices, selecting cutting tools, determining a suitable sequence of operations, determining quality checks to be made and equipment to be used)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 (to include first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing)			
		2.8	Describe the main features of the lathe and the accessories that can be used (such as saddle, capstan/turret head, compound slide, tailstock, taper turning attachments, profile attachments, fixed and travelling steadies)			
		2.9	Explain how to position and secure workholding devices to the machine spindle, and the checks to be made (such as ensuring that all seating/location faces are clean and undamaged, that (where appropriate) the workholding device location marks are lined up with those on the machine spindle, and checking that all bolts, cam locks or other securing devices are tightened securely)			
		2.10	Describe the effects of clamping the workpiece in a chuck/workholding device, and how this can cause damage or distortion in the finished components			
		2.11	Describe the various turning operations that can be performed, and the shapes and types of tooling that can be used (such as solid high-speed tooling, brazed tip tooling, interchangeable tipped tooling)			
		2.12	Explain how to mount and secure the cutting tools in the tool holding devices (such as front or rear tools posts; mounting drills in chucks or by the use of Morse taper sockets; the importance of ensuring that the tool is at the correct centre height and that tool overhang is kept to a minimum)			
		2.13	Explain how to check that cutting tools are in a safe and usable condition and how to handle and store tools safely/correctly			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Describe the effects of backlash in machine slides and screws, and how this can be overcome			
		2.15	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			
		2.16	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, type of tool used, size of material, operations being performed, workholding method/security of workpiece, condition of machine, finish and tolerance required)			
		2.17	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			
		2.18	Describe the checks to be carried out on the components before removing them from the machine, and the equipment that will need to be used (including micrometers, Verniers and surface texture comparison methods			
		2.19	Explain how to check that the measuring equipment is within current calibration dates and that the instruments are correctly zeroed; measuring internal and external dimensions (such 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)			
		2.20	Describe the problems that can occur with the turning activities (such as defects caused by incorrectly ground tools, inappropriate feeds/speeds, damage by workholding devices), and how these can be overcome			

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 machine in a safe condition on completion of the turning activities (such as correctly isolated, cutting tools removed, cleaning the machine and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 122: Preparing and Using Milling Machines

Unit reference number: K/504/6375

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use milling machines. 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 F.

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	Prepare and use milling machines	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices at all times during the machining activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Machine guards are in place and correctly adjusted • Components are held securely (without damage or distortion) • Cutting tools are maintained in a suitable/safe condition • Make sure the work area is maintained and left in a safe and tidy condition			
		1.3	Plan the machining activities before they start them			
		1.4	Obtain and prepare the appropriate materials, tools and equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Machine components made from two of the following types of material: • Low carbon/mild steel • High carbon steel • Aluminium/aluminium alloys • Cast iron • Brass/brass alloys • Plastic/nylon/composite • Other specific material			
		1.6	Mount and set the required workholding devices, workpiece and cutting tools			
		1.7	Mount, secure and machine components, using two of the following workholding devices: • Fixed vice • Swivel or universal vice • Fixtures • Direct clamping to machine table • Angle plates • Vee block and clamps • Magnetic or pneumatic devices • Chucks • Indexing device			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Mount and use four of the following types of milling cutters/tools tools: • Face mills • Slab/cylindrical cutters • End mills • Slot drills • Side and face cutters • Slot cutters • Slitting saws • Vee cutters • Taps • Twist/core drills • Reamers • Boring bars • Other form cutters			
		1.9	Set and adjust the machine tool speeds and feeds to achieve the component specification			
		1.10	Use the machine tool controls safely and correctly, in line with operational procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce machined components that combine different operations and have features that cover all of the following: • Flat faces • Square faces • Parallel faces • Steps/shoulders • Open ended slots • Enclosed slots Plus two more of the following: • Angular faces • Recesses • Drilled holes • Tee slots • Bored holes • Indexed or rotated forms • Profile forms (such as vee, concave, convex, gear forms, serrations, special forms)			
		1.12	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
		1.13	Carry out the necessary checks for accuracy, to include all of the following: • Linear dimensions • Depths • Flatness • Squareness • Surface finish • Slots (such as position, width, depth) • Angles (where appropriate) • Hole size/fit (where appropriate)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Use the following measuring equipment during the machining and checking activities: • External micrometers • Vernier/digital/dial callipers • Dial test indicators (DTI) • Surface finish equipment (such as comparison plates, machines) Plus four more of the following: • Rules • Squares • Internal micrometers • Depth micrometers • Depth Verniers • Feeler gauges • Bore/hole gauges • Slip gauges • Radius/profile gauges • Protractors • Coordinate measuring machine (CMM)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Produce components to all of the following quality and accuracy standards, as applicable to the operation: • Components to be free from false tool cuts, burrs and sharp edges • General dimensional tolerance +/- 0.25mm or +/- 0.010” • There must be one or more specific dimensional tolerances within +/- 0.1mm or +/- 0.004” • Flatness and squareness within 0.125mm per 25mm or 0.005” per inch • Reamed holes within H8 • Surface finish 63 µin or 1.6µm • Angles within +/- 1 degree			
		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	Shut down the equipment to a safe condition on completion of the machining activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use milling machines	2.1	Describe the safe working practices and procedures to be followed when preparing and using milling machines (such as ensuring the correct isolation of the machine before mounting cutters and workholding devices; fitting and adjusting machine guards, ensuring that the workpiece is secure and that cutters are free from the workpiece before starting the machine)			
		2.2	Describe the hazards associated with the milling operations (such as revolving/moving parts of machinery, airborne and hot metal particles, sharp cutting tools and burrs and sharp edges on component), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be worn for the milling activities (such as correctly fitting overalls and safety glasses; ensuring that, if they have long hair, it is tied back or netted; and removing any jewellery or other items that can become entangled in the machinery)			
		2.4	Describe the safety mechanisms on the machine (such as emergency stop buttons, emergency brakes), and the procedure for checking that they function correctly			
		2.5	Describe the correct operation of the machine controls in both hand and power modes, how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency			
		2.6	Describe the planning and preparing to carry out the machining operations (such as obtaining the component drawing, determining the machines required, selecting materials, selecting workholding methods and devices, selecting cutting tools, determining a suitable sequence of operations, determining quality checks to be made and equipment to be used)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 (to include first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing)			
		2.8	Describe the main features of the milling machine, and the accessories that can be used (such as vertical heads, indexing devices)			
		2.9	Explain how to position and secure workholding devices to the machine table, and the checks to be made (such as ensuring all seating/location faces are clean and undamaged, ensuring that the device is suitably aligned using instruments or tenons, as appropriate, and checking that all bolts or other securing devices are tightened securely)			
		2.10	Describe the effects of clamping the workpiece in a vice or other workholding device, and how this can cause damage or distortion in the finished components			
		2.11	Describe the various milling operations that can be performed, and the types of cutters that are used (such as face mills, slab/cylindrical cutters, side and face cutters, end mills, slot drills, form cutters, twist drills)			
		2.12	Explain how to mount and secure the cutting tools in the tool holding devices and to the machine spindle (such as face mills on stub arbors or direct to the machine spindle; slab mills/cylindrical cutters and side and face cutters on long arbors; end mills and slot drills in collet chucks; mounting drills in chucks or by the use of Morse taper sockets)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain how to position the workpiece in relation to the milling cutters to give conventional or climb milling conditions			
		2.14	Explain how to check that the milling cutters are in a safe and usable condition, and how to handle and store cutters safely			
		2.15	Describe the effects of backlash in machine slides and screws, and how this can be overcome			
		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, type of tool used, 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	Describe the checks to be carried out on the components before removing them from the machine, and the equipment that will need to be used (including micrometers, Verniers and surface texture comparison methods)			
		2.20	Explain how to check that the measuring equipment is within current calibration dates and that the instruments are correctly zeroed; measuring linear dimensions (such as lengths, depths, slots, positions, angles, profiles); measuring geometric features (such as flatness, squareness, parallelism); how to check surface finish (such as by using comparison blocks or instruments)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Describe the problems that can occur with the milling activities (such as defects caused by worn cutters, inappropriate feeds/speeds, damage by workholding devices), and how these can be overcome			
		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 machine in a safe condition on completion of the milling activities (such as correctly isolated, cutting tools removed, cleaning the machine and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 123: Preparing and Using Grinding Machines

Unit reference number: T/504/6377

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use grinding machines. 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 F.

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	Prepare and use grinding machines	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices at all times during the grinding activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Machine guards are in place and are correctly adjusted • Components are held securely (without damage or distortion) • Grinding wheels are maintained in a suitable/safe condition • Make sure the work area is maintained and left in a safe and tidy condition			
		1.3	Plan the grinding activities before they start them			
		1.4	Obtain and prepare the appropriate materials, tools and equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Prepare grinding wheels to include carrying out two of the following: • Dressing and 'trueing up' grinding wheels • Wheel forming (such as chamfers, radii, angular forms, profiles) • Relieving the wheel sides			
		1.6	Grind components made from two of the following types of material: • Low carbon/mild steel • High carbon steel • Aluminium/aluminium alloys • Cast iron • Brass/brass alloys • Plastic/nylon/composite • Other specific material			
		1.7	Mount and set the required workholding devices, and set and secure the workpiece			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Mount, secure and machine components using two of the following workholding devices: • Magnetic chuck or blocks • Fixed vice • Swivel or universal vice • Angle plates • Vee block and clamps • Fixtures • Chucks • Centres • Mandrels			
		1.9	Set and adjust the machine tool speeds and feeds to achieve the component specification (where appropriate)			
		1.10	Use the machine tool controls safely and correctly in line with operational procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce ground components that combine different operations and have features that cover five of the following: • Flat faces • Parallel faces • Faces square to each other • Vertical faces • Angular faces • Steps and shoulders • Slots • Parallel diameters • Stepped diameters • Tapered diameters • Counterbores • Tapered bores • Parallel bores • Profile forms			
		1.12	Measure and check all dimensional and geometrical aspects of the component are to the specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Carry out the necessary checks for accuracy, to include all of the following: • Dimensions • Parallelism • Surface texture Plus two more from the following: • Flatness • Squareness • Profile • Angle/taper • Concentricity • Ovality/lobbing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Use the following measuring equipment during the machining and checking activities: • External micrometers • Vernier/digital/dial callipers • Dial test indicators (DTI) • Surface finish equipment (such as comparison plates, machines) Plus two more of the following: • Squares • Internal micrometers • Depth micrometers • Depth verniers • Comparators (external or internal) • Feeler gauges • Bore/hole gauges • Slip gauges • Radius/profile gauges • Protractors • Coordinate measuring machine (CMM)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Produce components to all of the following quality and accuracy standards, as applicable to the operation: • Components to be free from false grinding cuts, wheel marks, burrs and sharp edges • General dimensional tolerance +/- 0.125mm or +/- 0.005” • There must be one or more specific dimensional tolerances within +/- 0.025mm or +/- 0.001” • Flatness and squareness within 0.025mm per 25mm or 0.001” per inch • Surface texture 8 µin or 0.2µm • Angles/tapers within +/- 30 minutes			
		1.16	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			
		1.17	Shut down the equipment to a safe condition on completion of the grinding activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use grinding machines	2.1	Describe the safe working practices and procedures to be followed when preparing and using grinding machines (such as ensuring the correct isolation of the machine before mounting the workholding devices and workpiece; fitting and adjusting machine guards and dust extraction equipment, ensuring that the workpiece is secure and grinding wheels are free from damage and clear of the workpiece before starting the machine)			
		2.2	Describe the hazards associated with the grinding operations (such as revolving/moving parts of machinery, sparks/airborne particles, bursting grinding wheels, insecure components, burrs and sharp edges on component), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be worn for the grinding activities (such as correctly fitting overalls and safety glasses; ensuring that, if they have long hair, it is tied back or netted; and removing any jewellery or other items that can become entangled in the machinery)			
		2.4	Describe the safety mechanisms on the machine, and the procedure for checking that they function correctly			
		2.5	Describe the correct operation of the machine controls in both hand and power modes, how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.6	Explain how to plan and prepare to carry out the grinding operations (such as obtaining the component drawing, determining the machines required, selecting workholding methods and devices, selecting grinding wheels, determining a suitable sequence of operations, determining quality checks to be made and equipment to be used)			
		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 (to include first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing)			
		2.8	Describe the main features of the grinding machine, and the accessories that can be used			
		2.9	Describe the range of workholding methods and devices that are used on grinding machines (such as magnetic chucks and blocks, vices, angle plates, fixtures, centres, mandrels, collets and chucks)			
		2.10	Explain how to position and secure workholding devices and the workpiece to the machine table, and the checks to be made (such as ensuring that all seating/location faces are clean and undamaged, the device is suitably aligned using instruments or tenons, as appropriate, checking that all bolts or other securing devices are tightened securely)			
		2.11	Describe the effects of clamping the workpiece in a vice or other workholding device, and how this can cause damage or distortion in the finished components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.12	Describe the various grinding operations that can be performed, and the types of grinding wheels that are used (such as surface grinding using solid, segmented and cup wheels; cylindrical grinding wheels and internal grinding wheels)			
		2.13	Explain how to check that the grinding wheels are in a safe and serviceable condition (such as free from damage, cracks, correctly balanced)			
		2.14	Describe the importance of 'trueing up' and dressing wheels to prevent glazing and burning of the workpiece, and methods of forming the wheels to the required profile (such as use of pantograph, diamond dressing units)			
		2.15	Describe the effects of backlash in machine slides and screws, and how this can be overcome			
		2.16	Describe the techniques of taking trial cuts and checking dimensional accuracy; the application of roughing and finishing cuts and the effect on wheel life, surface finish and dimensional accuracy			
		2.17	Describe the factors that affect the selection of grinding feeds and speeds, and the depth of cut that can be taken (such as type of material, type of grinding wheel, operations being performed, workholding method/security of workpiece, condition of machine, finish and tolerance required)			
		2.18	Describe the application of cutting fluids with regard to a range of different materials, and why some materials do not require cutting fluids to be used			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Explain how to recognise grinding faults, and how to identify when grinding wheels need dressing			
		2.20	Describe the checks to be carried out on the components before removing them from the machine, and the equipment that will need to be used (including micrometers, Verniers and surface texture comparison methods)			
		2.21	Explain how to check that the measuring equipment is within current calibration dates and that the instruments are correctly zeroed; measuring linear dimensions (such as diameters, lengths, depths, slots, positions, angles, profiles); measuring geometric features (such flatness, squareness, parallelism); how to check surface finish (such as by using comparison blocks or instruments)			
		2.22	Describe the problems that can occur with the grinding activities (such as defects caused by glazed wheels, inappropriate feeds/speeds, damage by workholding devices), and how these 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 machine in a safe condition on completion of the grinding activities (such as correctly isolated, cutting tools removed, cleaning the machine and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 124: Preparing and Proving CNC Machine Tool Programs

Unit reference number: F/504/6379

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and prove CNC machine tool programs. 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 F.

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	Prepare and prove CNC machine tool programs	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices at all times during the programming activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • The correct component drawings are obtained and checked for currency and validity • The appropriate reference manuals and programming codes are used to suit the machine controller • The machine controller is prepared ready to accept the operating program • The prepared program is input/loaded into the controller safely and correctly • Programs are stored safely and correctly in the appropriate format • Program media is stored safely and correctly, away from contaminants and corruption			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Prepare and prove programs for one of the following types of CNC machine tool: • Two axis machine • Three axis machine • Multiple axis machines (5 or more) • Machining centres			
		1.4	Plan the programming activities before they start them			
		1.5	Determine an operational sequence that avoids wasted tool/cutter movements and tool changes			
		1.6	Develop component programs using appropriate programming codes and techniques			
		1.7	Produce CNC programs using one of the following methods: • Entered directly into the machine controller • Using computer software			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Develop part programs which contain all of the following, as applicable to the machine type: • All necessary positional information • Appropriate codes • Machine management commands (preparatory/auxiliary functions) • Repetitions within programs (using features such as subroutines, canned cycles, labels) • Absolute or incremental co-ordinates • Tool/cutter change positions • Tool information (such as lengths, offsets, radius compensation)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Develop programs to produce components which cover eight of the following features: • Parallel diameters • Stepped diameters • Tapered diameters • Flat faces • Internal undercuts • External undercuts • Steps/shoulders • Parallel faces • Faces that are square to each other • Angular faces • Internal profiles • External profiles • Tapped holes • Drilled holes • Holes on pitched circles • Holes linearly pitched • Parting-off • Enclosed slots/recesses • Open ended slots • Eccentric diameters • External screw threads			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	...continued • Internal screw threads • Chamfers and radii • Bored holes • Special forms (such as concave, convex)			
		1.10	Develop part programs to machine components made from two of the following types of material: • Low carbon/mild steel • High carbon steel • Aluminium/aluminium alloys • Cast iron • Brass/brass alloys • Plastic/nylon/composite • Other specific material			
		1.11	Specify positional information and machine axes that are consistent with the requirements of each stage/operation			
		1.12	Load/input the program to the machine controller, and check/prove the program for errors using approved procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Prove the part program using six of the following: • Single block mode • Graphic displays/modelling • Data input facilities • Full dry run (in air) • Search facilities • Edit facilities • Program override controls (spindle speed, feed rate, tool data) • Program save/store facilities			
		1.14	Confirm that the program operates safely and correctly, by checking all of the following: • Datums for each machine axis are set in relation to all equipment and tooling used • All operations are carried out to the program co-ordinates • Tool change positions are safe and clear of the workpiece and machine equipment • The correct tools are selected at the appropriate points in the program • Tool offsets are correctly entered into the machine controller • Tool cutter paths are executed safely and correctly • Auxiliary functions operate at the correct point in the program (cutter start/stop, coolant flow) • Programs have been saved in the appropriate format			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Save and store the program in line with organisational 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	Shut down the equipment to a safe condition on completion of the programming activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and prove CNC machine tool programs	2.1	Describe the safe working practices and procedures to be followed when developing and proving CNC machine tool programs			
		2.2	Describe the hazards associated with using CNC machine tools (such as automatic machine operations, power operated chucks, revolving/moving parts of machinery, airborne and hot metal particles, sharp cutting tools and burrs and sharp edges on component), and how they can be minimised			
		2.3	Describe the importance of wearing the appropriate protective clothing and equipment (PPE), and of keeping the work area clean and tidy			
		2.4	Describe the safety mechanisms on the machine (such as emergency stop buttons, emergency brakes), and the procedure for checking that they function correctly			
		2.5	Describe the correct operation of the various hand and automatic modes of machine control (such as program operating and control buttons)			
		2.6	Explain how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency			
		2.7	Explain how to use and extract information from engineering drawings or data and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken			
		2.8	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, absolute and incremental systems, workpiece zero/reference points and system of tolerancing			
		2.9	Describe the computer coding language used in CNC programs (with regard to machine axes, positional information, machine management and auxiliary functions)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how to prepare part programs (using operational sequences and machining techniques that avoid unnecessary tool/cutter movements or tool changes)			
		2.11	Describe the use of features that enable reductions in program size and input time (such as canned cycles, subroutines and labels)			
		2.12	Describe the function keys and operating system of the machine computer control system being operated			
		2.13	Explain how to set machine datums for each of the machine axes being used			
		2.14	Explain how to set the machine control system in the programming and editing mode, download (input) and upload (output) modes			
		2.15	Explain how to deal with error messages and faults on the program or equipment			
		2.16	Explain how to access the program edit facility, in order to enter tooling data (such as tool datums, positions, lengths, offsets and radius compensation)			
		2.17	Describe the use of tool posts, magazines, carousels and turrets, and how to identify the tools in relationship to the operating program			
		2.18	Explain how to conduct trial runs (using single block run, dry run and feed and spindle speed override controls)			
		2.19	Describe the factors that may affect the feeds and spindle speeds being used, and why they may need to be adjusted from the programmed values (such as condition of material, workholding method, tooling used, tolerance and finish to be achieved)			
		2.20	Describe the checks to be made before allowing the CNC machine to operate in full program run mode			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Explain how to save the completed programs in the appropriate format, and the need to store programs and storage devices safely and correctly, away from contaminants and possible corruption			
		2.22	Describe the typical problems that can occur with the programming, loading and editing activities, and what to do if they occur			
		2.23	Describe the methods and procedures used to minimise the chances of infecting a computer with a virus			
		2.24	Describe the implications if the computer they are using does become infected with a virus and who to contact if it does occur			
		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 machine in a safe condition on completion of the activities (such as correctly isolated, operating programs closed or removed, cleaning the machine and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 125: Preparing and Using CNC Turning Machines

Unit reference number: F/504/6382

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use CNC turning machines. 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 F.

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	Prepare and use CNC turning machines	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices at all times during the turning activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Machine guards are in place and correctly adjusted • Components are held securely (without damage or distortion) • Cutting tools are maintained in a suitable/safe condition • The work area is maintained and left in a safe and tidy condition			
		1.3	Plan the CNC machining activities before they start them			
		1.4	Load/input the program to the machine controller and check the program for errors using the approved procedures			
		1.5	Mount and set the required workholding devices, workpiece and cutting tools			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Position and secure workpieces, using two of the following workholding methods and devices: • Chucks with hard jaws • Chucks with soft jaws • Fixtures • Drive centres • Collet chucks • Faceplates • Magnetic/pneumatic devices • Other workholding devices			
		1.7	Machine components made from two of the following types of material: • Low carbon/mild steel • High carbon steel • Aluminium/aluminium alloys • Cast iron • Brass/brass alloys • Plastic or composite • Other specific material			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Select and mount the appropriate tool holding device and six of the following types of cutting tool: • Roughing tool • Finishing tool • Parting-off tool • Screw-thread tool • Profiling tools • Form tools • Centre drills • Twist/core drills • Boring tools • Reamers • Maxi-tipped drills • Carbide insert drills			
		1.9	Check that all safety mechanisms are in place, and that the equipment is set correctly for the required operations			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Prepare the tooling for operation by carrying out all the following activities, as applicable to the machine type: • Positioning tools in the correct location in the tool posts, turrets, magazine or carousel • Checking the tool numbers in relation to the CNC program • Entering relevant tool data (such as tool lengths, tool offsets, radius compensation) into the CNC program or control system, as appropriate • Pre-setting tooling using setting jigs/fixtures • Setting tool datum • Saving changes to the program			
		1.11	Run the operating program, and check and adjust the machine tool speeds, feeds and operating parameters to achieve the component specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Confirm that the machine and program operate safely and correctly, by checking all of the following: • Datums for each machine axis are set in relation to all equipment and tooling used • The machining carried out meets the drawing specification • Tool change positions are safe and clear of the workpiece and machine equipment • The correct tools are selected at the appropriate points in the program • Tool offsets are correctly entered • Tool cutter paths are executed safely and correctly • Auxiliary/miscellaneous functions operate at the correct point in the program (cutter start/stop, coolant flow) • Programs have been saved in the appropriate format			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce machined components that combine different operations and have features that cover all of the following: • Parallel diameters • Stepped diameters • Flat faces • Drilled holes • Chamfers and radii Plus four more from the following: • Tapered diameters • Undercuts • Internal profiles • External profiles • Reamed holes • Tapped holes • Parting-off • Eccentric diameters • External screw threads • Internal screw threads • Bored holes			
		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: • External diameters • Linear dimensions (such as lengths, depths) • Parallelism/cylindricity • Surface finish Plus four more from the following: • Internal diameters • Bore/hole size/fit • Angle/taper • Thread fit • Concentricity/coaxiality • Grooves/undercuts (such as position, width, depth) • Eccentricity • Ovality			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Use all of the following measuring equipment during the machining and checking activities: • External micrometers • Vernier/digital/dial callipers • Dial test indicators (DTI) • Surface finish equipment (such as comparison plates, machines) Plus four more of the following: • Rules • Internal micrometers • Depth micrometers • Depth Verniers • Slip gauges • Bore/hole gauges • Thread gauges (such as ring, plug, profile) • Plug gauges • Radius/profile gauges • Protractors • Coordinate measuring machine (CMM)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Produce components to all of the following quality and accuracy standards, as applicable to the operation: • Components to be free from false tool cuts, burrs and sharp edges • General dimensional tolerance +/- 0.25mm or +/- 0.010” • There must be one or more specific dimensional tolerances within +/- 0.1mm or +/- 0.004” • Surface finish 63 µin or 1.6µm • Reamed holes within H8 • Screw threads BS medium fit • Angles/tapers within +/- 0.5 degree			
		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 equipment to a safe condition on completion of the machining activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use CNC turning machines	2.1	Describe the safe working practices and procedures to be followed when preparing and using CNC lathes (such as ensuring the correct isolation of the machine before mounting workholding devices and tooling; fitting and adjusting machine guards; ensuring that the workpiece is secure and tooling is free from the workpiece before starting the machine)			
		2.2	Describe the hazards associated with the using CNC lathes, (such as automatic machine operations, power operated chucks, revolving/moving parts of machinery, airborne and hot metal particles, sharp cutting tools, and burrs and sharp edges on components), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be worn for the CNC turning activities (such as correctly fitting overalls and safety glasses; ensuring that, if they have long hair, it is tied back or netted; and removing any jewellery or other items that can become entangled in the machinery)			
		2.4	Describe the safety mechanisms on the machine (such as emergency stop buttons, emergency brakes), and the procedure for checking that they function correctly			
		2.5	Describe the correct operation of the various hand and automatic modes of machine control (such as program operating and control buttons)			
		2.6	Explain how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency			
		2.7	Explain how to use and extract information from engineering drawings or data and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.8	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, absolute and incremental systems, workpiece zero/reference points and system of tolerancing			
		2.9	Describe the computer coding language used in CNC programs, with regard to machine axes, positional information, machine management and auxiliary/miscellaneous functions			
		2.10	Explain how to set the machine controller in the program and editing mode, and how to enter or download the prepared program			
		2.11	Explain how to deal with error messages and faults on the program or equipment			
		2.12	Describe the range of workholding methods and devices that are used on CNC lathes			
		2.13	Explain why it is important to set the workholding device in relationship to the machine datums and reference points			
		2.14	Describe the methods of setting the workholding devices, and the tools and equipment that can be used			
		2.15	Describe the range of cutting tools that are used on CNC lathes, and typical applications			
		2.16	Explain how to check that the cutting tools are in a safe and serviceable condition			
		2.17	Describe the use of tungsten carbide, ceramic and diamond indexible tips, and the factors that determine their selection and use (such as the condition of material supplied, hardness of the material, the cutting characteristics of the material, tolerances to be achieved, component surface finish and specifications)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Describe the various tool holding devices that are used, and the methods of correctly mounting and securing the cutting tools to the tool holders			
		2.19	Describe the advantages of using pre-set tooling, and how to set the tooling by using setting jigs/fixtures			
		2.20	Describe the use of tool posts, magazines and carousels, and how to position and identify the tools in relationship to the operating program			
		2.21	Explain how to place the machine into the correct operating mode, and how to access the program edit facility in order to enter tooling data (such as tool datums, positions, lengths, offsets and radius compensation)			
		2.22	Explain how to conduct trial runs using single block run, dry run, and feed and speed override controls			
		2.23	Describe the items that they need to check before allowing the machine to operate in full program run mode			
		2.24	Describe the factors that affect the feeds and speeds that can be used, and why these may need to be adjusted from the program setting (such as type and condition of material, workholding method, tooling used, tolerance and finish to be achieved)			
		2.25	Describe the application of cutting fluids with regard to a range of different materials, and why some materials do not require the use of cutting fluids			
		2.26	Explain how to save the completed programs in the appropriate format, and the importance of storing programs and storage devices safely and correctly, away from contaminants and possible corruption			
		2.27	Describe the typical problems that can occur with the CNC turning activities, and what to do if they occur			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 machine in a safe condition on completion of the activities (such as correctly isolated, operating programs closed or removed, cleaning the machine, ensuring that any spilt cutting fluids are correctly dealt with and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 126: Preparing and Using CNC Milling Machines

Unit reference number: L/504/6384

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use CNC milling machines. 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 F.

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	Prepare and use CNC turning machines	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices at all times during the turning activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Machine guards are in place and correctly adjusted • Components are held securely (without damage or distortion) • Cutting tools are maintained in a suitable/safe condition • The work area is maintained and left in a safe and tidy condition			
		1.3	Plan the CNC machining activities before they start them			
		1.4	Load/input the program to the machine controller and check the program for errors using the approved procedures			
		1.5	Mount and set the required workholding devices, workpiece and cutting tools			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Position and secure workpieces, using two of the following workholding methods and devices: • Machine vices • Fixtures • Chucks • Angle plate • Direct clamping to machine table • Pneumatic or magnetic table • Ancillary indexing devices • Other workholding devices			
		1.7	Machine components made from two of the following types of material: • Low carbon/mild steel • High carbon steel • Aluminium/aluminium alloys • Cast iron • Brass/brass alloys • Plastic/nylon/composite • Other specific material			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Select and mount four of the following types of milling cutters to the appropriate tool holding device: • Face mills • End mills • Twist/core drills • Boring tools • Reamers • Slot drills • Special profile cutters			
		1.9	Check that all safety mechanisms are in place, and that the equipment is set correctly for the required operations			
		1.10	Prepare the tooling for operation, by carrying out all of the following activities, as applicable to the machine type: • Securing tools to the machine spindle or positioning tools in the correct position in the tool magazine/carousel • Checking that tools have specific tool number in relation to the operating program • Entering all relevant tool data to the operating program (such as tool lengths, tool offsets, radius compensation) • Pre-setting tooling using setting jigs/fixtures (where appropriate) • Setting tool datum • Saving changes to the program			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Run the operating program, and check and adjust the machine tool speeds, feeds and operating parameters to achieve the component specification			
		1.12	Confirm that the machine and program operates safely and correctly, by checking all of the following: • Datums for each machine axis are set in relation to all equipment and tooling used • All operations are carried out to the program co-ordinates • Tool change positions are safe and clear of the workpiece and machine equipment • The correct tools are selected at the appropriate points in the program • Tool offsets are correctly entered into the machine controller • Tool cutter paths are executed safely and correctly • Auxiliary functions operate at the correct point in the program (such as cutter start/stop, coolant flow) • Programs have been saved in the appropriate format			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce machined components that combine different operations and have features that cover all of the following: • Flat faces • Steps/shoulders • Open ended slots • Enclosed slots/recesses • Drilled holes linearly pitched Plus three more from the following: • Parallel faces • Square faces • Angular faces • Internal profiles • External profiles • Drilled holes on pitched circles • Bored holes • Reamed holes • Tapped holes • Circular/curved profiles • Special forms (such as concave, convex)			
		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: • Linear dimensions (such as lengths, depths) • Slots (such as position, width, depth) • Flatness • Surface finish Plus four more from the following: • Squareness • Parallelism • Hole size/fit • Angles • Recesses • Thread fit			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Use all of the following measuring equipment during the machining and checking activities: • External micrometers • Vernier/digital/dial callipers • Dial test indicators (DTI) • Surface finish equipment (such as comparison plates, machines) Plus four more of the following: • Rules • Internal micrometers • Depth micrometers • Depth Verniers • Slip gauges • Bore/hole gauges • Thread gauges • Plug gauges • Radius/profile gauges • Vernier protractors • Coordinate measuring machine (CMM)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Produce components to all of the following quality and accuracy standards, as applicable to the operation: • Components to be free from false tool cuts, burrs and sharp edges • General dimensional tolerance +/- 0.25mm or +/- 0.010” • There must be one or more specific dimensional tolerances within +/- 0.1mm or +/- 0.004” • Surface finish 63 µin or 1.6µm • Reamed holes within H8 • Screw threads BS medium fit • Angles/tapers within +/- 0.5 degree • Flatness and squareness 0.001” per inch or 0.025mm per 25mm			
		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 equipment to a safe condition on completion of the machining activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use CNC milling machines	2.1	Describe the safe working practices and procedures to be followed when preparing and using CNC milling machines (such as ensuring the correct isolation of the machine before mounting workholding devices and tooling; fitting and adjusting machine guards; ensuring that the workpiece is secure and that tooling is free from workpiece before starting the machine)			
		2.2	Describe the hazards associated with the using CNC milling machines (such as automatic machine operations, revolving/moving parts of machinery, airborne and hot metal particles, sharp cutting tools, lifting and handling workholding devices, and burrs and sharp edges on component), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be worn for the CNC milling activities (such as correctly fitting overalls and safety glasses; ensuring that, if they have long hair, it is tied back or netted; and removing any jewellery or other items that can become entangled in the machinery)			
		2.4	Describe the safety mechanisms on the machine (such as emergency stop buttons, emergency brakes), and the procedure for checking that they function correctly			
		2.5	Describe the correct operation of the various hand and automatic modes of machine control (such as program operating and control buttons)			
		2.6	Explain how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency			
		2.7	Explain how to use and extract information from engineering drawings or data and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.8	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, absolute and incremental systems, workpiece zero/reference points and system of tolerancing			
		2.9	Describe the computer coding language used in CNC programs (with regard to machine axes, positional information, machine management and auxiliary functions)			
		2.10	Explain how to set the machine controller in the program and editing mode, and how to enter or download the prepared program			
		2.11	Explain how to deal with error messages and faults on the program or equipment			
		2.12	Describe the range of workholding methods and devices that are used on CNC milling machines			
		2.13	Explain why it is important to set the workholding device in relationship to the machine axis and reference points			
		2.14	Describe the methods of setting the workholding devices, and the tools and equipment that can be used			
		2.15	Describe the range of milling cutters/cutting tools that are used on CNC milling machines, and their typical applications			
		2.16	Explain how to check that the cutting tools are in a safe and serviceable condition			
		2.17	Describe the use of tungsten carbide, ceramic and diamond indexible tips, and the factors which will determine their selection and use (such as the condition of material supplied, hardness of the material, the cutting characteristics of the material, tolerances to be achieved, component surface finish and specifications)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Describe the various tool holding devices that are used, and the methods of correctly mounting and securing the cutting tools to the tool holders and machine spindle			
		2.19	Describe the advantages of using pre-set tooling, and how to set the tooling by using setting jigs/fixtures			
		2.20	Describe the use of tool magazines and carousels, and how to position and identify the tools in relationship to the operating program			
		2.21	Explain how to place the machine into the correct operating mode, and how to access the program edit facility in order to enter tooling data (such as tool datums, positions, lengths, offsets and radius compensation)			
		2.22	Explain how to conduct trial runs (using single block run, dry run, and feed and speed override controls)			
		2.23	Describe the items that they need to check before allowing the machine to operate in full program run mode			
		2.24	Describe the factors that affect the feeds and speeds that can be used, and why these may need to be adjusted from the program setting (such as type and condition of material, workholding method, tooling used, tolerance and finish to be achieved)			
		2.25	Describe the application of cutting fluids with regard to a range of different materials, and why some materials do not require the use of cutting fluids			
		2.26	Explain how to save the completed programs in the appropriate format, and the importance of storing programs and storage devices safely and correctly, away from contaminants and possible corruption			
		2.27	Describe the typical problems that can occur with the CNC milling activities, and what to do if they occur			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 machine in a safe condition on completion of the activities (such as correctly isolated, operating programs closed or removed, cleaning the machine, and ensuring that any spilt cutting fluids are correctly dealt with and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 127: Preparing and Using CNC Machining Centres

Unit reference number:	**D/504/6387**
QCF level:	**2**
Credit value:	**14**
Guided learning hours:	**64**

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use CNC machine centres. 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 F.

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	Prepare and use CNC machining centres	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices at all times during the machining activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Machine guards are in place and correctly adjusted • Components are held securely (without damage or distortion) • Cutting tools are maintained in a suitable/safe condition • The work area is maintained and left in a safe and tidy condition			
		1.3	Plan the CNC machining activities before they start them			
		1.4	Load/input the program to the machine controller, and check the program for errors using the approved procedures			
		1.5	Mount and set the required workholding devices, workpiece and cutting tools			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Position and secure workpieces, using two of the following workholding methods and devices: • Clamping direct to machine table • Machine vice • Chucks with hard jaws • Chucks with soft jaws • Collet chucks • Jigs and fixtures • Faceplates • Angle plate • Indexing/rotating device • Magnetic or pneumatic devices • Other workholding devices			
		1.7	Machine components made from two of the following types of material: • Low carbon/mild steel • High carbon steel • Aluminium/aluminium alloys • Cast iron • Brass/brass alloys • Plastic/nylon/composite • Other specific material			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Select and mount the appropriate tool holding device and six of the following types of cutting tool: • Turning tools • Boring tools • Facing tools • Profiling tools • Parting-off tool • Thread cutting tools • Centre drills • Twist/core drills • Reamers • Recessing/undercutting tools • Face mills • Slotting cutters • Slitting saws • End mills • Slot drills • Grinding wheels • Taps • Dies			
		1.9	Check that all safety mechanisms are in place and that the equipment is set correctly for the required operations			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Prepare the tooling for operation, by carrying out all of the following activities, as applicable to the machine type: • Positioning tools in the correct position in the tool posts, turrets, magazine or carousel • Checking that tools have a specific tool number in relation to the operating program • Entering relevant tool data to the operating program (such as tool lengths, tool offsets, radius compensation) • Pre-setting tooling by using setting jigs/fixtures • Setting tool datum • Saving changes to the program			
		1.11	Run the operating program, and check and adjust the machine tool speeds, feeds and operating parameters to achieve the component specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Confirm that the machine and program operates safely and correctly, by checking all of the following: • Datums for each machine axis are set in relation to all equipment and tooling used • All operations are carried out to the program co-ordinates • Tool change positions are safe and clear of the workpiece and machine equipment • The correct tools are selected at the appropriate points in the program • Tool offsets are correctly entered into the machine controller • Tool cutter paths are executed safely and correctly • Auxiliary functions operate at the correct point in the program (cutter start/stop, coolant flow) • Programs have been saved in the appropriate format			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce machined components that combine different operations, and have features that cover ten of the following: • Parallel diameters • Stepped diameters • Tapered diameters • Eccentric diameters • Drilled holes • Reamed holes • Bored holes • Tapped holes • External screw threads • Internal screw threads • Parting-off • Chamfers and radii • Tapered holes • Flat faces • Square faces • Parallel faces • Angular faces • Shoulders and steps • Drilled holes linearly pitched • Drilled holes on pitched circles • Indexed or rotated forms			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	...continued • Internal profiles • External profiles • Open ended slots • Enclosed slots/recesses • Grooves/undercuts • Special forms (such as concave, convex)			
		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 eight of the following: • External diameters • Internal diameters • Linear dimensions (such as lengths, depths) • Bore/hole size/fit • Surface finish • Angle/taper • Thread fit • Grooves/undercuts (such as position, width, depth) • Slots (such as position, width, depth) • Concentricity • Eccentricity • Flatness • Parallelism • Squareness • Ovality			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Use all of the following measuring equipment during the machining and checking activities: • External micrometers • Vernier/digital/dial callipers • Dial test indicators (DTI) • Surface finish equipment (such as comparison plates, machines) Plus four more of the following: • Rules • Internal micrometers • Depth micrometers • Depth Verniers • Slip gauges • Bore/hole gauges • Thread gauges (such as ring, plug, profile) • Plug gauges • Radius/profile gauges • Protractors • Coordinate measuring machine (CMM)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Produce components to all of the following quality and accuracy standards, as applicable to the operation: • Components to be free from false tool cuts, burrs and sharp edges • General dimensional tolerance +/- 0.25mm or +/- 0.010” • There must be one or more specific dimensional tolerances within +/- 0.1mm or +/- 0.004” • Surface finish 63 µin or 1.6µm • reamed holes within H8 • Screw threads BS medium fit • Angles/tapers within +/- 0.5 degree • Flatness and squareness 0.001” per inch or 0.025mm per 25mm			
		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 equipment to a safe condition on completion of the machining activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use CNC machining centres	2.1	Describe the safe working practices and procedures to be followed when preparing and using CNC machining centres (such as ensuring the correct isolation of the machine before mounting workholding devices and tooling; fitting and adjusting machine guards; ensuring that the workpiece is secure and that tooling is free from the workpiece before starting the machine)			
		2.2	Describe the hazards associated with the using CNC machining centres (such as automatic machine operations, power operated workholding devices, revolving/moving parts of machinery, airborne and hot metal particles, sharp cutting tools, and burrs and sharp edges on components), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be worn for the CNC machining activities (such as correctly fitting overalls and safety glasses; ensuring that, if they have long hair, it is tied back or netted; and removing any jewellery or other items that can become entangled in the machinery)			
		2.4	Describe the safety mechanisms on the machine (such as emergency stop buttons, emergency brakes), and the procedure for checking that they function correctly			
		2.5	Describe the correct operation of the various hand and automatic modes of machine control (such as program operating and control buttons)			
		2.6	Explain how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency			
		2.7	Explain how to use and extract information from engineering drawings or data and related specifications (to include symbols and conventions to appropriate BS or ISO standards in relation to work undertaken			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.8	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, absolute and incremental systems, workpiece zero/reference points and system of tolerancing			
		2.9	Describe the computer coding language used in CNC programs (with regard to machine axes, positional information, machine management and auxiliary functions)			
		2.10	Explain how to set the machine controller in the program and editing mode, and how to enter or download the prepared program			
		2.11	Explain how to deal with error messages and faults on the program or equipment			
		2.12	Describe the range of workholding methods and devices that are used on CNC machining centres			
		2.13	Explain why it is important to set the workholding device in relationship to the machine datum/axis and reference points			
		2.14	Describe the methods of setting the workholding devices, and the tools and equipment that can be used			
		2.15	Describe the range of cutting tools that are used on CNC machining centres, and their typical applications			
		2.16	Explain how to check that the cutting tools are in a safe and serviceable condition			
		2.17	Describe the use of tungsten carbide, ceramic and diamond indexible tips, and the factors that determine their selection and use (the condition of material supplied, hardness of the material, the cutting characteristics of the material, tolerances to be achieved, component surface finish and specifications)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Describe the various tool holding devices that are used, and the methods of correctly mounting and securing the cutting tools to the tool holders			
		2.19	Describe the advantages of using pre-set tooling, and how to set the tooling by using setting jigs/fixtures			
		2.20	Describe the use of tool posts, magazines and carousels, and how to position and identify the tools in relationship to the operating program			
		2.21	Explain how to place the machine into the correct operating mode, and how to access the program edit facility in order to enter tooling data (such as tool datums, positions, lengths, offsets and radius compensation)			
		2.22	Explain how to conduct trial runs (using single block run, dry run and feed and speed override controls)			
		2.23	Describe the items that they need to check before allowing the machine to operate in full program run mode			
		2.24	Describe the factors that affect the feeds and speeds that can be used, and why these may need to be adjusted from the program setting (such as type and condition of material, workholding method, tooling used, tolerance and finish to be achieved)			
		2.25	Describe the application of cutting fluids with regard to a range of different materials, and why some materials do not require the use of cutting fluids			
		2.26	Explain how to save the completed programs in the appropriate format, and the importance of storing programs and storage devices safely and correctly, away from contaminants and possible corruption			
		2.27	Describe the typical problems that can occur with the CNC machining activities, and what to do if they occur			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 machine in a safe condition on completion of the activities (such as correctly isolated, operating programs closed or removed, cleaning the machine, and ensuring that any spilt cutting fluids are correctly dealt with and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 128: Preparing and Using Industrial Robots

Unit reference number: D/504/6390

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use industrial robots. 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 F.

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	Prepare and use industrial robots	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices during the robot programming activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Check that all the teach pendant/computer equipment is correctly connected, and is in a safe and usable working condition (such as cable undamaged, safely routed and PAT tested) • Power up the equipment and activate the programming software • Set up the computer system to produce the program • Ensure that the correct process input/output and control data to produce the program is obtained and checked for currency and validity • Store completed program media safely and correctly, away from contaminants or possible corruption			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Produce robot programs for one of the following engineering applications: • Welding • Surface coating • Gluing/sealing • Machine loading/unloading • Assembly • Logistics movement/control • Packaging • Stud welding • Other specific activity			
		1.4	Prepare and use one of the following types of industrial robot: • Cartesian (gantry) • SCARA • Articulated • Parallel • Other specific type			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Prepare, load and prove programs using one of the following types of robot programming methods: • Positional commands (x, y, z) • Teach pendant • Lead by the nose • Off-line programming • Other specific method			
		1.6	Plan the programming activities before they start them			
		1.7	Determine an operational sequence that avoids wasted robot arm movements and tool/accessory changes			
		1.8	Produce industrial robot control programs, in the appropriate formats, containing all the relevant and necessary data for the engineering activity to be carried out			
		1.9	Select and set up one of the following types of robot end effectors for the engineering application of: • Welding guns • Spot welders • Spray guns • Grippers • Drills • Vacuum devices • Other specific tooling			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Develop programs that contain all of the following, as applicable to the robot type: • Safe start and stop positions • All necessary positional information • Type of motion (such as joint interpolated, linear, circular) • Preparatory commands and process management/auxiliary functions • Repetitive programs (sub-routines, canned cycles, labels) • Speed/acceleration parameters • Sensor information • Part programs downloaded from a computer (such as patch programs) • Use of workframes (such as tool, global, joint, user)			
		1.11	Load/input the program to the robot controller, and check the program for errors using the approved procedures			
		1.12	Make sure that codes and other references used in the programs are applicable to the type of controller used			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Prove the robot program using four of the following: • Single block run • Search facilities • Program override controls • All modes (such as auto, T1, T2 and remote) • Full dry run • Edit facilities • Data input facilities			
		1.14	Save and store the program, in line with organisational procedures			
		1.15	Mount and set the required workholding devices and robot tooling			
		1.16	Run the operating program, and check and adjust the operating parameters to achieve the output specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Carry out operations for one of the applications identified in assessment criteria 1.3, to include all of the following: • Checking that all safety mechanisms are in place and that the equipment is set correctly for the required operations • Positioning work in relation to the robot parameters (such as securing in the workholding device) • Running the operating program in accordance with operating procedures • Checking that all operations are carried out safely and correctly • Editing programs using the correct procedure (where appropriate) • Examining the completed work visually and/or using suitable test/measuring instruments, gauges or checking fixtures, as appropriate to the operations performed • Determining if the completed setup completes the operations to the required specification, including repeatability and accuracy			
		1.18	Measure and check that all dimensional and geometrical aspects of the output are to the specification			
		1.19	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			
		1.20	Shut down the equipment to a safe condition on completion of the robotic activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use industrial robots	2.1	Describe the safe working practices and procedures to be followed when developing and proving industrial robot operating programs			
		2.2	Describe the hazards associated with using industrial robots (such as automatic/sudden movements of arm, power operated accessories), and how they can be minimised			
		2.3	Describe the importance of wearing the appropriate protective clothing and equipment (PPE), and of keeping the work area clean and tidy			
		2.4	Describe the safety mechanisms on the robot and operating envelope (such as emergency stop buttons, movement/hazard sensors), and the procedure for checking that they function correctly			
		2.5	Explain how to stop the robot in both normal and emergency situations, and the procedure for restarting after an emergency			
		2.6	Describe the correct operation of all available modes (such as automatic operation, teach pendant, program operating and control buttons)			
		2.7	Explain how to drive the robot in each type of coordinate frame (such as tool, global, joint, user)			
		2.8	Explain how to drive the robot at different speeds, including jog mode			
		2.9	Describe the main robot types that are available, and the importance of understanding that a different robot may use a completely different syntax for similar functions			
		2.10	Describe the information and data required in order to produce complete and accurate robot programs			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain how to extract and interpret general and technical data and information from different sources (such as drawings, computer models, symbols and conventions, BS or ISO standards) in order to produce the robot program			
		2.12	Describe the factors to be taken into account when producing robot programs (including the type of robot and its control capabilities, safety, the product/environment being controlled)			
		2.13	Explain how to produce effective and efficient programs to avoid unnecessary operations (including the use of macro programs and canned cycles, to reduce program size)			
		2.14	Describe the methods and procedures used to check that the completed program will perform safely, accurately and efficiently (such as conducting trial runs, using single block run, dry run and speed override controls)			
		2.15	Explain how to save the completed programs in the appropriate format, and the importance of storing program safely and correctly, away from contaminants and possible corruption			
		2.16	Explain how to back up completed or edited programs, and the implications if this is not carried out effectively			
		2.17	Describe the methods and procedures used to minimise the chances of infecting a computer with a virus			
		2.18	Describe the implications if the computer they are using does become infected with a virus and who to contact if it does occur			
		2.19	Describe the problems that can occur with the downloading and running of the robot program, and how these can be overcome			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Describe the various workholding devices that are used for robot applications, and the methods of positioning and setting them in relation to the robot's operating parameters (such as jigs and fixtures)			
		2.21	Describe the various tools and end effector equipment that are used for the particular robot operations (such as mechanical grippers, welding torches, stud guns, spray guns, drilling attachments)			
		2.22	Explain why they need to ensure that tools are positioned correctly in relationship to the robot's reference points and tool centre points			
		2.23	Describe the importance of checking that the tool change positions (where appropriate) are clear of the workpiece and can be safely and quickly achieved			
		2.24	Describe the need to ensure that all guards are in place and that the interlock systems are in correct working order			
		2.25	Explain how to run the robot operating program and check that all operations are carried out safely and correctly			
		2.26	Explain how to check that the finished operations meet the work specification			
		2.27	Describe the typical problems that can occur with the programming, loading and editing activities, and what to do if they occur			
		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 machine in a safe condition on completion of the activities (such as correctly isolated, operating programs closed or removed, cleaning the machine, and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 129: Maintaining Mechanical Devices and Equipment

Unit reference number:	**T/504/6394**
QCF level:	**2**
Credit value:	**14**
Guided learning hours:	**64**

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to maintain mechanical devices and equipment. 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 F.

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	Maintain mechanical devices and equipment	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: • 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 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			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out maintenance activities on two of the following types of mechanical equipment: • Gearboxes • Compressors • Process control valves • Machine tools • Processing plant • Mechanical structures • Engines • Transfer equipment • Pumps • Workholding devices • Lifting and handling equipment • Company-specific equipment			
		1.4	Plan the maintenance activities before they start them			
		1.5	Obtain all the information they need for the safe removal and replacement of the equipment components			
		1.6	Obtain and prepare the appropriate tools and equipment			
		1.7	Apply appropriate maintenance diagnostic techniques and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Use four of the following maintenance diagnostic techniques, tools and aids: • Fault finding techniques (such as half-split, input/output, unit substitution) • Diagnostic aids (such as manuals, flowcharts, troubleshooting guides, maintenance records) • Information gathered from fault reports • Visual checks (such as signs of leakage, damage, missing parts, wear/deterioration) • Alignment checks • Movement checks (such as excessive movement or clearance, loose fittings and connections) • Force/pressure checks (such as spring pressure, belt or chain tension) • Overheating checks (such as bearings, friction surfaces) • Sensory input (such as sight, sound, smell, touch) • Information from monitoring equipment or gauges • Operating (such as manual operation, timing and sequencing) • Test instrumentation measurement (such as pressure, flow, timing, sequence, movement) • Measuring instruments (such as dial test indicators, torque measuring devices, feeler gauges)			
		1.9	Use appropriate methods and techniques to remove and replace the required components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Carry out all of the following maintenance activities, as applicable to the equipment being maintained: • Dismantling equipment to unit/sub-assembly level • Dismantling units to component level • Proof marking/labelling of components • Checking components for serviceability • Replacing all 'lifed' items (such as seals, bearings, gaskets) • Replacing damaged/defective components • Replenishing oils and greases • Setting, aligning and adjusting replaced components • Tightening fastenings to the required torque • Making 'off-load' checks before starting up			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Remove and refit a range of mechanical components, to include eight of the following: • Shafts • Couplings • Gears • Clutches • Valves and seats • Pistons • Brakes • Splines • Bearing and seals • Fitting keys • Springs • Diaphragms • Cams and followers • Chains and sprockets • Pulleys and belts • Levers and links • Slides • Rollers • Housings			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	...continued • Actuating mechanisms • Structural components • Locking and retaining devices (such as circlips, pins) • Other specific components			
		1.12	Carry out tests on the maintained equipment, in accordance with the test schedule/defined test procedures			
		1.13	Carry out checks on the maintained equipment, to include three of the following: • Correct operation of moving parts • Correct working clearance of parts • Backlash in gears • Belt/chain tension • Bearing loading • Torque loading of fasteners • Operational performance • Functionality test the system			
		1.14	Maintain mechanical equipment in compliance with one or more of the following: • Organisational guidelines and codes of practice • Equipment manufacturers' operation range • BS and/or ISO standards			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	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			
		1.16	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 maintain mechanical devices and equipment	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the mechanical maintenance activities undertaken			
		2.2	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy			
		2.3	Describe the hazards associated with carrying out mechanical maintenance activities (such as handling oils, greases, stored energy/force, 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	Describe the basic principles of how the equipment functions, its operating sequence, the working purpose of individual units/components and how they interact			
		2.8	Describe the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing)			
		2.9	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)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how to evaluate sensory information (sight, sound, smell, touch)			
		2.11	Describe the sequence to be adopted for the dismantling/re-assembly of various types of assemblies			
		2.12	Describe the methods and techniques used to dismantle/assemble mechanical equipment (such as release of pressures/force, proof marking, extraction, pressing, alignment)			
		2.13	Describe the methods of checking that components are fit for purpose, and how to identify defects and wear characteristics			
		2.14	Describe the identification, application, fitting and removal of different types of bearings (such as roller, ring, thrust)			
		2.15	Describe the methods and techniques of fitting keys and splines			
		2.16	Describe the identification, application, fitting and removal of different types of gears			
		2.17	Explain how to correctly tension belts and chains			
		2.18	Describe the identification and application of different types of locking device			
		2.19	Describe the methods of checking that removed components are fit for purpose, and the need to replace 'lifed' items (such as seals and gaskets)			
		2.20	Describe the uses of measuring equipment (such as micrometers, verniers, run-out devices and other measuring devices)			
		2.21	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 are configured correctly for the intended purpose			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.22	Explain how to make adjustments to components/assemblies to ensure that they function correctly (such as setting working clearance, setting travel, setting backlash in gears, preloading bearings)			
		2.23	Describe the importance of making 'off-load' checks before running the equipment under power			
		2.24	Describe the importance of completing maintenance documentation and/or reports following the maintenance activity			
		2.25	Explain how to use lifting and handling equipment in the maintenance activity			
		2.26	Describe the problems associated with the mechanical maintenance activity, and how they can be overcome			
		2.27	Explain when to act on their own initiative and when to seek help and advice from others			
		2.28	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 locations, 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 130: Assembling and Testing Fluid Power Systems

Unit reference number: J/504/6397

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to assemble and test fluid power systems. 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 F.

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	Assemble and test fluid power systems	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: • 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 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	Assemble one of the following types of fluid power system: • Pneumatic • Hydraulic • Vacuum			
		1.4	Plan the assembly activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Obtain all the information they need for the safe assembly of the fluid power system			
		1.6	Obtain and prepare the appropriate components, assembly tools and test equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Produce fluid power assemblies that contain a range of components, including all of the following: • Rigid pipework • Hoses • Valves • Cylinders/actuators Plus six more from the following: • Pumps • Compressors • Accumulators • Reservoirs/storage devices • Motors • Lubricators • Pressure intensifiers • Regulators • Gauges/indicators • Switches • Sensors • Receivers • Filters • Bearings • Cables and wires • Gaskets and seals • Other specific components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Use the appropriate methods and techniques to assemble the components in their correct positions			
		1.9	Apply fluid power assembly methods and techniques to include all of the following: • Checking components for serviceability • Positioning equipment/components • Aligning pipework and connections • Dressing and securing pipes and hoses • Setting, aligning and adjusting system components • Securing by using mechanical fixings • Applying screw fastener locking devices • Tightening fastenings to the required torque • Applying hose/cable clips and fasteners • Making de-energised checks before filling and/or pressurising the system			
		1.10	Secure the components, using the specified connectors and securing devices			
		1.11	Check the completed assembly to ensure that all operations have been completed and that the finished system meets the required specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Carry out quality checks, to include all of the following, using appropriate equipment: • The system is complete, as per specification • Dimensions are within specification requirements • Components are correctly positioned • Components are correctly aligned • Direction and flow indicators on components are correct • Components are securely held in place • Connections to components are tightened to the required torque • Pipework is free from ripple and creases • Electrical connections are correctly made (where applicable)			
		1.13	Carry out tests on the assembled system, in accordance with the test schedule/defined test procedures			
		1.14	Carry out all of the following checks to ensure the accuracy and quality of the tests carried out: • The test equipment is correctly calibrated • The test equipment used is appropriate for the tests being carried out • Test procedures used are as recommended in the appropriate specifications • Test readings are taken at the appropriate points, and where appropriate components are adjusted to give the required readings • Test equipment is operated within its specification range			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out tests and adjustments on the assembled system, to include: • Leak test Plus one more from the following: • Pressure line pressure tests • Return line pressure test • Flow • Speed • Sequence • Operational performance • Contamination			
		1.16	Produce fluid power assemblies which meet all of the following: • All components are correctly assembled and aligned, in accordance with the specification • Moving parts are correctly adjusted and have appropriate clearances • The system functions in line with the specification requirements • The system is leak free			
		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 assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to assemble and test fluid power systems	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the fluid power assembly 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 assembly activities on fluid power equipment (such as handling fluids, stored energy/force, misuse of tools), and how these can be minimised			
		2.4	Explain how to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers' manuals, symbols used in fluid power, and other documents needed in the assembly activities			
		2.5	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			
		2.6	Describe the procedure for obtaining drawings, job instructions, related specifications, components, materials and other consumables necessary for the assembly activities			
		2.7	Describe the basic principles of how the fluid power equipment functions, its operating sequence, the purpose of individual units/components and how they interact			
		2.8	Describe the different types of pipework, fittings and manifolds, and their application			
		2.9	Describe the identification and application of different types of valve (such as poppet, spool, piston, disc)			
		2.10	Describe the identification and application of different types of sensors and actuators (such as rotary, linear, mechanical, electrical)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Describe the identification and application of different types of cylinder (such as single acting, double acting)			
		2.12	Describe the identification and application of different types of pump (such as positive and non-positive displacement)			
		2.13	Describe the identification and application of different types compressors (such as screw, piston, rotary vane)			
		2.14	Describe the application and fitting of static and dynamic seals			
		2.15	Describe the techniques used to assemble/install fluid power equipment (such as marking out the positions of components; making pipe bends using fittings and by hand bending methods; connecting components using rigid and flexible pipework; using gaskets/seals and jointing/sealing compounds)			
		2.16	Describe the need to ensure that pipework is supported at appropriate intervals, and the need to eliminate stress on the pipework connections			
		2.17	Describe the need to ensure cleanliness of the fluid power system, and the ways of purging pipework before connection to components and pressure sources			
		2.18	Describe the recognition of contaminants and the problems they can create, and the effects and likely symptoms of contamination in the system			
		2.19	Describe the methods of testing the fluid power system; the types of test equipment to be used, and their selection for particular tests			
		2.20	Explain how to make safety checks of the system before carrying out tests, to ensure that all pipes and components are secure and that moving parts are chocked or parked			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Explain how to connect suitably calibrated test equipment into the circuit, and how to connect the circuit to a suitable pressure source containing appropriate ancillary equipment			
		2.22	Explain how to carry out the tests (such as applying test pressures in incremental stages; checking for leaks; taking appropriate test readings; adjusting appropriate components to give required operating conditions)			
		2.23	Explain how to determine pressure settings, and their effect on the system			
		2.24	Explain how to display/record test results, and the documentation used			
		2.25	Explain how to interpret the test readings obtained, and the significance of the readings gained			
		2.26	Describe the importance of ensuring that test equipment is used only for its intended purpose and within its specified range and limits			
		2.27	Explain how to check that tools and test equipment are free from damage or defect, are in a safe and usable condition, are within calibration, and are configured correctly for the intended purpose			
		2.28	Describe the problems associated with the fluid power assembly and testing activity, and how they can be overcome			
		2.29	Explain when to act on their own initiative and when to seek help and advice from others			
		2.30	Describe the importance of leaving the work area in a safe and clean condition on completion of the assembly activities (such as returning hand tools and test equipment to is 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 131: Maintaining Fluid Power Equipment

Unit reference number: F/504/6401

QCF level: 2

Credit value: 14

Guided learning hours: 61

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to maintain fluid power equipment. 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 F.

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	Maintain fluid power equipment	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: • 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) • Follow job instructions, maintenance drawings and procedures • Check that tools and test instruments to be used are within calibration 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	Carry out maintenance activities on one of the following types of fluid power equipment: • Pneumatic • Hydraulic • Vacuum			
		1.4	Plan the maintenance activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Obtain all the information they need for the safe isolation, removal and replacement of the system components			
		1.6	Obtain and prepare the appropriate tools and test equipment			
		1.7	Apply appropriate maintenance diagnostic techniques and procedures			
		1.8	Use four of the following maintenance diagnostic techniques, tools and aids: • Fault finding techniques (such as six point, half-split, input/output, unit substitution, emergent sequence) • Diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records) • Information gathered from fault reports • Inspecting (such as checking for damage, wear/deterioration, leaks, loose fittings and connections) • Sensory input (such as sight, sound, smell, touch) • Monitoring equipment or gauges • Operating the equipment (such as manual operation, timing and sequencing) • Test instrumentation measurement (such as pressure, flow, timing, sequence, movement)			
		1.9	Use two of the following types of fluid power test instruments: • Measuring devices • Pressure indicators • Flow indicators • Test rigs • Self-diagnostic equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Use the appropriate methods and techniques to remove and replace the required components			
		1.11	Carry out all of the following maintenance activities, as applicable to the equipment being maintained: • Chocking/supporting cylinders/rams/components • Releasing stored energy • Draining and removing fluids (as applicable) • Disconnecting/removing hoses and pipes • Removing and replacing units/components (such as pumps, cylinders, valves, actuators) • Proof marking/labelling of removed components • Checking components for serviceability • Replacing damaged/defective components • Replacing all 'lifed' items (such as seals, filters, gaskets) • Tightening fastenings to the required torque • Setting, aligning and adjusting replaced components • Prime, bleed and recharge the system (as applicable) • Making de-energised checks before re-pressurising the system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Remove and replace a range of fluid power components, to include all of the following: • Pipework/hoses • Valves • Cylinders/actuators Plus five more of the following: • Reservoirs/storage devices • Accumulators • Pressure intensifiers • Compressors • Receivers • Regulators • Gauges/indicators • Pumps • Motors • Gaskets and seals • Pistons • Spools • Bearings • Switches • Sensors • Lubricators • Filters			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	...continued • Cables and wires • Timers • Coolers • Other specific components			
		1.13	Carry out tests on the maintained system in accordance with the test schedule/defined test procedures			
		1.14	Carry out all of the following checks to ensure the accuracy and quality of the tests carried out: • The test equipment is correctly calibrated • The test equipment used is appropriate for the tests being carried out • Test procedures used are as recommended in the appropriate specifications • Test readings are taken at the appropriate points, and where appropriate components are adjusted to give the required readings • Test equipment is operated within its specification range			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out tests on the maintained equipment, to include both of the following: • Leak test • Operational performance Plus one more from the following: • Pressure line pressure tests • Return line pressure test • Flow • Speed • Sequence • Fluid contamination test			
		1.16	Maintain fluid power equipment in compliance with one or more of the following: • Organisational guidelines and codes of practice • Specific system requirements • Equipment manufacturers' operation range • BS and/or ISO standards			
		1.17	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			
		1.18	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 maintain fluid power equipment	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the fluid power 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 fluid power equipment (such as handling fluids, stored energy/force, misuse of tools), and how these can be minimised			
		2.4	Describe the system isolation procedures or permit-to-work procedure that applies			
		2.5	Explain how to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers' manuals, history/maintenance reports, symbols used in fluid power, and other documents needed in the maintenance activities			
		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 fluid power equipment functions, its operating sequence, the purpose of individual units/components and how they interact			
		2.9	Describe the different types of pipework, fittings and manifolds, and their application			
		2.10	Describe the identification and application of different types of valve (such as poppet, spool, piston, disc)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Describe the identification and application of different types of sensors and actuators (such as rotary, linear, mechanical, electrical)			
		2.12	Describe the identification and application of different types of cylinder (such as single acting, double acting)			
		2.13	Describe the identification and application of different types of pump (such as positive and non-positive displacement)			
		2.14	Describe the identification and application of different types compressors (such as screw, piston, rotary vane)			
		2.15	Describe the application and fitting of static and dynamic seals			
		2.16	Describe the techniques used to dismantle/assemble fluid power equipment (such as release of energy/force, proof marking, extraction)			
		2.17	Describe the methods of checking that components are fit for purpose			
		2.18	Explain how to make adjustments to components/assemblies to ensure that they function correctly			
		2.19	Explain how to determine pressure settings, and their effect on the system			
		2.20	Describe the selection of fluids for the system			
		2.21	Describe the recognition of contaminants and the problems they can create, and the effects and likely symptoms of contamination in the system			
		2.22	Describe the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.23	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)			
		2.24	Explain how to evaluate sensory information (sight, sound, smell, touch)			
		2.25	Explain how to use a range of fault diagnostic equipment to investigate the problem			
		2.26	Describe the care, handling and application of mechanical measuring/test equipment (such as measuring instruments, pressure and flow indicators and self-diagnostic equipment)			
		2.27	Describe the types of test equipment to be used, and their selection for particular tests			
		2.28	Explain how the test equipment is connected into the circuit, and the methods of doing this			
		2.29	Describe the techniques, methods and procedures to be used during the tests			
		2.30	Explain how to display/record test results, and the documentation used			
		2.31	Explain how to interpret the test readings obtained, and the significance of the readings gained			
		2.32	Describe the importance of ensuring that test equipment is used only for its intended purpose and within its specified range and limits			
		2.33	Explain how to check that tools and test equipment are free from damage or defect, are in a safe and usable condition, are within calibration, and are configured correctly for the intended purpose			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.34	Describe the problems associated with maintaining fluid power equipment, and how they can be overcome			
		2.35	Explain when to act on their own initiative and when to seek help and advice from others			
		2.36	Describe the importance of leaving the work area in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to is 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 132: Producing Sheet Metal Components and Assemblies

Unit reference number: J/504/6402

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce sheet metal components and assemblies. 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 F.

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 sheet metal components and assemblies	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 sheet metalworking activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Ensure that all power tool cables, extension leads or air supply hoses are in a tested and serviceable condition • Return all tools and equipment to the correct location on completion of the sheet metalworking activities • Check that all measuring equipment is within calibration date			
		1.3	Plan the sheet metalworking activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Use sheet metal (up to and including 3 mm) in two different materials from the following: • Hot rolled mild steel • Cold rolled mild steel • Coated mild steel (such as primed, tinned and galvanised) • Stainless steel • Aluminium • Brass • Copper • Lead • Titanium			
		1.5	Obtain the appropriate tools and equipment for the sheet metalworking operations, and check that they are in a safe and usable condition			
		1.6	Use a range of marking out equipment, to include all of the following: • Scriber • Punch • Rule or tape • Straight edge • Square • Protractor • Dividers or trammels • Chalk, blueing or paint			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Mark out the components for the required operations, using appropriate tools and techniques			
		1.8	Use marking out methods and techniques, including: • Direct marking using instruments Plus one more from the following: • Use of templates • Tracing/transfer methods			
		1.9	Mark out material, to include all of the following features: • Datum and centre lines • Square/rectangular profiles • Angles • Circles • Curved profiles • Cutting and bending detail (including allowances) • Hole centring and outlining (such as circular or linear)			
		1.10	Cut and shape the materials to the required specification, using appropriate tools and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Cut and finish material to the marked out shape, using both of the following hand tools: • Tin snips • Bench shears Plus two more from the following: • Hacksaw • Hand power tools (such as drill, nibbling, saw) • Trepanning • Files • Pneumatic tools • Thermal device • Other specific tool			
		1.12	Cut and finish material to the marked out shape, using the following machine tool: • Guillotine Plus two more of the following: • Pillar drill • Bench saw • Punch/cropping machine • Nibbling machine • Trepanning machine • Band saw			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Perform cutting operations to produce components with all three of the following shapes: • Square or rectangular profiles • Angled profiles • External curved profiles Plus two more from the following: • Notches • Internal curved contours • Round holes • Square holes			
		1.14	Use both of the following types of forming equipment/techniques: • Bending machine (hand or powered) • Rolling machine (hand or powered) Plus two more from the following: • Hammers/panel beating equipment • Stakes and formers • Presses • Jenny/wiring machine • Wheeling machine • Swaging machine • Shrinking techniques • Stretching techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out forming operations which produce components having all of the following shapes: • Bends/upstands • Folds/safe edges • Tray/box sections • Cylindrical sections Plus one more from the following: • Wired edges • Swages • Curved panels • Ribbed components • Cowlings and rounded covers • Square to round trunking • Lobster-back trunking • Concertina ducting or trunking			
		1.16	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
		1.17	Assemble sheet metal components, using two of the following methods: • Temporary tack welding • Soldering or brazing • Resistance spot welding • Riveting (such as hollow or solid) • Adhesive bonding • Flanged and mechanically fastened (such as bolts, screws) • Self securing joints (such as knocked up, paned down, swaged, joggled)			
		1.18	Measure and check that all dimensional and geometrical aspects of the component are to the specification			
		1.19	Produce sheet metal components which meet all of the following: • All dimensions are within +/- 2.0mm or +/- 0.079” • Finished components meet the required shape/geometry (square, straight, angles 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			
		1.20	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			
		1.21	Leave the work area in a safe and tidy condition on completion of the fitting activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce sheet metal components and assemblies	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the sheet metalworking activities undertaken			
		2.2	Describe the personal protective clothing and equipment (PPE) to be worn when carrying out the sheet metal activities (such as leather gloves, eye protection, ear protection), and the importance of keeping the work area safe and tidy			
		2.3	Describe the correct methods of moving or lifting sheet materials			
		2.4	Describe the safe working practices and procedures to be observed when using manual and power operated tools			
		2.5	Describe the hazards associated with carrying out sheet metalworking activities (such as handling sheet materials, using dangerous or badly maintained tools and equipment, operating guillotines and bending machines, and when using hand and bench shears), and how they can be minimised			
		2.6	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		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	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.9	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)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	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			
		2.11	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)			
		2.12	Describe the ways of laying out the marking-out shapes or patterns to maximise use of materials			
		2.13	Describe the tools and techniques available for cutting and shaping sheet metal (such as tin snips, bench shears, guillotines, portable power tools, bench drills, saws)			
		2.14	Describe the use and care of tools and equipment (including checks that must be made to ensure that the tools are fit for purpose - such as sharp, undamaged, plugs and cables secure and free from damage, PAT tested, machine guards or safety devices operating correctly)			
		2.15	Describe the hand tools used in sheet metal forming activities (such as range of hammers, stakes, formers, sand bags), and typical operations that they are used for			
		2.16	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)			
		2.17	Describe the methods of stretching and shrinking materials, and the tools, equipment and techniques used for this			
		2.18	Explain how to set up the various machines to produce the required forms (setting up of rolls; setting fingers on bending machines; setting forming tools for swaging)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Describe the ways of limiting distortion, marking, creases, flats (in curved sections)			
		2.20	Describe the characteristics of the various materials used (with regard to the bending and forming process)			
		2.21	Explain how the materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming			
		2.22	Describe the importance of using tools or equipment only for the purpose intended; the care that is required when using the tools or equipment; the proper way of preserving tools or equipment between operations			
		2.23	Describe the various methods of securing the assembled components, and the range of mechanical fastening devices that are used (such as nuts and bolts, rivets, 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)			
		2.24	Describe the preparations to be carried out on the components prior to assembling them			
		2.25	Explain how to set up and align the various components, and the tools and equipment that are used for this			
		2.26	Describe the methods of temporarily holding the joints together to aid the assembly activities (such as clamps, rivet clamps)			
		2.27	Describe the inspection techniques that can be applied to check that shape (including straightness) and dimensional accuracy are to specification and within acceptable limits			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.28	Describe the problems that can occur with the sheet metalworking activities (such as defects caused by incorrectly set or blunt shearing blades), and how these can be overcome			
		2.29	Explain when to act on their own initiative and when to seek help and advice from others			
		2.30	Describe the importance of leaving the work area and equipment in a safe and clean condition on completion of the sheet metal activities (such as storing power leads, isolating machines, cleaning the equipment and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 133: Producing Platework Components and Assemblies

Unit reference number: L/504/6403

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce platework components and assemblies. 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 F.

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 platework components and assemblies	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 plateworking activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Ensure that all power tool cables, extension leads or air supply hoses are in a tested and serviceable condition • Return all tools and equipment to the correct location on completion of the plateworking activities • Check that all measuring equipment is within calibration date			
		1.3	Plan the plateworking activities before they start them			
		1.4	Use the following materials: • Flat plate Plus one more from the following: • Pipe/tube • Solid bar (such as square, round, hexagonal) • Rolled sections (angle, channel, RSJ, rail section) • Non-ferrous materials			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Obtain the appropriate tools and equipment for the plateworking operations, and check that they are in a safe and usable condition			
		1.6	Use a range of marking out equipment, to include all of the following: • Scriber • Punch • Rule or tape • Straight edge • Square • Protractor • Dividers or trammels • Chalk, blueing or paint			
		1.7	Mark out the components for the required operations, using appropriate tools and techniques			
		1.8	Use marking out methods and techniques, including: • Direct marking using instruments Plus one more from the following: • Use of templates • Tracing/transfer methods • Other specific method			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Mark out material, to include all of the following features: • Datum and centre lines • Square/rectangular profiles • Angles • Circles • Curved profiles • Cutting and bending detail (including allowances) • Hole centring and outlining (such as circular or linear)			
		1.10	Cut and shape the materials to the required specification, using appropriate tools and techniques			
		1.11	Cut and finish material to the marked out shape, using both of the following: • Guillotine • Drill (such as bench, pillar, radial) Plus two more from the following: • Abrasive disc • Cropping machine • Machine saw			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Perform cutting operations to produce components that combine operations and cover all of the following features: • Components with parallel sides • Components with sides square to each other • Holes linearly pitched Plus two more from the following: • Components with angled sides • Bevelled edges or weld preps • Components with curved contours • Holes radially pitched			
		1.13	Use two of the following types of forming equipment/techniques: • Bending machine (hand or powered) • Rolling machine (hand or powered) • Presses • Heating techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Perform forming operations to produce components that combine operations and cover all of the following features: • Bends at 90° • Bends of various angles • Cylinders Plus two more of the following: • Set plate ends • Box square and rectangular sections • Curved plates • Pipe sections • Cones • Segments of a cylindrical tank • Curved section or sector of an otherwise flat plate • Counter-curved sections • Flattening or straightening plate			
		1.15	Use the appropriate methods and techniques to assemble and secure the components in their correct positions			
		1.16	Assemble platework components using two of the following methods: • Temporary tack welding • Riveting (hot or cold) • Adhesive bonding • Mechanically fastened (such as bolts, screws)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Measure and check that all dimensional and geometrical aspects of the components are to the specification			
		1.18	Produce platework components which meet all of the following: • All dimensions are within +/- 3.0mm or +/- 0.125” • Finished components meet the required shape/geometry (such as square, straight, angles 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			
		1.19	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			
		1.20	Leave the work area in a safe and tidy condition on completion of the platework activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce platework components and assemblies	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the plateworking activities undertaken			
		2.2	Describe the personal protective clothing and equipment (PPE) to be worn when carrying out the plateworking activities (such as leather gloves, eye protection, ear protection), and the importance of keeping the work area safe and tidy			
		2.3	Describe the correct methods of moving or lifting long and heavy sheet and section materials			
		2.4	Describe the hazards associated with carrying out heavy plateworking activities (such as handling sheet materials, using dangerous or badly maintained tools and equipment, operating guillotines, cropping and bending machines, and when using power saws, drilling machines and abrasive cutting discs), and how they can be minimised			
		2.5	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.6	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			
		2.7	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.8	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)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	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			
		2.10	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)			
		2.11	Describe the ways of laying out the marking-out shapes or patterns to maximise use of materials			
		2.12	Describe the tools and techniques available for cutting and shaping heavy plate and section materials (such as guillotines, cropping machines, abrasive discs (such as hand held portable machines and bench type radiac cutting machines), drilling machines and machine saws)			
		2.13	Describe the selection and fitting of abrasive cutting discs, cutting disc identification markings, how to identify the correct type of disc for the type of material being cut; statutory regulations regarding the fitting and use of abrasive discs			
		2.14	Describe the use and care of tools and equipment (including checks that must be made to ensure that the tools are fit for purpose - such as cutting blades are sharp and undamaged, setting and adjusting guillotine blades for the material thickness, ensuring machine guards, interlocks or other safety devices are operating correctly)			
		2.15	Describe the various shearing machine cutting methods and techniques (such as cutting to marking out; using machine back-stops; setting plate at an angle to the machine slides)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.16	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)			
		2.17	Explain how to set up the various machines to produce the required forms (setting up of rolls; releasing formed work from rolls; setting up bending machines and setting forming tools)			
		2.18	Describe the ways of limiting distortion, marking, creases, flats (in curved sections)			
		2.19	Describe the characteristics of the various materials used (with regard to the bending and forming process); how the materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming			
		2.20	Describe the various methods of securing the assembled components; the range of mechanical fastening devices that are used (such as nuts and bolts, rivets, screws, special fasteners); tack welding methods and techniques			
		2.21	Describe the preparations to be carried out on the components prior to assembling them			
		2.22	Explain how to set up and align the various components, and the tools and equipment that are used for this			
		2.23	Describe the methods of temporarily holding the joints together to aid the assembly activities			
		2.24	Describe the inspection techniques that can be applied to check that shape (including straightness) and dimensional accuracy are to specification and within acceptable limits			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.25	Describe the problems that can occur with the heavy plateworking activities, and how these can be overcome (such as defects caused by incorrectly set or blunt shearing blades)			
		2.26	Explain when to act on their own initiative and when to seek help and advice from others			
		2.27	Describe the importance of leaving the work area and equipment in a safe and clean condition on completion of the platework activities (such as removing and storing power leads, isolating machines, cleaning the equipment, and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 134: Cutting and Shaping Materials Using Thermal Cutting Equipment

Unit reference number: R/504/6404

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to cut and shape materials using thermal cutting equipment. 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 F.

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	Cut and shape materials using thermal cutting equipment	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Confirm that the equipment is safe and fit for purpose, by carrying out all of the following checks: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • The equipment selected is suitable for the operations to be performed • Regulators, hoses and valves are securely connected and free from leaks and damage • The correct gas nozzle is fitted to the cutting torch • A flashback arrestor is fitted to the gas equipment • Appropriate gas pressures are set • The correct procedure is used for lighting, adjusting and extinguishing the cutting flame • Hoses are safely routed and protected at all times • Gas cylinders are handled and stored safely and correctly			
		1.3	Plan the thermal cutting activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Produce thermal cuts in the following form of material (metal of 3mm and above): • Plate Plus one more from the following: • Rolled sections • Pipe/tube • Structures			
		1.5	Produce cut profiles for one type of material from the following: • Mild steel • High tensile/special steel • Stainless steel • Other appropriate metal			
		1.6	Obtain the appropriate tools and equipment for the cutting operations, and check that they are in a safe and usable condition			
		1.7	Set up the thermal cutting equipment for the operations to be performed			
		1.8	Use the following thermal cutting method: • Hand-held oxy-fuel gas cutting equipment Plus one more from the following: • Hand-held plasma gas cutting equipment • Simple, portable, track-driven cutting equipment (electrical or mechanical) • Fixed bench gas cutting equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Where appropriate, mark out the components for the required operations, using appropriate tools and techniques			
		1.10	Operate the thermal cutting equipment to produce items/cut shapes to the dimensions and profiles specified			
		1.11	Perform thermal cutting operations, to include all of the following: • Down-hand straight cuts (freehand) • Cutting regular shapes • Making radial cuts Plus three more from the following: • Making straight cuts (track guided) • Making vertical cuts • Making overhead cuts • Cutting irregular shapes • Making angled cuts • Cutting chamfers • Gouging/flushing • Bevelled edge – weld preparations • Cutting out holes			
		1.12	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
		1.13	Produce thermally-cut components which meet all of the following: • Dimensional accuracy is within the tolerances specified on the drawing/specification, or within +/- 3mm • Angled/radial cuts are within specification requirements • Cuts are clean and smooth, and free from flutes			
		1.14	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			
		1.15	Shut down the equipment to a safe condition on conclusion of the machining activities			
		1.16	Leave the work area in a safe and tidy condition on completion of the thermal cutting activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to cut and shape materials using thermal cutting equipment	2.1	Describe the specific safety precautions to be taken when working with thermal cutting equipment in a fabrication environment (including general workshop safety; protecting other workers by siting protective screens; fire and explosion prevention; safety in enclosed/confined spaces; fume control)			
		2.2	Describe the personal protective clothing and equipment (PPE) to be worn when working with thermal cutting equipment (such as leather aprons and gloves, eye/ear protection)			
		2.3	Describe the correct methods of moving or lifting plate and section materials			
		2.4	Describe the hazards associated with carrying out thermal cutting activities (including trailing hoses, naked flames, fumes and gases, explosive gas mixtures, oxygen enrichment, spatter, hot metal, enclosed spaces), and how they can be minimised			
		2.5	Describe the safe working practices and procedures for using thermal equipment, in line with British Compressed Gas Association (BCGA) codes of practice (to include setting up procedures, and emergency shutdown procedures)			
		2.6	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.7	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 undertaken			
		2.8	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the basic principles of thermal cutting, the various types of thermal cutting equipment available, and typical applications			
		2.10	Describe the accessories that can be used with hand-held thermal cutting equipment to aid cutting operations (such as cutting guides, trammels, templates); arrangements for attaching cutting aids to the equipment			
		2.11	Describe the gases used in thermal cutting; gas identification and colour codes; their particular characteristics and safety procedures			
		2.12	Explain how to set up the thermal cutting equipment (including connection of hoses, regulators and flashback arrestors, selection of cutting torch and nozzle size in relationship to material thickness and operations performed)			
		2.13	Describe the preparations prior to cutting (including checking connections for leaks, setting gas pressures, setting up the material/workpiece, and checking the cleanliness of materials used)			
		2.14	Describe the holding methods that are used to aid thermal cutting, and the equipment that can be used			
		2.15	Describe the setting of operating conditions (including flame control, and the effects of mixtures and pressures associated with thermal cutting)			
		2.16	Describe the correct procedure for lighting and extinguishing the flame (to include lighting the cutting torch and adjusting gas controls to produce a neutral flame; methods of starting the cut and controlling the cutting speed, direction and angle of cut; the procedure for extinguishing the flame and the importance of following the procedure)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Describe the procedures to be followed for cutting specific materials, and why these procedures must always be adhered to			
		2.18	Describe the problems that can occur with thermal cutting (including causes of distortion during thermal cutting and methods of controlling distortion), and how they can be avoided			
		2.19	Describe the effects of oil, grease, scale or dirt on the cutting process			
		2.20	Describe the causes of cutting defects, how to recognise them, and methods of correction and prevention			
		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 thermal cutting activities (such as safely storing gas cylinders and cutting equipment, removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 135: Preparing and Proving CNC Fabrication Machine Tool Programs

Unit reference number: Y/504/6405

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and prove CNC fabrication tool programs. 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 F.

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	Prepare and prove CNC fabrication machine tool programs	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices at all times during the programming activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Obtain the correct component drawings, and check them for currency and validity • Use the appropriate reference manuals and programming codes to suit the machine controller • Prepare the machine controller to accept the operating program • Input/load the prepared program into the controller safely and correctly • Store the programs safely and correctly in the appropriate format • Store program media safely and correctly, away from contaminants or corruption			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Prepare and prove programs for one of the following types of CNC machine tool: • Shearing machine • Punching machine • Forming machine • Bending machine • Plasma cutting • Water cutting • Laser cutting • Gas cutting			
		1.4	Plan the programming activities before they start them			
		1.5	Determine an operational sequence that avoids wasted tool/cutter movements and tool changes			
		1.6	Develop component programs, using appropriate programming codes and techniques			
		1.7	Produce CNC programs using one of the following methods: • Entered directly into the machine controller • Using computer software			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Develop part programs that contain all of the following, as applicable to the machine type: • All necessary positional information • Appropriate codes • Machine management commands (preparatory/auxiliary functions) • Repetitions within programs (using features such as sub-routines, canned cycles, labels) • Absolute or incremental co-ordinates • Tool/cutter change positions • Tool information (such as lengths, offsets, radius compensation)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Develop programs to produce components combining several different operations, covering four of the following: • Straight cuts • Square/rectangular profiles • Curved profiles • Internal profiles • Holes linearly pitched • Holes radially pitched • Louvers • Swages • Bends at 90° • Bends of various angles • Multi-bend platework • Curved plates • Other specific operations			
		1.10	Develop part programs to produce components made from two of the following types of material: • Ferrous • Non-ferrous • Stainless • Special alloys • Other specific materials			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Specify positional information and machine axes that are consistent with the requirements of each stage/operation			
		1.12	Load/input the program to the machine controller, and check the program for errors using the approved procedures			
		1.13	Confirm that the program operates safely and correctly, by checking all of the following: • All operations are carried out to the program co-ordinates • Tool change/park positions are safe and clear of the workpiece and machine equipment • The correct tools are selected at the appropriate points in the program (where applicable) • Tool offsets are correctly entered into the machine controller • Tool cutter head paths are executed safely and correctly • Auxiliary functions operate at the correct point in the program • Programs have been saved in the appropriate format			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Prove the part program using six of the following: • Single block run • Graphic displays/modelling • Data input facilities • Full dry run • Search facilities • Edit facilities • Program override controls (speed, feed, tool data) • Program save/store facilities			
		1.15	Save and store the program in line with organisational procedures			
		1.16	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			
		1.17	Shut down the equipment to a safe condition on completion of the programming activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and prove CNC fabrication machine tool programs	2.1	Describe the safe working practices and procedures to be followed when developing and proving CNC fabrication machine tool programs			
		2.2	Describe the hazards associated with using CNC fabrication machine tools (such as automatic machine operations, power operated workholding devices, moving parts of machinery, sharp cutting tools and burrs and sharp edges on components), and how they can be minimised			
		2.3	Describe the importance of wearing the appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy			
		2.4	Describe the safety mechanisms on the machine, and the procedure for checking that they function correctly (such as emergency stop buttons, emergency brakes)			
		2.5	Describe the correct operation of the various hand and automatic modes of machine control (such as program operating and control buttons)			
		2.6	Explain how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency			
		2.7	Explain how to use and extract information from engineering drawings or data and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken			
		2.8	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, absolute and incremental systems, workpiece zero/reference points and system of tolerancing			
		2.9	Describe the computer coding language used in CNC fabrication machine programs (with regard to machine axes, positional information, machine management and auxiliary functions)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how to prepare part programs, using operational sequences and machining techniques that avoid unnecessary tool/cutter head movements or tool changes			
		2.11	Describe the use of repetitive programs and canned cycles to reduce program size and input time			
		2.12	Describe the function keys and operating system of the machine computer control system being operated			
		2.13	Explain how to set machine datums for each of the machine axes being used			
		2.14	Explain how to set the machine controller in the program and editing mode, and how to enter or download the prepared program			
		2.15	Explain how to deal with error messages and faults on the program or equipment			
		2.16	Explain how to access the program edit facility in order to enter tooling data (such as tool datums, positions, lengths, offsets and radius compensation)			
		2.17	Describe the use of tool posts, magazines and carousels, and how to identify the tools in relationship to the operating program			
		2.18	Explain how to conduct trial runs, using single block run, dry run and feed and speed override controls			
		2.19	Describe the factors affecting the feeds and speeds that can be used, and why they may need to be adjusted from the program setting (such as condition of material, workholding method, tooling used, tolerance and finish to be achieved)			
		2.20	Describe the items that they need to check before allowing the machine to operate in full program run mode			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Explain how to save the completed programs in the appropriate format, and the importance of storing program safely and correctly, away from contaminants and possible corruption			
		2.22	Describe the methods and procedures used to minimise the chances of infecting a computer with a virus			
		2.23	Describe the implications if the computer they are using does become infected with a virus and who to contact if it does occur			
		2.24	Describe the typical problems that can occur with the programming, loading and editing activities, and what to do if they occur			
		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 machine in a safe condition on completion of the activities (such as correctly isolated, operating programs closed or removed, cleaning the machine, and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 136: Preparing and Using CNC Fabrication Machinery

Unit reference number: D/504/6406

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use CNC fabrication machinery. 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 F.

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	Prepare and use CNC fabrication machinery	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Ensure that they apply all of the following checks and practices at all times during the CNC fabrication machining activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Ensure that machine guards are in place and are correctly adjusted • Ensure that components are held securely (without damage or distortion) • Ensure that tooling is maintained in a suitable/safe condition • Make sure that the work area is maintained and left in a safe and tidy condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Prepare one of the following CNC fabrication machines in readiness for production: • Shearing machine • Punching machine • Forming machine • Bending machine • Plasma cutting • Laser cutting • Water cutting • Gas cutting			
		1.4	Plan the CNC machining activities before they start them			
		1.5	Load/input the program to the machine controller, and check the program for errors using the approved procedures			
		1.6	Mount and set the required workholding devices, workpiece and tooling			
		1.7	Position and secure workpieces, using two of the following workholding methods and devices: • Jigs and fixtures • Clamps and stops • Pneumatic/magnetic devices • Other workholding devices			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Set up the machine to produce components, combining several different operations and covering four of the following: • Straight cuts • Square/rectangular profiles • Curved profiles • Internal profiles • Holes linearly pitched • Holes radially pitched • Louvers • Swages • Bends at 90° • Bends of various angles • Multi-bend platework • Curved plates • Other specific operations			
		1.9	Produce components using one of the following types of material: • Ferrous • Non-ferrous • Stainless • Special alloys • Other specific materials			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Select and mount, in the appropriate holding device, one of the following types of cutting/forming tool: • Shearing blades • Hole punching tools • Forming tools • Nibbling tools • Bending tools • Cutting heads/nozzles			
		1.11	Check that all safety mechanisms are in place and that the equipment is set correctly for the required operations			
		1.12	Prepare the tooling by carrying out all of the following activities, as applicable to the machine type: • Pre-setting tooling, using setting jigs/fixtures • Setting tool datums • Mounting tools in the correct position in the tool-posts, turrets, magazine or carousel • Checking that tools have a specific tool number in relationship to the operating program • Entering all relevant tool data into the operating program (such as tool lengths, tool offsets, radius compensation) • Saving changes to the program			
		1.13	Run the operating program, and check and adjust the machine tool speeds/feeds and operating parameters to achieve the component specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Confirm that the machine and program operate safely and correctly, by checking all of the following: • All operations are carried out to the program co-ordinates • Tool change positions are safe and clear of the workpiece and machine equipment • The correct tools are selected at the appropriate points in the program • Tool offsets are correctly entered into the machine controller • Tool cutter paths are executed safely and correctly • Auxiliary functions operate at the correct point in the program (cutter start/stop, coolant flow) • Programs have been saved in the appropriate format			
		1.15	Measure and check that all dimensional and geometrical aspects of the component are to the specification			
		1.16	Carry out the necessary checks for accuracy of three of the following: • Linear dimensions • Position of features • Accuracy of profiles • Flatness/freedom from excessive distortion • Accuracy of louvres and swages			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Produce components that meet all of the following: • Dimensional accuracy is within specification tolerance • Components are free from deformity, burrs and sharp edges • Profiles conform to specification/template requirements			
		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 equipment to a safe condition on completion of the machining activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use CNC fabrication machinery	2.1	Describe the specific safety precautions to be taken when setting up workholding devices and tooling on CNC fabrication machines			
		2.2	Explain how to start and stop the machine, in normal and emergency situations			
		2.3	Describe the importance of ensuring that the machine is isolated from the power supply before mounting the cutting and forming tools and workholding devices			
		2.4	Describe the importance of wearing the appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy			
		2.5	Describe the hazards associated with working on CNC fabrication machines (such as moving machinery, automatic machine operation, handling of cutting and forming tools, lifting and handling workholding devices, handling sheet materials), and how they can be minimised			
		2.6	Explain how to handle and store cutting and forming tools and programs, safely and correctly			
		2.7	Explain how to use and extract information from engineering drawings or data and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken			
		2.8	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.9	Explain how to carry out currency/issue checks of the specifications they are working with			
		2.10	Describe the range of workholding methods and devices that are used on CNC fabrication machines			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Explain why it is important to set the workholding device/workpiece in relationship to the machine datums and reference points			
		2.12	Describe the methods of setting the workholding devices/workpieces, and the tools and equipment that can be used			
		2.13	Describe the range of cutting and forming tools that are used on the CNC fabrication machine			
		2.14	Explain how to check that the cutting and forming tools are in a safe and serviceable condition			
		2.15	Describe the various tool holding devices that are used, and the methods of correctly mounting and securing the cutting and forming tools to the tool holders			
		2.16	Describe the advantages of using pre-set tooling, and how to set the tooling by using setting jigs/fixtures			
		2.17	Describe the use of tool-posts, magazines and carousels, and how to position and identify the tools in relationship to the operating program			
		2.18	Explain how to set and secure the workpiece to the machine/workholding device; the effects of clamping the workpiece; and how material removal can cause warping/distortion of the finished workpiece			
		2.19	Explain how to place the machine into the correct operating mode, and how to access the program edit facility in order to enter tooling data (such as tool datums, positions, lengths, offsets and radius compensation)			
		2.20	Explain how to interpret the visual display and the various messages displayed			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Describe the function of error messages, and what to do when an error message is displayed			
		2.22	Explain how to find the correct restart point in the program, when the machine has been stopped before completion of the program			
		2.23	Describe the operation of the various hand and automatic modes of machine control (such as hand wheels, joysticks, program operating and control buttons)			
		2.24	Explain how to operate the machine using single-block run, full program run and feed/speed override controls			
		2.25	Explain how to make adjustments to the program operating parameters			
		2.26	Explain how to conduct trial runs using single block run, dry run, and feed and speed override controls			
		2.27	Describe the items that they need to check before allowing the machine to operate in full program run mode			
		2.28	Explain how the various types of materials used will affect the feeds/speeds that can be used			
		2.29	Describe the typical problems that can occur with the setting up and operating of the machine and workholding devices, and what to do if they occur			
		2.30	Explain how to save the completed or edited programs in the appropriate format, and the need to store programs and storage devices safely and correctly, away from contaminants and possible corruption			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.31	Explain when to act on their own initiative and when to seek help and advice from others			
		2.32	Describe the importance of leaving the work area and machine in a safe condition on completion of the activities (such as correctly isolated, operating programs closed or removed, cleaning the machine, ensuring that any spilt cutting fluids are correctly dealt with, and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 137: Preparing and Using Manual Metal Arc Welding Equipment

Unit reference number: K/504/6408

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use manual metal arc welding equipment. 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 F.

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	Prepare and use manual metal arc welding equipment	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Prepare for the manual metal arc welding process by carrying out all of the following: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Check the condition of, and correctly connect, welding leads, earthing arrangements and electrode holder • Set and adjust the welding conditions/parameters, in accordance with the welding procedure specification • Prepare the work area for the welding activities (such as positioning welding screens and fume extraction) • Prepare the materials and joint in readiness for welding (such as cleaning of joint faces, grinding weld preparations, setting up the joint, supporting the joint) • Make sure that the work area is maintained and left in a safe and tidy condition			
		1.3	Plan the welding activities before they start them			
		1.4	Obtain and prepare the appropriate welding equipment and welding consumables			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Use manual metal-arc welding and related equipment to include either of the following: • Alternating current (AC) equipment • Direct current (DC) equipment			
		1.6	Use two types of electrode from the following: • Rutile • Basic • Cellulosic • Other suitable electrodes			
		1.7	Prepare and support the joint, using the appropriate methods			
		1.8	Tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding			
		1.9	Weld the joint to the specified quality, dimensions and profile			
		1.10	Produce three of the following welded joints, of at least 150mm long, using single or multi-run welds (as appropriate), with at least one stop and start included: • Fillet lap joints • Tee fillet joints • Corner joints • Butt joints			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce joints as follows: One type of material from the following: • Carbon steel • Stainless steel • And one form of material from the following: • Sheet (less than 3mm) • Plate • Section • Pipe/tube • Other forms			
		1.12	Weld joints in good access situations, in two of the following BS EN ISO 6947 positions: • Flat (PA) • Horizontal vertical (PB) • Horizontal (PC) • Vertical upwards (PF) • Vertical downwards (PG)			
		1.13	Use appropriate methods and equipment to check the quality, and check that all dimensional and geometrical aspects of the weld are to the specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Check that the welded joint conforms to the specification by checking all of the following: • Dimensional accuracy • Alignment/squareness • Size and profile of weld • Number of runs			
		1.15	Carry out non destructive testing of the welds, using one of the following: • Dye penetrant • Fluorescent penetrant • Magnetic particle			
		1.16	Carry out destructive tests on weld specimens, using one of the following: • Macroscopic examination • Nick break test • Bend tests (such as face, root or side, as appropriate)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Identify all of the following weld defects: • Lack of continuity of the weld • Uneven and irregular ripple formation • Incorrect weld size or profile Plus four more of the following: • Undercutting • Overlap • Inclusions • Porosity • Surface cracks • Internal cracks • Lack of fusion • Lack of penetration			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Produce welded joints which meet all of the following (with reference to BS 4872 Part 1 Weld test requirements): • Welds meet the required dimensional accuracy • Fillet welds are equal in leg length and slightly convex in profile, with the size of the fillet equivalent to the thickness of the material welded • The weld contour is linear, of uniform profile, free from excessive undulations, with regular and even ripple formation • The welds are adequately fused, and with minimal undercut, overlap and surface inclusions • Weld finishes are built up to the full section of the weld • Joins at stop/start positions merge smoothly, with no pronounced hump or crater in the weld surface • Tack welds are blended in to form part of the finished weld, without excessive hump • Corner joints have minimal burn through to the underside of the joint or, where appropriate, penetration is present to a maximum depth of 3mm for at least 75% of the joint • The weld surface is free from cracks, and substantially free from porosity, shrinkage cavities and trapped slag • The weld surface and adjacent parent metal is substantially free from arcing or chipping marks			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	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			
		1.20	Shut down and make safe the welding equipment on completion of the welding activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use manual metal arc welding equipment	2.1	Describe the safe working practices and procedures to be followed when preparing and using MMA welding equipment (such as general workshop safety; appropriate personal protective equipment (PPE); fire prevention; protecting other workers from the effects of the welding arc; safety in enclosed/confined spaces; fume extraction/control)			
		2.2	Describe the hazards associated with MMA welding (such as live electrical components; poor earthing; the electric arc; fumes and gases; spatter; hot slag and metal; grinding and mechanical metal/slag removal; elevated working; welding in enclosed spaces; slips, trips and falls), and how they can be minimised			
		2.3	Describe the personal protective equipment to be worn for the welding activities (such as correctly fitting overalls; leather aprons, welding gloves/gauntlets; safety boots; head/eye shield with correct shade of filter)			
		2.4	Describe the manual metal arc welding process (such as basic principles of fusion welding, AC and DC power sources, power ranges)			
		2.5	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			
		2.6	Describe the types of electrodes used, and the correct control, storage and drying of electrodes			
		2.7	The types of welded joints to be produced (such as lap joints, corner joints, tee joints, butt welds, single and multi-run welds)			
		2.8	Describe the terminology used for the appropriate welding positions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Explain how to prepare the materials in readiness for the welding activity (such as ensuring that the material is free from excessive surface contamination such as rust, scale, paint, oil/grease and moisture); ensuring that edges to be welded are correctly prepared (such as made flat, square or bevelled)			
		2.10	Explain how to set up and restrain the joint, and the tools and techniques to be used (such as the use of jigs and fixtures, restraining devices - such as clamps and weights/blocks; setting up the joint in the correct position and alignment)			
		2.11	Describe the tack welding size and spacing in relationship to material thickness			
		2.12	Describe the checks to be made prior to welding (such as confirming the correct set-up of the joint; condition of electrical connections, welding return and earthing arrangements; checking operating parameters)			
		2.13	Describe the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as striking and initiating the arc; fine adjustment of parameters; correct manipulation and welding speed of electrode; blending in stops/starts and tack welds)			
		2.14	Explain how to close down the welding equipment safely and correctly			
		2.15	Explain how to control distortion (such as welding sequence; deposition technique)			
		2.16	Describe the problems that can occur with the welding activities (such as causes of distortion and methods of control; effects of welding on materials and sources of weld defects), and how these can be overcome			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Describe the safe working practices and procedures to be adopted when preparing the welds for examination (such as handling hot materials, using chemicals for cleaning and etching, using equipment to fracture welds)			
		2.18	Explain how to prepare the welds for examination (such as removing slag, spatter and surface irregularities; cleaning the weld, polishing and making saw cuts on welds to be fracture tested)			
		2.19	Explain how to check the welded joints for uniformity, alignment, position, weld size and profile			
		2.20	Describe the various procedures for visual examination of the welds for cracks, porosity and slag inclusions (such as dye penetrant, fluorescent penetrant; magnetic particle testing)			
		2.21	Describe the various procedures for carrying out destructive tests on the welds (such as macroscopic examination, bend tests, nick break tests)			
		2.22	Describe the methods of removing a specimen of weld from a suitable position in the joint (such as a stop/start position using a non-thermal process, such as hand saws, power saws, abrasive discs)			
		2.23	Explain how to examine the welds after the tests and check for such defects as the degree of penetration and fusion, inclusions, porosity, cracks, undercut and overlap, uneven and irregular ripple formation			
		2.24	Explain when to act on their own initiative and when to seek help and advice from others			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.25	Describe the importance of leaving the work area and equipment in a safe condition on completion of the welding activities (such as isolation of electrical supplies; safely storing welding cables and electrode holders; storing electrodes; removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 138: Preparing and Using Manual TIG or Plasma-Arc Welding Equipment

Unit reference number: M/504/6409

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use manual TIG or plasma-arc welding equipment. 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 F.

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	Prepare and use manual TIG or plasma-arc welding equipment	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Prepare for the TIG or plasma-arc welding process by carrying out all of the following: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Check the condition of and correctly connect welding leads, earthing arrangements, hoses and welding torch • Set and adjust the welding conditions/parameters, in accordance with the welding procedure specification • Prepare the work area for the welding activities (such as positioning welding screens and fume extraction) • Prepare the materials and joint in readiness for welding (such as cleaning of joint faces, grinding weld preparations, setting up the joint, supporting the joint) • Make sure that the work area is maintained and left in a safe and tidy condition			
		1.3	Plan the welding activities before they start them			
		1.4	Obtain and prepare the appropriate welding equipment and welding consumables			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Use manual welding and related equipment, to include one of the following welding processes: • TIG • Plasma-arc			
		1.6	Use welding consumables appropriate to the material and application, to include one of the following: • AC current types • DC current types			
		1.7	Prepare and support the joint, using the appropriate methods			
		1.8	Tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding			
		1.9	Weld the joint to the specified quality, dimensions and profile			
		1.10	Produce three of the following welded joints of at least 150mm long, by single or multi-run (as appropriate), with at least one stop and start included: • Fillet lap joints • Tee fillet joints • Corner joints • Butt joints And using one of the following methods: • With filler wire • Without filler wire (autogenously)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce joints in the following: One type of material from the following: • Carbon steel • Stainless steel • Aluminium And two forms of material from the following: • Sheet (less than 3mm) • Plate • Section • Pipe/tube • Other forms			
		1.12	Weld joints in good access situations, in two of the following BS EN ISO 6947 positions: • Flat (PA) • Horizontal vertical (PB) • Horizontal (PC) • Vertical upwards (PF) • Vertical downwards (PG)			
		1.13	Use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Check that the welded joint conforms to the specification, by checking all of the following: • Dimensional accuracy • Alignment/squareness • Size and profile of weld • Number of runs			
		1.15	Carry out non-destructive testing of the welds, using one of the following: • Dye penetrant • Fluorescent penetrant • Magnetic particle			
		1.16	Carry out destructive tests on weld specimens, using one of the following : • Macroscopic examination • Nick break test • Bend tests (such as face, root or side, as appropriate)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Identify all of the following weld defects: • Lack of continuity of the weld • Uneven and irregular ripple formation • Incorrect weld size or profile Plus four more of the following: • Undercutting • Overlap • Inclusions • Porosity • Internal cracks • Surface cracks • Lack of fusion • Lack of penetration			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Produce welded joints which meet all of the following (with reference to BS 4872 Part 1 Weld test requirements): • Welds meet the required dimensional accuracy • Fillet welds are equal in leg length and slightly convex in profile (where applicable), with the size of the fillet equivalent to the thickness of the material welded • The weld contour is linear, of uniform profile, free from excessive undulations, with regular and even ripple formation • The welds are adequately fused, and there is minimal undercut, overlap and surface inclusions • Weld finishes are built up to the full section of the weld • Joins at stop/start positions merge smoothly, with no pronounced hump or crater in the weld surface • Tack welds are blended in to form part of the finished weld, without excessive hump • Corner joints have minimal burn through to the underside of the joint or, where appropriate, penetration is present to a maximum depth of 3mm for at least 75% of the joint • The weld surface is free from cracks, and substantially free from porosity, shrinkage cavities and trapped slag • The weld surface and adjacent parent metal is substantially free from arcing or chipping marks			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	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			
		1.20	Shut down and make safe the welding equipment on completion of the welding activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use manual TIG or plasma-arc welding equipment	2.1	Describe the safe working practices and procedures to be followed when preparing and using TIG or plasma-arc welding equipment (such as general workshop safety; appropriate personal protective equipment (PPE); fire prevention; protecting other workers from the effects of the welding arc; safety in enclosed/confined spaces; fume extraction/control)			
		2.2	Describe the hazards associated with TIG and plasma-arc welding (such as live electrical components; poor earthing; the electric arc; fumes and gases; hot metal; welding in enclosed spaces; slips, trips and falls), and how they can be minimised			
		2.3	Describe the personal protective equipment to be worn for the welding activities (such as correctly fitting overalls; leather aprons, welding gloves/gauntlets; safety boots; head/eye shield with correct shade of filter)			
		2.4	Describe the correct handling and storage of gas cylinders (such as manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features)			
		2.5	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			
		2.6	Describe the manual TIG or plasma-arc welding process (such as basic principles of fusion welding; the major parts of the welding equipment and their function)			
		2.7	Describe the types, selection and application of filler wires and welding electrodes			
		2.8	Describe the reasons for using shielding gases, and the types and application of the various gases			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the gas pressures and flow rates (in relationship to the type of material being welded)			
		2.10	Describe the types of welded joints to be produced (such as lap joints, corner joints, tee joints and butt welds)			
		2.11	Describe the terminology used for the appropriate welding positions			
		2.12	Explain how to prepare the materials in readiness for the welding activity (such as ensuring that the material is free from excessive surface contamination - such as rust, scale, paint, oil/grease and moisture; ensuring edges to be welded are correctly prepared - such as made flat, square or bevelled)			
		2.13	Explain how to set up and restrain the joint, and the tools and techniques to be used (such as the use of jigs and fixtures, restraining devices such as clamps and weights/blocks; setting up the joint in the correct position and alignment)			
		2.14	Describe the tack welding size and spacing (in relationship to material thickness)			
		2.15	Describe the checks to be made prior to welding (such as confirming the correct set-up of the joint; the condition of electrical connections, welding return and earthing arrangements; operating parameters)			
		2.16	Describe the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as fine adjustment of parameters; correct manipulation of the torch; blending in stops/starts and tack welds)			
		2.17	Explain how to control distortion (such as welding sequence; deposition technique)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Describe the problems that can occur with the welding activities (such as causes of distortion and methods of control; effects of welding on materials and sources of weld defects), and how these can be overcome			
		2.19	Explain how to close down the welding equipment safely and correctly			
		2.20	Describe the safe working practices and procedures to be adopted when preparing the welds for examination (such as handling hot materials, using chemicals for cleaning and etching, using equipment to fracture welds)			
		2.21	Explain how to prepare the welds for examination (such as removing surface irregularities; cleaning the weld, polishing and making saw cuts on welds to be fracture tested)			
		2.22	Explain how to check the welded joints for uniformity, alignment, position, weld size and profile			
		2.23	Describe the various procedures for visual examination of the welds for cracks, porosity and slag inclusions (such as dye penetrant, fluorescent penetrant; magnetic particle testing)			
		2.24	Describe the various procedures for carrying out destructive tests on the welds (such as macroscopic examination, bend tests, nick break tests)			
		2.25	Describe the methods of removing a specimen of weld from a suitable position in the joint (such as a stop/start position) using a non thermal process (such as hand saws, power saws, abrasive discs)			
		2.26	Explain how to examine the welds after the tests and how to check for such defects as the degree of penetration and fusion, inclusions, porosity, cracks, undercut and overlap, uneven and irregular ripple formation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.27	Explain when to act on their own initiative and when to seek help and advice from others			
		2.28	Describe the importance of leaving the work area and equipment in a safe condition on completion of the welding activities (such as isolation of electrical supplies, safely storing equipment and consumables, removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 139: Preparing and Using Semi-Automatic MIG, MAG and Flux Cored Arc Welding Equipment

Unit reference number: H/504/6410

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use semi-automatic MIG, MAG and Flux cored arc welding ewquipment. 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 F.

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	Prepare and use manual MIG, MAG and other continuous wire welding equipment	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines.			
		1.2	Prepare for the MIG, MAG or flux cored-wire arc welding process by carrying out all of the following: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Check the condition of, and correctly connect, welding leads/cables, hoses, shielding gas supply and wire feed mechanisms • Set and adjust the welding conditions/parameters, in accordance with the welding procedure specification • Prepare the work area for the welding activities (such as positioning welding screens and fume extraction) • Prepare the materials and joint in readiness for welding (such as cleaning of joint faces, grinding weld preparations, setting up the joint, supporting the joint) • Make sure the work area is maintained and left in a safe and tidy condition			
		1.3	Plan the welding activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Obtain and prepare the appropriate welding equipment and welding consumables			
		1.5	Use manual/semi-automatic welding and related equipment to include one of the following: • MIG • MAG • Flux cored wire welding equipment			
		1.6	Use consumables appropriate to the material and application, to include: One of the following wire types: • Solid wire • Cored wire Plus one of the following types of shielding gas: • Inert • Active			
		1.7	Prepare and support the joint, using the appropriate methods			
		1.8	Tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding			
		1.9	Weld the joint to the specified quality, dimensions and profile			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Produce three of the following welded joints of at least 150mm long, by single or multi-run (as appropriate), with at least one stop and start included: • Fillet lap joints • Tee fillet joints • Corner joints • Butt joints			
		1.11	Produce joints as follows: One type of material from the following: • Carbon steel • Stainless steel • Aluminium And two forms of material from the following: • Plate • Section • Sheet (less than 3mm) • Pipe/tube • Other forms			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Weld joints in good access situations in two of the following BS EN ISO 6947 positions: • Flat (PA) • Horizontal vertical (PB) • Horizontal (PC) • Vertical upwards (PF) • Vertical downwards (PG)			
		1.13	Use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification			
		1.14	Check that the welded joint conforms to the specification, by checking all of the following: • Dimensional accuracy • Alignment/squareness • Size and profile of weld • Number of runs			
		1.15	Carry out non-destructive testing of the welds, using one of the following: • Dye penetrant • Fluorescent penetrant • Magnetic particle			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Carry out destructive tests on weld specimens using one of the following : • Macroscopic examination • Nick break test • Bend tests (such as face, root or side, as appropriate)			
		1.17	Identify all of the following weld defects: • Lack of continuity of the weld • Uneven and irregular ripple formation • Incorrect weld size or profile Plus four more of the following: • Undercutting • Overlap • Inclusions • Porosity • Internal cracks • Surface cracks • Lack of fusion • Lack of penetration			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Produce welded joints which meet all of the following (with reference to BS 4872 Part 1 Weld test requirements): • Welds meet the required dimensional accuracy • Fillet welds are equal in leg length and slightly convex in profile, with the size of the fillet equivalent to the thickness of the material welded • The weld contour is linear, of uniform profile, free from excessive undulations, with regular and even ripple formation • The welds are adequately fused, and there is minimal undercut, overlap and surface inclusions • Weld finishes are built up to the full section of the weld • Joins at stop/start positions merge smoothly, with no pronounced hump or crater in the weld surface • Tack welds are blended in to form part of the finished weld, without excessive hump • Corner joints have minimal burn through to the underside of the joint or, where appropriate, penetration is present to a maximum depth of 3mm for at least 75% of the joint • The weld surface is free from cracks, and substantially free from porosity, shrinkage cavities and trapped slag • The weld surface and adjacent parent metal is substantially free from arcing or chipping marks			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	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			
		1.20	Shut down and make safe the welding equipment on completion of the welding activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use manual MIG, MAG and other continuous wire welding equipment	2.1	Describe the safe working practices and procedures to be followed when preparing and using MIG, MAG or flux cored wire arc welding equipment (such as general workshop safety; appropriate personal protective equipment (PPE); fire prevention; protecting other workers from the effects of the welding arc; safety in enclosed/confined spaces; fume extraction/control)			
		2.2	Describe the hazards associated with MIG, MAG or flux cored-wire arc welding (such as live electrical components; poor earthing; the electric arc; fumes and gases; spatter; hot slag and metal; grinding and mechanical metal/slag removal; elevated working; enclosed spaces; slips, trips and falls), and how they can be minimised			
		2.3	Describe the personal protective equipment to be worn for the welding activities (such as correctly fitting overalls; leather aprons, welding gloves/gauntlets; safety boots; head/eye shield with correct shade of filter)			
		2.4	Describe the correct handling and storage of gas cylinders (such as manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features)			
		2.5	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			
		2.6	Describe the semi-automatic MIG, MAG or flux cored wire arc welding process (such as basic principles of fusion welding, power sources, the major parts of the welding equipment and their function)			
		2.7	Describe the types, selection and application of electrode wires (such as solid and cored)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.8	Describe the reasons for using shielding gases, and the types and application of the various gases			
		2.9	Describe the gas pressures and flow rates (in relation to the type of material being welded)			
		2.10	Describe the types of welded joints to be produced (such as lap joints, corner joints, tee joints and butt welds)			
		2.11	Describe the terminology used for the appropriate welding positions			
		2.12	Explain how to prepare the materials in readiness for the welding activity (such as ensuring that the material is free from excessive surface contamination - such as rust, scale, paint, oil/grease and moisture; ensuring edges to be welded are correctly prepared - such as made flat, square or bevelled)			
		2.13	Explain how to set up and restrain the joint, and the tools and techniques to be used (such as the use of jigs and fixtures, restraining devices - such as clamps and weights/blocks; setting up the joint in the correct position and alignment)			
		2.14	Describe the tack welding size and spacing (in relation to material thickness)			
		2.15	Describe the checks to be made prior to welding (such as confirming the correct set-up of the joint; the condition of electrical connections, welding return and earthing arrangements; wire feed mechanisms; gas supply; operating parameters)			
		2.16	Describe the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as fine adjustment of parameters; correct manipulation of the welding gun; blending in stops/starts and tack welds)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Describe the methods/modes of metal transfer and their uses (such as dip, globular, free flight, spray and pulsed)			
		2.18	Explain how to close down the welding equipment safely and correctly			
		2.19	Explain how to control distortion (such as welding sequence; deposition technique)			
		2.20	Describe the problems that can occur with the welding activities (such as causes of distortion and methods of control; effects of welding on materials and sources of weld defects), and how these can be overcome			
		2.21	Describe the safe working practices and procedures to be adopted when preparing the welds for examination (such as handling hot materials, using chemicals for cleaning and etching, using equipment to fracture welds)			
		2.22	Explain how to prepare the welds for examination (such as removing surface irregularities; cleaning the weld, polishing and making saw cuts on welds to be break tested)			
		2.23	Explain how to check the welded joints for uniformity, alignment, position, weld size and profile			
		2.24	Describe the various procedures for visual examination of the welds for cracks, porosity and slag inclusions (such as dye penetrant, fluorescent penetrant; magnetic particle testing)			
		2.25	Describe the various procedures for carrying out destructive tests on the welds (such as macroscopic examination, bend tests, nick break tests)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.26	Describe the methods of removing a specimen of weld from a suitable position in the joint (such as a stop/start position), using a non thermal process (such as hand saws, power saws, abrasive discs)			
		2.27	Explain how to examine the welds after the tests, and how to check for such defects as the degree of penetration and fusion, inclusions, porosity, cracks, undercut and overlap, uneven and irregular ripple formation			
		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 condition on completion of the welding activities (such as isolation of electrical supplies; safely storing welding cables and electrode holders; storing electrodes; removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 140: Preparing and Using Manual Oxy/Fuel Gas Welding Equipment

Unit reference number: Y/504/6419

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and use manual oxy/fuel gas welding equipment. 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 F.

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	Prepare and use manual gas welding equipment	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 for the gas welding process by carrying out all of the following: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Check regulators, hoses and check that valves are securely connected and free from leaks and damage • Check/fit the correct gas nozzle to the torch • Check that a flashback arrestor is fitted • Set appropriate gas pressures • Use the correct procedure for lighting, adjusting and extinguishing the welding flame • Use appropriate and safe procedures for handling and storing of gas cylinders • Prepare the work area for the welding activities (such as positioning welding screens and fume extraction) • Prepare the materials and joint in readiness for welding (such as cleaning of joint faces, grinding weld preparations, setting up the joint, supporting the joint) • Make sure the work area is maintained and left in a safe and tidy condition			
		1.3	Plan the welding activities before they start them			
		1.4	Obtain and prepare the appropriate welding equipment and welding consumables			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Prepare and support the joint, using the appropriate methods			
		1.6	Tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding			
		1.7	Weld the joint to the specified quality, dimensions and profile			
		1.8	Produce three of the following welded joints of at least 150mm long, by single or multi-run (as appropriate), with at least one stop and start included: • Fillet lap joints • Tee fillet joints • Corner joints • Butt joints • Welds made without filler wire (autogenously) Using one of the following methods: • With filler wire • Without filler wire (autogenously)			
		1.9	Produce joints in one form of material from the following: • Sheet (less than 3mm) • Plate • Section • Pipe/tube • Other forms			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Weld joints in good access situations in two of the following BS EN ISO 6947 positions: • Flat (PA) • Horizontal vertical (PB) • Horizontal (PC) • Vertical upwards (PF) • Vertical downwards (PG)			
		1.11	Use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification			
		1.12	Check that the welded joint conforms to the specification, by checking all of the following: • Dimensional accuracy • Alignment/squareness • Size and profile of weld • Number of runs			
		1.13	Carry out non-destructive testing of the welds, using one of the following: • Dye penetrant • Fluorescent penetrant • Magnetic particle			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Carry out destructive tests on weld specimens using one of the following: • Macroscopic examination • Nick break test • Bend tests (such as face, root or side, as appropriate)			
		1.15	Identify all of the following weld defects: • Lack of continuity of the weld • Uneven and irregular ripple formation • Incorrect weld size or profile Plus four more of the following: • Undercutting • Overlap • Inclusions • Porosity • Surface cracks • Internal cracks • Lack of fusion • Lack of penetration			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Produce welded joints which meet all of the following (with reference to BS 4872 Part 1 Weld test requirements): • Welds meet the required dimensional accuracy • Fillet welds are equal in leg length and slightly convex in profile (where appropriate), with the size of the fillet equivalent to the thickness of the material welded • The weld contour is linear, of uniform profile, free from excessive undulations, with regular and even ripple formation • The welds are adequately fused, and there is minimal undercut and overlap • Weld finishes are built up to the full section of the weld • Joins at stop/start positions merge smoothly, with no pronounced hump or crater in the weld surface • Tack welds are blended in to form part of the finished weld, without excessive hump • Corner joints have minimal burn through to the underside of the joint or, where appropriate, penetration is present to a maximum depth of 3mm for at least 75% of the joint • The weld surface is free from cracks, and substantially free from porosity, shrinkage cavities and trapped slag • The weld surface and adjacent parent metal is substantially free from spatter or chipping marks			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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	Shut down and make safe the welding equipment on completion of the welding activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use manual gas welding equipment	2.1	Describe the safe working practices and procedures to be followed when preparing and using manual gas welding equipment (such as general workshop safety; appropriate personal protective equipment (PPE); fire and explosion prevention, protecting other workers, safety in enclosed/confined spaces; fume extraction/control)			
		2.2	Describe the hazards associated with manual oxy/fuel gas welding (such as naked flames, fumes and gases, explosive gas mixtures, oxygen enrichment, spatter, hot metal, elevated working, welding in enclosed spaces, slips trips and falls), and how they can be minimised			
		2.3	Describe the personal protective equipment to be worn for the welding activities (such as correctly fitting overalls; leather aprons, welding gloves/gauntlets; safety boots; head/eye shield with correct grade of filter)			
		2.4	Describe the correct handling and storage of gas cylinders (such as manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features)			
		2.5	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			
		2.6	Describe the manual gas welding process (such as basic principles of gas welding and related equipment; care of the equipment)			
		2.7	Describe the consumables associated with gas welding (such as types of filler wire, fluxes, the types of gas and its supply and control)			
		2.8	Explain how to prepare the welding equipment, and the checks to be made to ensure that it is safe and ready to use (such as connection of hoses, torch, flashback arrestors, hose check valves and regulators)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Explain how to check connections for leaks, and the methods that are used			
		2.10	Explain how to set gas working pressures; reading the gauges to establish content and pressures			
		2.11	Describe the types of welded joints to be produced (such as lap joints, corner joints, tee joints and butt welds)			
		2.12	Describe the terminology used for the appropriate welding positions			
		2.13	Explain how to prepare the materials in readiness for the welding activity (such as ensuring that the material is free from excessive surface contamination - such as rust, scale, paint, oil/grease and moisture; ensuring edges to be welded are correctly prepared - such as made flat, square or bevelled)			
		2.14	Explain how to set up and restrain the joint, and the tools and techniques to be used (such as the use of jigs and fixtures, restraining devices - such as clamps and weights/blocks; setting up the joint in the correct position and alignment)			
		2.15	Describe the tack welding size and spacing (in relation to material thickness)			
		2.16	Describe the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as selection of nozzle, lighting and adjusting the flame, correct manipulation of torch and filler rods)			
		2.17	Describe the safe and correct sequence for shutting down the equipment (such as sequence of turning off the gases, extinguishing the flame and closing valves on the gas supply/cylinders)			
		2.18	Describe the control of heat input to prevent filler material and parent material faults (such as welding sequence; deposition technique)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Describe the problems that can occur with the welding activities (such as causes of distortion and methods of control; effects of welding on materials and sources of weld defects), and how these can be overcome			
		2.20	Describe the safe working practices and procedures to be adopted when preparing the welds for examination (such as handling hot materials, using chemicals for cleaning and etching, using equipment to fracture welds)			
		2.21	Explain how to prepare the welds for examination (such as removing surface irregularities; cleaning the weld, polishing and making saw cuts on welds to be break tested)			
		2.22	Explain how to check the welded joints for uniformity, alignment, position, weld size and profile			
		2.23	Describe the various procedures for visual examination of the welds for cracks, porosity and inclusions (such as dye penetrant, fluorescent penetrant; magnetic particle testing)			
		2.24	Describe the various procedures for carrying out destructive tests on the welds (such as macroscopic examination, bend tests, nick break tests)			
		2.25	Describe the methods of removing a specimen of weld from a suitable position in the joint (such as a stop/start position), using a non thermal process (such as hand saws, power saws, abrasive discs)			
		2.26	Explain how to examine the welds after the tests, and how to check for such defects as the degree of penetration and fusion, inclusions, porosity, cracks			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.27	Explain when to act on their own initiative and when to seek help and advice from others			
		2.28	Describe the importance of leaving the work area and equipment in a safe condition on completion of the gas welding activities (such as isolation of gas cylinders; safely storing cylinders, hoses and torches; storing filler rods; removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 141: Preparing and Using Manual Flame Brazing and Braze Welding Equipment

Unit reference number: L/504/6420

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 prepare and use manual flame brazing and braze welding equipment. 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 f.

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	Prepare and use manual flame brazing and braze welding equipment	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 for the manual flame brazing or braze welding process by carrying out all of the following: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Check that hoses, regulators and valves are securely connected and free from leaks and damage • Check/fit the correct size gas nozzle to the torch • Check that a flashback arrestor and check valves are fitted • Set appropriate gas pressures • Use the correct procedure for lighting, adjusting and extinguishing the flame • Use appropriate and safe procedures for handling and storing of gas cylinders (where appropriate) • Prepare the work area for the activities (such as positioning screens and fume extraction equipment) • Prepare the materials and joint in readiness for brazing or braze welding (such as cleaning of joint faces, setting up the joint, supporting the joint) • Make sure the work area is maintained and left in a safe and tidy condition			
		1.3	Plan the brazing or braze welding activities before they start them			
		1.4	Obtain and prepare the appropriate manual flame brazing or braze welding equipment and consumables			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Set up, check, adjust and use both of the following manual flame processes and related equipment: • Brazing • Braze welding			
		1.6	Use specified consumables appropriate to the parent metals, to include one of the following: • Self fluxing rods • Flux coated/impregnated rods • Powder/paste flux and rods			
		1.7	Prepare and support the joint, using the appropriate methods			
		1.8	Tack the joint at appropriate intervals, and check the joint for accuracy before final brazing or braze welding			
		1.9	Produce the brazed or braze welded joints of the required quality and of specified dimensional accuracy			
		1.10	Produce joints in two of the following materials: • Copper to copper • Brass to brass • Copper to brass • Copper to carbon • Other appropriate materials			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce joints in good access situations, covering two of the following: • Lap joints • Tee joints • Corner joints • Butt joints • Socket joints			
		1.12	Produce joints in the following positions: For brazing, use one of the following: • Horizontal flow • Vertical down flow • Vertical up flow For braze welding, use one of the following: • Flat position • Horizontal-vertical position			
		1.13	Produce joints in both of the following: • Sheet/plate • Pipe/tube			
		1.14	Use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the joint are to the specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out destructive tests on weld specimens, using one of the following: • Macroscopic examination • Nick break test			
		1.16	Identify all of the following brazing and braze welding defects: • Lack of continuity of the brazed and braze welded joint • Uneven and irregular ripple formation • Incorrect joint size or profile Plus three more of the following: • Overlap • Inclusions • Porosity • Surface cracks • Lack of penetration			
		1.17	Produce brazed and braze welded components which meet all of the following: • Achieve the specified joint quality • Meet the required dimensional accuracy within specified tolerance • Are of good appearance, free from flux residues and excess filler metal			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 and make safe the brazing or braze welding equipment on completion of the activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and use manual flame brazing and braze welding equipment	2.1	Describe the safe working practices and procedures to be observed when working with manual flame gas brazing and braze welding equipment (such as general workshop safety; appropriate personal protective equipment (PPE); fire and explosion prevention, protecting other workers, safety in enclosed/confined spaces; fume extraction/control)			
		2.2	Describe the hazards associated with flame brazing and braze welding (such as naked flames, explosive gas mixes, oxygen enrichment, fumes and gasses, hot metal, enclosed spaces), and how they can be minimised			
		2.3	Describe the personal protective equipment to be worn for the brazing and braze welding activities (such as correctly fitting overalls; leather aprons, eye protection with the appropriate shade of filter)			
		2.4	Describe the correct handling and storage of gas cylinders (such as manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features)			
		2.5	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			
		2.6	Describe the manual flame brazing and braze welding process (such as basic principles of the process, wetting and capillary flow, deposition of brazed beads, role of fluxes)			
		2.7	Describe the types of filler metal and fluxes; forms of filler metal			
		2.8	Describe the types of joints to be produced (such as lap, tee, corner, butt)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Explain how to set up and support the joint (such as methods of cleaning joint faces; use of jigs and fixtures, restraining devices; self-locating joints; pre-placement of filler metal and flux)			
		2.10	Explain how to prepare the brazing and braze welding equipment, and the checks to be made to ensure that it is safe and ready to use (such as connection of hoses, torch, flashback arrestors, hose check valves and regulators)			
		2.11	Explain how to check hose connections for leaks, and the methods that are used			
		2.12	Explain how to set gas working pressures; reading the gauges to establish content and pressures			
		2.13	Explain how to prepare the materials in readiness for the brazing and braze welding activity (such as ensuring that the material is free from surface contamination -such as rust, scale, paint, oil/grease and moisture; ensuring edges to be brazed/braze welded are correctly prepared - such as made flat, square)			
		2.14	Describe the correct use of the torch to produce a range of joints (such as selection of nozzle, adjustment of the flame, application of flux and the correct manipulation of torch and filler wire)			
		2.15	Describe the control of heat input to prevent filler material and parent material faults (such as brazing/braze welding sequence; deposition technique)			
		2.16	Describe the safe and correct sequence for shutting down the brazing or braze welding equipment (such as sequence of turning off the gases, extinguishing the flame and closing valves on gas supply/cylinders)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Describe the importance of complying with job instructions and the joining procedure specification			
		2.18	Describe the problems that can occur with the joining activities (such as incorrect heat pattern (hot or cold spots); fluxing technique; formation of oxides during the process; distortion of the joint due to overheating), and how these can be overcome			
		2.19	Describe the methods of removing flux residues and cleaning the finished joint			
		2.20	Describe the safe working practices and procedures to be adopted when preparing the brazed and braze welded joints for examination (such as handling hot materials, using chemicals for cleaning, using equipment to fracture joints)			
		2.21	Explain how to prepare the joints for examination (such as removing surface irregularities; cleaning and degreasing the brazed or braze welded joint, making saw cuts on joints to be fracture tested)			
		2.22	Explain how to check the brazed or braze welded joints for uniformity, alignment, position, joint size and profile			
		2.23	Describe the various procedures for carrying out destructive tests on the joints (such as macroscopic examination and nick break tests)			
		2.24	Explain how to examine the joints after the tests and check for such defects as the degree of penetration, inclusions, porosity, cracks			
		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 brazing or braze welding activities (such as isolation of gas cylinders; safely storing cylinders, hoses and torches; storing filler rods; removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 142: 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 F.

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: • 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: • 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: • 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 • 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: • 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: • 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: • 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: • BS and ISO standards and procedures Plus one more from the following: • 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: • 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)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 143: Wiring and Testing Electrical Equipment and Circuits

Unit reference number: Y/504/6422

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to wire and test electrical equipment and circuits. 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 F.

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	Wire and test electrical equipment and circuits	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 activities during the wiring and testing activities: • 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 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 and usable condition, including PAT tested • Ensure that the electrical system is kept free from foreign objects, dirt or other contamination • Where appropriate, apply procedures and precautions to eliminate electrostatic discharge (ESD) hazards • 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	Wire up three of the following electrical systems: • Domestic lighting circuits • Domestic power circuits • Motor start and control • Vehicle heating or ventilating • Vehicle lighting • Vehicle starting and ignition • Instrumentation and control 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) • Air conditioning control circuits • Refrigeration control circuits • Heating/boiler control circuits • Aircraft lighting circuits • Power generation and control circuits • Avionic circuits and systems • Emergency lighting systems • Communication systems • Computer systems • Other specific electrical circuits			
		1.4	Plan the wiring and testing activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Use appropriate sources to obtain the required specifications, circuit diagrams and test information			
		1.6	Obtain the correct tools and equipment for the wiring and testing operations, and check that they are in a safe and usable condition			
		1.7	Use two of the following test instruments during the wiring and testing activities: • Multimeter • Insulation resistance tester • Polarity tester/indicator • RCD tester • Earth-loop impedance tester • Other specific test equipment			
		1.8	Mount and secure the electrical components safely and correctly, to meet specification requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Wire circuits using three of the following types of cables: • Single core • Multicore • PVC twin and earth • Flexible (such as cotton or rubber covered) • Data/communication • Fibre-optics • Screened • Coaxial • Ribbon cables • Mineral insulated • Armoured • Wiring loom/harness			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Connect up ten of the following electrical modules/components to produce circuits: • Isolators • Switches • Sockets • Contactors • Motor starters • Solenoids • Relays • Alarm devices • Motors • Pumps • Heaters • Blowers • Lamp holders • Panel lamps • Luminaires • Ballast chokes • Consumer units • Residual current device (RCD) • Instruments • Transformers			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	...continued • Panels or sub-assemblies • Control devices • Cable connectors • Fuses • circuit breakers • Sensors • Actuators • Junction boxes • Terminal blocks • Electronic modules/units • Other electrical components			
		1.11	Install and terminate the cables to the appropriate connections on the components			
		1.12	Apply wiring methods and techniques to include six of the following: • Positioning and securing of equipment and components • Levelling and alignment of components • Determining current rating and lengths of cables required • Securing by using mechanical fixings (such as screws, nuts and bolts) • Laying in cables without twisting or plaiting • Feeding cables into conduit without twisting or plaiting • Leaving sufficient slack for termination and movement			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Carry out eight of the following cable termination activities: • Stripping cable sheaths without damage to conductor insulation • Removing cable insulation • Connecting accessories (such as plugs, sockets multi-way connectors) • Making mechanical/screwed/clamped connections • Crimping (such as spade end, loops, tags and pins) • Soldering and de-soldering • Terminating armoured cables • Terminating mineral insulated cables • Sealing/protecting cable connections • Attaching suitable cable identification • Securing wires and cables (such as clips, plastic strapping, lacing, harnessing) • Heat shrinking (devices and boots) • Earth bonding • Cable glands and grips			
		1.14	Use appropriate test methods and equipment to check that the completed circuit is safe and meets all aspects of the specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Carry out checks and adjustments, appropriate to the equipment and circuits being wired, to include three of the following: • Making visual checks (such as completeness, signs of damage, incorrect termination) • Movement checks (such as loose fittings and connections) • Testing that the equipment operates to the circuit specification • Carrying out fault finding techniques (such as half-split, input/output, unit substitution) Plus three more from the following: • Protective conductor resistance values • Insulation resistance values • Continuity • Voltage levels • Load current • Polarity • Resistance • Capacitance • Power rating • Frequency values • Inductance • RCD disconnection time • Specialised tests (such as speed, sound, light, temperature)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Produce electrical circuits in accordance with one or more of the following standards: • BS 7671/IET wiring regulations • Other BS and/or ISO standards • Company standards and procedures			
		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 wiring and testing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to wire and test electrical equipment and circuits	2.1	Describe the specific safety practices and procedures that they need to observe when wiring and testing electrical equipment (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 equipment, and with the tools and equipment used, (such as using sharp instruments for stripping cable insulation), 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	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)			
		2.12	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)			
		2.13	Explain how to check that the positions selected for mounting the components do not interfere with or damage existing services (such as cable harnesses, pipework or electricity supplies)			
		2.14	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			
		2.15	Describe the techniques used to terminate electrical equipment (such as plugs and sockets; soldering; screwed, clamped and crimped connections, glands and sealed connectors)			
		2.16	Describe the use of BS7671/IET wiring regulations when selecting wires and cables and when carrying out tests on systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Describe the methods of attaching markers/labels to components or cables to assist with identification (such as colour coding conductors, using coded tabs)			
		2.18	Describe the tools and equipment used in the wiring and testing activities (including the use of cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools)			
		2.19	Explain how to check that tools and equipment are free from damage or defects, and are in a safe, PAT tested, calibrated and usable condition			
		2.20	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)			
		2.21	Describe the care, handling and application of electrical test and measuring instruments (such as multimeter, insulation resistance tester, loop impedance test instruments)			
		2.22	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			
		2.23	Explain how to identify suitable test points within the circuit, and how to position the test instruments into the circuit whilst ensuring the correct polarity and without damaging the circuit components and the test equipment			
		2.24	Explain how to set the instrument's zero readings; obtaining instrument readings and comparing them with circuit parameters			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.25	Explain why electrical bonding/earthing is critical, and why it must be both mechanically and electrically secure			
		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 (such as half split, unit substitution and input/output)			
		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 in a safe and clean condition on completion of the wiring and testing activities (such as returning hand tools and test equipment to is 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 144: Forming and Assembling Electrical Cable Enclosure and Support Systems

Unit reference number: D/504/6423

QCF level: 2

Credit value: 13

Guided learning hours: 65

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to form and assemble electrical cable enclosure and support systems. 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 F.

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	Form and assemble electrical cable enclosure and support systems	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 electrical cable enclosure forming and assembly activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions and assembly/installation drawings at all times • Ensure that the electrical cable enclosure system is kept free from foreign objects, dirt or other contamination • Return all tools and equipment to the correct location on completion of the installation activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Form and assemble the following types of electrical cable enclosures/support systems: • Metal conduit systems Plus one more from the following: • Non-metallic conduit systems • Non-metallic trunking systems • Metal trunking system • Traywork systems			
		1.4	Plan the assembly and installation of the cable enclosure system before they start			
		1.5	Obtain the correct tools and equipment for the cutting, forming and assembly operations, and check that they are in a safe and usable condition			
		1.6	Cut and form the cable enclosure components to the required size and shape, using appropriate tools and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Construct cable enclosures/support system components, to include carrying out all of the following: • Selecting the correct type and size of conduit, trunking or traywork (with regard to number of cables and climatic conditions) • Cutting the materials to the correct lengths (taking into account allowances for bends or joints required) • Removing all burrs and sharp edges • Producing external threads on conduit • Producing or fabricating bends, up to and including 90° • Producing or fabricating bends over 90° • Making tee/multiple junctions in trunking/traywork (where applicable) • Producing or fabricating offsets • Producing or fabricating bridge/saddle sets			
		1.8	Assemble the cable enclosure system, using the appropriate connectors			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Assemble cable enclosure/support systems that include all of the following: • Bends/elbows (solid or inspection type) • Boxes (such as circular or square, terminal or multi branch) • Horizontal runs • Vertical drops Plus three more from the following: • Straight connectors/couplings • Tee pieces (such as solid or inspection type) • Reducers • Conversion units and adaptors • Cross over units (such as bridge or saddle sets) • Off sets			
		1.10	Mount and secure the cable enclosure components safely and correctly to meet the specification requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Apply all of the following installation methods and techniques: • Marking out the location of the trunking, traywork or conduit • Positioning and securing the trunking, traywork or conduit using mechanical fixings • Drilling and preparing holes for the trunking, traywork or conduit • Levelling and alignment of the wiring enclosures and components			
		1.12	Check the completed assembly to ensure that all operations have been completed, and that the finished assembly is secure and meets the required specification			
		1.13	Check the completed assembly, to include carrying out all of the following: • Checking for level and alignment • Checking that all connections are secure • Checking that sufficient supports are used and that they are correctly spaced • Checking that correct outlets are used (such as for sockets, switches, light fittings, wire junction and inspection fittings)			
		1.14	Produce cable enclosure/support systems in accordance with one or more of the following standards: • BS 7671/IET wiring regulations • Other BS and/or ISO standards • Company standards and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	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			
		1.16	Leave the work area in a safe and tidy condition on completion of the forming and assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to form and assemble electrical cable enclosure and support systems	2.1	Describe the specific safety practices and procedures that they need to observe when forming and assembling cable enclosure/support systems (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)			
		2.2	Describe the hazards associated with forming and assembling cable enclosure/support systems, and with the tools and equipment used (such as using bending and forming equipment, handling long lengths of pipe and trunking, using solvents and adhesives), 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	Describe the interpretation of circuit and wiring diagrams, and specifications used for the installation (including BS and ISO schematics, wiring regulations, symbols and terminology)			
		2.5	Describe the various types of electrical cable enclosure and support systems used, and their typical applications			
		2.6	Describe the factors to be taken into account when choosing metallic or non-metallic systems, and the effects of ambient temperatures within conduit and trunking systems			
		2.7	Describe the marking out lengths to be cut, taking into account any allowances (such as for bending, screwing, gluing)			
		2.8	Describe the methods of holding workpieces without damaging them (such as the use of a pipe vice)			
		2.9	Describe the tools and equipment used in the cutting, bending and forming operations (such as the use of conduit bending machines, threading equipment, hot air torches and bending springs)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Describe the methods of producing bends and sets in conduit materials (such as 90° bends, offsets, bridge sets)			
		2.11	Describe the methods of bending plastic conduit (such as using hot air guns and springs)			
		2.12	Explain how to produce fabricated bends in trunking and traywork section material (such as bends, tee junctions, double and saddle sets)			
		2.13	Describe the methods of forming screw threads on ends of conduit, and of using appropriate tools to remove all sharp edges and burrs			
		2.14	Describe the various fittings used to assemble conduit, trunking and traywork systems (including screwed fittings, cemented fittings, straight connectors, bends, tees, inspection fittings, light, power and control outlet boxes)			
		2.15	Describe the importance and use of inspection fittings (such as elbows and junction boxes)			
		2.16	Describe the problems to look for when checking finished components/installations (such as dimensional checks, position and angle of bends/sets, out of alignment, loose connections, insufficient supports, damaged threads, deformed pipe around area of bend, burrs and sharp edges that could damage cables, ensuring that trunking lengths are free from swarf or other obstructions before connecting into the system)			
		2.17	Explain how to join the system components (such as using screw fittings, cemented fittings, fabricated components, nuts and bolts)			
		2.18	Explain how to check alignment of components (including use of plumb bobs, levels and by visual means)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Describe the methods of supporting and securing the components (such as position and spacing of supporting brackets and devices, using pipe clips, saddles and supports)			
		2.20	Describe drilling masonry, and the types and application of masonry fixing devices used in installation work			
		2.21	Describe the need to ensure that components are clear of services (such as gas water or electricity) before drilling walls			
		2.22	Describe the problems that can occur with the installation operations, and how these 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 in a safe and clean condition on completion of the assembly/installation activities (such as returning tools and equipment to its 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 145: Assembling, Wiring and Testing Electrical Panels/Components Mounted in Enclosures

Unit reference number: H/504/6424

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to assemble, wire and test electrical panels/components mounted in enclosures. 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 F.

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	Assemble, wire and test electrical panels/components mounted in enclosures	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	Carry out all of the following during the mounting of the electrical components: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, assembly drawings and test procedures at all times • Ensure that the components are free from damage, foreign objects, dirt or other contamination • Check that the tools and test instruments are within calibration date and are in a safe, tested and usable condition • Prepare the electrical components and enclosures for the assembly operations • Use safe and approved techniques to mount the electrical components in the enclosures • 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 assembly activities			
		1.3	Plan the electrical assembly, wiring and testing activities before they start them			
		1.4	Use appropriate sources to obtain the required specifications, circuit diagrams, components, assembly and test information			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Obtain the correct tools and equipment for the assembly and test operations, and check that they are in a safe and usable condition			
		1.6	Use the appropriate methods and techniques to assemble the components in their correct positions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Mount electrical components on panels or into enclosures, to include twelve of the following items: • Enclosure partitions • Component mounting plates • Component marking • Trunking • Conduit • Contactors • Overload and other relays • Transformers/chokes • Circuit breakers/fuses • Panel meters (voltage, current) • Terminal blocks/junction boxes • Safety interlocks • Isolators • Bases for plug-in devices • Switches (push button, toggle) • Capacitors • Resistors • Rectifiers • Timers • Power supplies • Circuit boards			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	...continued • Thermistors/thermocouples • Indicators (lamps, LEDs) • Thermostats • Busbars • Soft starters • Variable speed drives • Limit switches • Sensors • Programmable controllers • Plugs/sockets • Grommets/grommet strip • Lighting fixtures • Batteries • Connector rails • Solenoids • Other specific components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Use ten of the following methods and techniques (and the appropriate tools) during the wiring activities: • Cable forming/bending • Cable supporting/tying • Cable/wire clamping • Cable protection (such as sleeving, grommets) • Cable/wire crimping • Insulation stripping • Making screwed connections • Soldering (where appropriate) • Cable routing • Connecting pre-formed looms • Wire marking/colour coding			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Carry out eight of the following activities during the mounting of the electrical components: • Setting working clearance • Drilling • Filing • Riveting • Sawing/cutting • Forming • Aligning components • Torque setting fasteners • Earth bonding • Securing using mechanical fasteners/threaded devices • Punching • Applying sealants/adhesives • Clamping • Crimping • Component marking • Making screw connections • Measuring			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Wire up electrical components on panels or in enclosures, using two of the following cable/wire types: • Single core cable • Multicore cable • Laminated copper • Data/communication cable • Mineral insulated cable • Screened cable • Fibre-optic • Braided copper • Twisted pair/ribbon cable • Other specialist cable			
		1.11	Secure the components, using the specified connectors and securing devices			
		1.12	Wire and terminate cables to the appropriate connections on the components			
		1.13	Use appropriate test methods and equipment to check that the completed assembly is safe and meets all aspects of the specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Carry out quality checks, to include all of the following: • Positional accuracy of all components • Correct orientation • Correct alignment • Component security • Security of all terminations • Correct termination of all wires to components • Completeness • Ensuring enclosure is free of debris (such as cable offcuts/insulation, enclosure/trunking breakouts) • Ensuring freedom from damage Plus all of the following electrical checks: • Continuity of cable/wiring connections (such as battery and lamp checks) • Earth continuity • Polarity • Protective conductor resistance values • Insulation resistance			
		1.15	Assemble electrical components on panels or in enclosures, in accordance with one or more of the following standards: • BS7671/IET wiring regulations • Other BS or ISO standards and procedures • Company standards and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 electrical assembly and testing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to assemble, wire and test electrical panels/components mounted in enclosures	2.1	Describe the specific safety practices and procedures that they need to observe when assembling, wiring and testing electrical components mounted in enclosures (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)			
		2.2	Describe the hazards associated with assembling, wiring and testing electrical panels (such as using sharp instruments for stripping cable insulation, use of soldering irons, carrying out insulation tests), 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	Describe the precautions to be taken to prevent electrostatic discharge (ESD) damage to circuits and sensitive components (such as use of earthed wrist straps, anti-static mats, special packaging and handling areas)			
		2.5	Explain what constitutes a hazardous voltage and how to recognise victims of electric shock			
		2.6	Explain how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)			
		2.7	Explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, graphical electrical symbols, BS and ISO wiring regulations, and other documents needed for the electrical component mounting, wiring and testing activities			
		2.8	Describe the basic principle of operation of the equipment/circuits being assembled and wired, and the purpose of individual components within the circuit			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the assembly methods and techniques to be used when wiring electrical panels or components mounted in enclosures (such as cable stripping, soldering, crimping, securing cables using cable ties, lacing/strapping of wires)			
		2.10	Describe the type of components and sub-assemblies that are used in the assembly activities (such as contactors, relays, circuit breakers/fuses, solenoids, switches, transformers, ballast chokes, terminal blocks, sub-assemblies)			
		2.11	Describe the preparations to be undertaken on the components and enclosure, prior to the mounting activities			
		2.12	Explain how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used			
		2.13	Explain how to identify any orientation requirements, values or polarity for the components used in the electrical wiring activities			
		2.14	Describe the methods of attaching identification markers/labels during electrical assembly activities			
		2.15	Describe the different types of cabling, and their application (such as multicore cables, single core cables, single insulated, double insulated, steel wire armoured (SWA), mineral insulated (MI), screened cables)			
		2.16	Explain why electrical bonding/earthing is critical, and why it must be both mechanically and electrically secure			
		2.17	Describe the use of BS7671/IET wiring, and other regulations, when selecting wires and cables and when carrying out tests on electrical circuits			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Explain how to conduct any necessary checks to ensure the accuracy and quality of the assembly produced (such as visual checks for completeness and freedom from damage to conductors or components, mechanical checks for security of components and connections, ingress protection, electrical checks for electrical continuity and earth continuity, insulation resistance and polarity checks)			
		2.19	Explain how to check that tools and equipment are free from damage or defects, are in a safe, tested, calibrated and usable condition, and are configured correctly for the intended purpose			
		2.20	Describe the problems that can occur with the wiring and testing operations, and how these can be overcome			
		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 in a safe and clean condition on completion of the electrical assembly and wiring activities (such as returning hand tools and test equipment to the designated locations, cleaning the work area, removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 146: Assembling and Testing Electronic Circuits

Unit reference number: K/504/6425

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to assemble and test electronic circuits. 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 F.

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	Assemble and test electronic circuits	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	Carry out all of the following during the electronic assembly and testing activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, assembly drawings and test procedures at all times • Ensure that the components are free from damage, dirt or other contamination • Prepare the electronic components for the assembly operations (such as pre-forming and cleaning pins) • Use safe and approved techniques to mount the electronic components on the circuit boards • Check that the tools and test instruments are within calibration date and are in a safe, tested and usable condition • Where appropriate, apply procedures and precautions to eliminate electrostatic discharge (ESD) hazards (such as the use of grounded wrist straps and mats) • Follow clean work area protocols, where appropriate • Return all tools and equipment to the correct location on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Assemble one of the following circuit types: • Single-sided circuit • Flexible circuit • Thick film circuit • Double-sided circuit • Thin film circuit • Hybrid circuit			
		1.4	Plan the electronic assembly, wiring and testing activities before they start them			
		1.5	Use appropriate sources to obtain the required specifications, circuit diagrams, component assembly and test information			
		1.6	Obtain the correct tools and equipment for the assembly and test operations, and check that they are in a safe and usable condition			
		1.7	Assemble circuits using four of the following tools: • Heat shunts/tweezers • Snipe or long nosed pliers • Sleeving pliers • Component forming devices • Wire strippers • Side or end cutters • Mechanical fasteners (screwdriver, spanners) • Anti-static packaging, mats and straps • Specialised assembly tools/equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Use the appropriate methods and techniques to assemble the components in their correct positions			
		1.9	Assemble electronic components using two of the following: • Manual soldering techniques • Surface mount techniques • Mechanical fixing methods			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Assemble circuits to the required specification, to include using fifteen of the following types of component: • Fixed resistors • Variable resistors • Potentiometers • Light dependent resistors (LDR) • Fixed capacitors • Variable capacitors • Electrolytic capacitors • Diodes • Zener diodes • Light emitting diodes (LEDs) • Transistors • Thyristors • Thermistors • Analogue or digital integrated circuits • Surface mount packages • Rectifiers • Switches			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	...continued • Mini transformers • Decoders • Regulators • Encoders or resolvers • Inverters or servo controllers • Edge connectors • Wiring pins/tags/wire links • Fixing spacers • Insulators • Small heat sinks • Cables • Cable connectors • Protection devices • Opto-electronics/optical fibre components • Relays • Inductors • Other specific electronic components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Assemble electronic components to produce five of the following types of circuit: • 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 • 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 • Other specific circuit			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Secure the components, using the specified connectors, securing devices and soldering techniques			
		1.13	Wire and terminate cables to the appropriate connections on the circuit boards			
		1.14	Use appropriate test methods and equipment to check that the completed assembly is safe and meets all aspects of the specification			
		1.15	Carry out visual checks on the completed circuits, to include all of the following: • Soldered joints are clean, shiny, free from solder spikes, bridges, holes, excess solder and flux • Components are correctly mounted for best physical support, and are correctly orientated • Excess component leads have been trimmed off to the standard required • Circuit tracks are free from faults (such as lifting, breaks, bridges, hot spots) • There are no obvious signs of damage, to components or to the substrate • All required connectors, wire links, spacers and other ancillary items are in place			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Use five of the following types of test equipment: • 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
		1.17	Carry out checks, adjustments and fault rectification where appropriate to the circuits being assembled, to include six of the following: • Logic states • DC voltage/current levels • AC voltage/current levels • Clock/timer switching • Oscillations • Attenuation • Pulse width/rise time • Open/short circuit • Resistance • Capacitance • Waveform analysis • Inductance • Frequency modulation/demodulation • Amplification • Signal noise/interference levels			
		1.18	Produce electronic circuits in accordance with one of the following: • BS or ISO standards and procedures • Customer standards and requirements • Company standards and procedures • Other international standard			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	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			
		1.20	Leave the work area in a safe and tidy condition on completion of the electronic assembly and testing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to assemble and test electronic circuits	2.1	Describe the specific safety practices and procedures that they need to observe when assembling and testing electronic circuits (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)			
		2.2	Describe the hazards associated with assembling and testing electronic circuits (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	Describe the precautions to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components (such as use of earthed wrist straps, anti-static mats, special packaging and handling areas)			
		2.5	Explain what constitutes a hazardous voltage and how to recognise victims of electric shock			
		2.6	Explain how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)			
		2.7	Explain how to use and extract information from circuit diagrams, block and schematic diagrams, equipment manuals, data sheets, test procedures and instructions (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken			
		2.8	Describe the various types of circuit boards used (such as printed circuit boards, thin film, thick film and flexible film circuitry)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	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)			
		2.10	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)			
		2.11	Describe the basic principles of operation of the electronic circuits being assembled, and the purpose of the individual modules/components within the circuits			
		2.12	Describe the application and use of circuit protection equipment (such as fuses and other overload protection devices)			
		2.13	Describe the preparation requirements for components to be used in the assembly (such as pre-forming component pins/legs)			
		2.14	Describe the methods of mounting and securing electronic components to various surfaces (such as the use of manual soldering techniques, surface mount technologies and mechanical fixing devices, use of heat sinks/shunts)			
		2.15	Describe the methods of attaching markers/labels to components or cables to assist with identification (such as colour coding conductors, using coded tabs)			
		2.16	Describe the use calculations and regulations, when selecting wires and cables and when carrying out tests on electronic circuits			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Describe the importance of making visual checks of the completed assembly (such as examination for excessive solder or solder spikes which may allow short circuits to occur, correct orientation of components for pin configuration or polarity, obvious signs of damage (such as heat damage) or strain on terminations)			
		2.18	Describe the tools and equipment used in the electronic assembly activities (including the use of cable stripping tools, crimping tools, soldering irons, specialist assembly tools)			
		2.19	Describe the importance of ensuring that all tools are in a safe and serviceable condition, are used correctly and are returned to their correct location on completion of the assembly activities			
		2.20	Describe the care, handling and application of electronic test and measuring instruments (such as multimeter, oscilloscope, signal generators, stabilised power supplies, logic probes/analyzers, measuring bridges)			
		2.21	Explain how to check that test equipment is safe to use (such as condition of power cables, using suitably fused test probes, clips and leads); how to check that equipment is within current calibration approval dates, and PAT tested; checking that the test equipment is suitable for the tests they are to carry out and can cover the range and values they are to measure			
		2.22	Explain how to connect to an approved power supply and, where appropriate, signal source; identifying correct test points in the circuit; how to position test instruments into circuits without damaging circuit components (such as using test probes, ensuring correct polarity, taking antistatic precautions); setting instrument zero readings; obtaining instrument readings and comparing them with expected results			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.23	Explain how to make adjustments to circuit components; making decisions on circuit performance and faulty components; removal and replacement of faulty components			
		2.24	Describe the fault-finding techniques to be used when the equipment fails to operate correctly (such as half split, unit substitution and input/output)			
		2.25	Describe the problems that can occur with the assembling and testing operations, and how these can be overcome			
		2.26	Explain when to act on their own initiative and when to seek help and advice from others			
		2.27	Describe the importance of leaving the work area in a safe and clean condition on completion of the electronic assembly and testing activities (such as returning hand tools and test equipment to the designated location, cleaning the work area, removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 147: Maintaining Electrical Equipment/Systems

Unit reference number: M/504/6426

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to maintain electrical equipment/systems. 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 F.

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	Maintain electrical equipment/ systems	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 electrical maintenance activities: • 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 electrical, mechanical, gas, air or fluids), where appropriate • Follow job instructions, maintenance drawings and procedures • Check that the tools and test instruments are within calibration date and are in a safe, PAT tested 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			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out maintenance/repair activities on two of the following types of electrical equipment: • Electrical plant • Wiring enclosures • Portable appliances • Generators • Alternators • Motors and starters • Heaters • Luminaires • Switchgear • Distribution panels • Transformers • Pumps • Fans/blowers • Other specific electrical equipment			
		1.4	Plan the maintenance activities before they start them			
		1.5	Obtain all the information they need for the safe removal and replacement of the equipment/system components			
		1.6	Obtain and prepare the appropriate tools and equipment			
		1.7	Apply appropriate maintenance diagnostic techniques and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Use four of the following maintenance diagnostic techniques, tools and aids: • Fault finding techniques (such as six point, half-split, input/output, unit substitution) • Diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records) • Information gathered from fault reports • Visual checks (such as signs of damage, overheating, missing parts, wear/deterioration) • Movement checks (such as loose fittings and connections) • Monitoring equipment or gauges • Test instrumentation measurement (such as voltage, resistance, current)			
		1.9	Use the appropriate methods and techniques to remove and replace the required components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Carry out maintenance/repair activities on three of the following electrical systems: • Single-phase lighting circuits • Single-phase power circuits • Three-phase power supplies • Direct current power supplies • Motor start and control • Vehicle heating or ventilating • Vehicle lighting • Vehicle starting and ignition • Instrumentation and control circuits • Alarm systems (such as fire, intruder, process control) • Electro-pneumatic or electro-hydraulic control circuits • Air conditioning control circuits • Refrigeration control circuits • Heating/boiler control circuits • Aircraft lighting circuits • Power generation and control circuits • Avionic circuits and systems • Emergency lighting systems • Communication systems • Computer systems • Other control systems • Other specific electrical systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Carry out all of the following maintenance activities: • Removing excessive dirt and grime • Dismantling/disconnecting equipment to the required level • Disconnecting and reconnecting wires and cables • Stripping cable insulation/protection • Attaching suitable cable identification markers • Removing electrical units/components • Removing/replacing cable end fittings • Checking components for serviceability • Making mechanical/screwed/clamped connections • Soldering and de-soldering • Crimping (such as tags and pins) • Replacing damaged/defective components • Removing and replacing damaged wires and cables • Setting and adjusting replaced components • Making de-energised checks before reconnecting power supply			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Replace/refit a range of electrical components, to include six of the following: • Cables and connectors • Locking and retaining devices • Overload protection devices • Inverter and servo controllers • Relay components • Rectifiers • Capacitors • Circuit boards • Luminaires • Switches or sensors • Contactors • Encoders or resolvers • Batteries • Transformers • Solenoids • Thermistors or thermocouples • Other specific components			
		1.13	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
		1.14	Carry out checks and tests on the maintained equipment, to include: • Making visual checks for completeness and freedom from damage Plus three more from the following: • Protective conductor resistance values • Insulation resistance values • Continuity • Voltage levels • Load current • Polarity • Resistance • Capacitance • Power rating • Frequency values • Inductance • RCD disconnection time • Specialised tests (such as speed, sound, light, temperature)			
		1.15	Maintain electrical equipment, in accordance with one or more of the following quality and accuracy standards: • BS 7671/IET wiring regulations • Other BS and/or ISO standards • Company standards and procedures • Equipment manufacturer's requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to maintain electrical equipment/ systems	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the electrical maintenance activities undertaken			
		2.2	Describe the isolation and lock-off procedure or permit-to-work procedure that applies to electrical maintenance activities (to include electrical isolation, locking off switchgear, removal of fuses, placing of maintenance warning notices, proving that isolation has been achieved and secured)			
		2.3	Describe the hazards associated with carrying out electrical maintenance activities (such as dangers of electric shock, capacitor discharge, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them			
		2.4	Explain what constitutes a hazardous voltage and how to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and how to obtain first aid assistance)			
		2.5	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy			
		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 obtain and interpret information from job instructions and other documentation used in the maintenance activities (such as drawings, specifications, manufacturers' manuals, BS and ISO wiring regulations, symbols and terminology)			
		2.8	Describe the basic principles of how the equipment functions, and the working purpose of individual units/components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing)			
		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 use a range of fault diagnostic equipment to investigate the problem			
		2.12	Describe the care, handling and application of electrical measuring instruments			
		2.13	Describe the different types of cabling used in the maintenance activities, and their methods of termination			
		2.14	Describe the techniques used to dismantle/assemble electrical equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections)			
		2.15	Describe the methods of removing and replacing cables and wires in wiring enclosures without causing damage to existing cables			
		2.16	Describe the use of BS 7671/IET wiring, and other regulations, when selecting wires and cables and when carrying out tests on systems			
		2.17	Describe the methods of attaching identification markers/labels to removed components or cables, to assist with re-assembly			
		2.18	Describe the tools and equipment used in the maintenance activities (such as the use of cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Describe the methods of checking that components are fit for purpose, and the need to replace 'lifed' items (such as seals and gaskets overload protection devices)			
		2.20	Explain how to check that tools and equipment are free from damage or defects, and are in a safe and usable condition			
		2.21	Describe the importance of completing documentation and/or reports following the maintenance activity			
		2.22	Describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on			
		2.23	Explain how to use appropriate lifting and handling equipment in the maintenance activity			
		2.24	Describe the problems that can occur during the electrical maintenance activity, and how they can be overcome			
		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 in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to is 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 148: Maintaining Electronic Equipment/Systems

Unit reference number: T/504/6427

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to maintain electronic equipment/systems. 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 F.

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	Maintain electronic equipment/ systems	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 activities: • 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 (where appropriate) • Follow job instructions, maintenance drawings and procedures • Take electrostatic discharge (ESD) precautions when handling sensitive components and circuit boards • Check that the tools and test instruments are within calibration date and are in a safe, PAT tested 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 • Leave the work area in a safe and tidy condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out maintenance/repair activities on three of the following types of electronic equipment: • Power supplies (such as switched mode, series regulation, shunt regulation) • Motor control systems (such as closed loop servo/proportional control, inverter control) • 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			
		1.4	Plan the maintenance activities before they start them			
		1.5	Obtain all the information they need for the safe removal and replacement of the equipment/system components			
		1.6	Obtain and prepare the appropriate tools and equipment			
		1.7	Apply appropriate maintenance diagnostic techniques and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Use four of the following maintenance diagnostic techniques, tools and aids: • Fault finding techniques (such as six point, input/output, half-split, unit substitution) • Diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records) • Information gathered from the person who reported the fault • Visual checks (such as signs of damage, overheating, missing parts, wear/deterioration) • Movement checks (such as loose fittings and connections) • Monitoring equipment or gauges • Test instrumentation measurement (such as voltage, resistance, current, waveform)			
		1.9	Use the appropriate methods and techniques to remove and replace the required components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Carry out all of the following maintenance techniques and procedures during the repair activities: • Removing excessive dirt and grime • Dismantling/disconnecting equipment to the required level • Disconnecting and reconnecting wires and cables • Checking the condition/deterioration of components • Soldering and de-soldering • Repairing circuit board tracks • Removing and replacing electronic units/circuit boards • Removing and replacing electronic components • Making adjustments to components and/or connections • Re-assembling of units or sub-assemblies			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Replace/refit a range of electronic components, to include twelve of the following: • Cables and connectors • Printed circuit boards • Fixed resistors • Variable resistors • Potentiometers • Light dependent resistor (LDR) • Fixed capacitors • Variable capacitors • Electrolytic capacitors • Mini transformers • Rectifiers • Thermistors • Thyristors • Transistors • Diodes • Zener diodes • Light emitting diodes (LEDs) • Sensors • Heat sinks • Protection devices			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	...continued • Surface mount packages • Integrated circuits • Decoders • Regulators • Encoders or resolvers • Inverters or servo controllers • Analogue or digital integrated circuits • Edge connectors • Switches • Wiring pins/tags/wire links • Opto-electronics/optical fibre components • Relays • Inductors • Protection devices • Surface mount packages • Integrated circuits • Decoders • Regulators • Encoders or resolvers • Inverters or servo controllers • Analogue or digital integrated circuits			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	...continued • Edge connectors • Switches • Wiring pins/tags/wire links • Opto-electronics/optical fibre components • Relays • Inductors			
		1.12	Use the correct joining/connecting techniques to deal with three of the following types of connection: • Push-fit connectors • Soldering or de-soldering • Clip assemblies • Threaded connections • Crimped connections • Zero insertion force (zif) connectors • Adhesive joints/assemblies • Edge connectors			
		1.13	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
		1.14	Carry out checks and tests on the maintained equipment, to include both of the following: • Visual checks (such as for solder bridges, dry joints, incorrect value components, signs of damage, missing components) • Movement checks (such as loose wires and connections, incorrectly seated devices/packages) Plus three more from the following: • Logic states • DC voltage/current levels • AC voltage/current levels • Clock/timer switching • Oscillations • Attenuation • Pulse width/rise time • Open/short circuit • Resistance • Capacitance • Wave form analysis • Inductance • Frequency modulation/demodulation • Amplification • Signal noise/interference levels			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Use five of the following types of test equipment: • 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			
		1.16	Carry out maintenance activities on electronic equipment, in accordance with one or more of the following: • Organisational guidelines and codes of practice • Equipment manufacturer's operation range • BS and ISO standards			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to maintain electronic equipment/ systems	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the electronic maintenance activities undertaken			
		2.2	Describe the isolation and lock-off procedure or permit-to-work procedure that applies to the electronic repair activities and the electronic equipment or circuits being worked on (such as electrical isolation, locking off switchgear, removal of fuses, placing maintenance warning notices, proving that isolation has been achieved and secured)			
		2.3	Describe the hazards associated with maintaining electronic equipment, and with the tools and equipment that are used (such as live electrical components, capacitor discharge, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how these can be minimised			
		2.4	Explain what constitutes a hazardous voltage and how to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and how to obtain first aid assistance)			
		2.5	Explain what constitutes a hazardous voltage and how to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and how to obtain first aid assistance)			
		2.6	Describe the procedure for obtaining drawings, job instructions, related specifications, replacement parts, materials and other consumables necessary for the maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.7	Explain how to extract information from job instructions, drawings and data (such as circuit diagrams, specifications, manufacturers' manuals, test procedures and other documents needed to carry out repairs)			
		2.8	Describe the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD) hazards			
		2.9	Describe the basic principles of how the electronic circuit functions, and the working purpose of individual units/components			
		2.10	Describe the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing; fault location using techniques such as half-split, input-to-output, function testing, unit substitution, and equipment self-diagnostics)			
		2.11	Describe the care, handling and application of electronic measuring instruments/fault diagnostic equipment to investigate the problem (such as multimeter, oscilloscope, signal generators, logic probes/analyzers, measuring bridges)			
		2.12	Explain how to check that test equipment is safe to use (such as condition of power cables, using suitably fused test probes, clips and leads); how to check that equipment is within current calibration approval dates and PAT tested; checking that the test equipment is suitable for the tests they are to carry out and can cover the range and values they are to measure			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain how to connect to an approved power supply and, where appropriate, signal source; identifying correct test points in the circuit; how to position test instruments into circuits without damaging circuit components (such as using test probes, ensuring correct polarity, taking antistatic precautions); setting instrument zero readings; obtaining instrument readings and comparing them with expected results			
		2.14	Describe the application of Ohm's Law and relevant calculations (including units of electronic measurement and their multiples and sub-multiples)			
		2.15	Describe the use of calculations and other regulations, when selecting wires and cables and when carrying out tests on electronic circuits			
		2.16	Explain how to make adjustments to circuit components; making decisions on circuit performance and faulty components; removal and replacement of faulty components			
		2.17	Explain how to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current-carrying capacity, ambient temperatures, connection orientation)			
		2.18	Describe the methods of removing and replacing the faulty components from the equipment (such as unplugging, de-soldering, removal of screwed, clamped, edge connected, zero insertion force, and crimped connections) without causing damage to other components, wiring, circuit boards or the surrounding structure			
		2.19	Describe the tools and equipment used in the repair activities (including the use of wire-stripping tools, crimping tools, soldering irons, insertion devices and connecting tools); how to check that they are in a safe and usable condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Describe the sequence for reconnecting the equipment, and the checks to be made prior to restoring power (such as checking components for correct polarity, ensuring that there are no exposed conductors, cable insulation is not damaged, all connections are mechanically and electrically secure, casings are free from loose screws, there are no wire ends or solder blobs/spikes that could cause short circuits, and all fuses/protection devices are installed)			
		2.21	Describe the importance of making de-energised checks before proving the equipment with the electrical supply on			
		2.22	Explain how to make adjustments to components/assemblies to ensure that they function correctly			
		2.23	Describe the documentation and/or reports to be completed following the maintenance activity, and the importance of ensuring that these reports are completed accurately and legibly			
		2.24	Describe the problems that can occur with the electronic equipment maintenance activity, and how they can be overcome			
		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 in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to is designated location, cleaning the work area, removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 149: Maintaining and Testing Process Instrumentation and Control Devices

Unit reference number: A/504/6428

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to maintain and test process instrumentation and control devices. 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 F.

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	Maintain and test process instrumentation and control devices	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 instrumentation maintenance activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Where appropriate, ensure the safe isolation of instruments (such as electrical, pneumatic, process) • Follow job instructions, maintenance drawings and procedures • Check that the tools and test instruments are within calibration date and are in a safe and usable condition • Ensure that the equipment/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			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out maintenance activities on two of the following types of instrumentation and control systems: • Pressure • Fluid level • Fluid flow • Temperature measurement • Fire detection • Gas detection • Emergency shutdown • Speed measurement • Noise • Vibration monitoring • Nucleonic and radiation measurement • Telemetry systems • Weight measurement • Alarm systems • Environmental • Other specific system			
		1.4	Plan the maintenance activities before they start them			
		1.5	Obtain all the information they need for the safe removal and replacement of the instruments and/or sensors			
		1.6	Obtain and prepare the appropriate tools and equipment			
		1.7	Apply appropriate maintenance diagnostic techniques and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Use four of the following maintenance diagnostic techniques, tools and aids: • Fault finding techniques (such as input/output, half-split, unit substitution) • Diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records) • Information gathered from the person who reported the fault • Visual checks (such as signs of damage, leaks, missing parts, wear/deterioration) • Movement checks (such as loose fittings and connections) • Monitoring equipment or gauges • Test instrumentation measurement (such as voltage, resistance, current)			
		1.9	Use the appropriate methods and techniques to remove and replace the required instruments/sensors			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Carry out all of the following instrumentation maintenance activities: • Removing excessive dirt and grime • Taking electrostatic discharge (ESD) precautions (where appropriate) • Disconnecting supply/signal connections • Removing instruments from the system • Dismantling equipment to the required level • Labelling/marking of components • Checking components for serviceability • Replacing all 'lifed' items (such as seals, gaskets) • Replacing instruments/devices in the system • Setting, aligning and adjusting components • Tightening fastenings to the required torque • re-connecting instrumentation pipework and power supply • Checking signal transmission is satisfactory • Replacing or repairing damaged/defective components (such as electrical, mechanical and back-up batteries) • Functionally testing the maintained equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Use four of the following types of instrumentation test and calibration equipment: • Signal sources • Standard test gauges • Analogue or digital meters • Digital pressure indicators • Calibrated flow meters • Special-purpose test equipment • Pressure sources • Comparators • Manometers • Current injection devices • Calibrated weights • Logic probes • Temperature baths • Workshop potentiometers • Dead weight testers • Insulation testers			
		1.12	Carry out tests on sensing elements and associated instruments			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Set up and test sensing elements and/or stand alone instruments, to include three of the following: • Pressure (such as bourdon tube gauge, capsule/diaphragm gauge, pressure transducers) • Temperature (such as thermocouple, resistance thermometers, liquid in steel thermometer) • Flow (such as differential pressure systems, balanced flow meters, positive displacement) • Level (such as displacer systems, purged dip leg, capacitance probes, differential pressure systems, ultrasonic probes) • Other instruments/sensing elements (such as fire or gas detection, noise or vibration, speed or weight)			
		1.14	Maintain instrumentation and control systems, in accordance with one or more of the following: • Organisational guidelines and codes of practice • Equipment manufacturer's operation range • BS and ISO standards			
		1.15	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			
		1.16	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 maintain and test process instrumentation and control devices	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the instrumentation maintenance activities undertaken			
		2.2	Describe the isolation and lock-off procedure or permit-to-work procedure that applies to the system and instruments being worked on, and how to check that any stored energy in pipework and instruments has been released			
		2.3	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy			
		2.4	Describe the hazards associated with carrying out instrumentation and control maintenance activities (such as live electrical components, process controller interface, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them			
		2.5	Explain what constitutes a hazardous voltage and how to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and how to obtain first aid assistance)			
		2.6	Describe the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD)			
		2.7	Explain how to obtain and interpret information from job instructions and other documents needed for the maintenance activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, symbols and terminology, BS and ISO wiring regulations)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.8	Describe the basic principles of operation of the instrumentation being maintained (to include pressure, temperature, level and flow instrument sensors)			
		2.9	Explain how to identify the various instrument sensors (including how to identify their markings, calibration information, component values, operating parameters and working range)			
		2.10	Describe the various maintenance diagnostic techniques and aids that can be used (such as flow charts, fault reports, visual checks, measuring, movement and alignment checks, testing)			
		2.11	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)			
		2.12	Explain how to select and use a range of fault diagnostic equipment to investigate the problem			
		2.13	Describe the care, handling and application of instrumentation and control measuring instruments			
		2.14	Describe the reasons for making sure that control systems are isolated or put into manual control, and that appropriate trip locks or keys are inserted, before removing any sensors or instruments from the system, and the consequences of failing to do this			
		2.15	Describe the techniques used to dismantle/remove the equipment (such as release of pressures/force, proof marking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)			
		2.16	Describe the methods of attaching identification marks/labels to removed components or cables, to assist with reassembly			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Describe the methods of checking that components are fit for purpose, and the need to replace batteries, boards and other failed items			
		2.18	Describe the correct way of re-fitting instruments to avoid faulty readings (such as caused by head correction, poor flow past the sensor, blockages, incorrect wiring, poor insulation or incorrect materials)			
		2.19	Explain how to carry out visual checks of the instruments (such as security of joints and physical damage)			
		2.20	Describe the need to carry out tests and calibration checks on the various sensing elements and stand alone instruments, and the use of standard calibration charts and tables			
		2.21	Describe the types and application of standard test equipment (such as pressure sources, deadweight tester, temperature baths, signal sources and comparators)			
		2.22	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			
		2.23	Describe the approved methods of carrying out the tests on each type of instrument/sensor; setting instrument zero readings; obtaining instrument readings and comparing them with the circuit parameters; making adjustments to instrument/circuit components			
		2.24	Describe the generation of maintenance documentation and/or reports following the maintenance activity			
		2.25	Describe the problems that can occur during the maintenance of the instrumentation and control system, and how they can be overcome			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.26	Describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials			
		2.27	Explain when to act on their own initiative and when to seek help and advice from others			
		2.28	Describe the importance of leaving the work area in a safe and clean condition on completion of the maintenance activities (such as returning tools and test equipment to is 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 150: Wiring and Testing Programmable Controller Based Systems

Unit reference number: F/504/6429

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to wire and test programmable controller-based systems. 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 F.

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	Wire and test programmable controller based systems	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 of the programmable controller equipment: • 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 activities • Follow job instructions, wiring drawings and test procedures at all times • Check that the tools and test instruments are within calibration date and are in a safe and usable condition • Ensure that the programmable controller system is kept free from foreign objects, dirt or other contamination • Where appropriate, apply procedures and precautions • Return all tools and equipment to the correct location on completion of the installation activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Connect and test equipment for one of the following types of programmable controller systems: • Monitoring system • Process/product control system • Diagnostic system • Combination system • Building services system • Other specific system			
		1.4	Plan the programmable controller wiring and testing activities before they start them			
		1.5	Use appropriate sources to obtain the required circuit diagrams, wiring, programming and test information			
		1.6	Obtain the correct tools and equipment for the wiring and testing operations, and check that they are in a safe and usable condition			
		1.7	Use two of the following test instruments during the wiring and testing activities: • Multimeter • Programming devices (such as loader terminal, hand held programmer, personal computer) • Signal generator • Network testing equipment • Other specific test equipment			
		1.8	Position and secure the programmable controller components and peripheral devices safely and correctly, to meet specification requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Connect up and test one of the following types of programmable controller equipment/components: • Unitary controller units • Rack mounted controller units • Modular controller units Plus five more items from the following: • Sensors (such as inductive, proximity, temperature, colour, optical) • Actuators (such as pneumatic or hydraulic) • Switches (such as emergency stop, limit, pressure) • Valves (such as pneumatic or hydraulic) • Safety interlocks • Motor starters • Barcode scanners • PC peripheral devices • Analogue to digital modules • PID (proportional, integral, derivative) controller • Modems • Printer's panels and sub-assemblies • Electrical wires and cable connections • Signal transmission components/cables • Overload protection devices • Other devices			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Connect and terminate the cables to the appropriate connections on the components			
		1.11	Apply wiring and connection methods and techniques, to include five of the following: • Locating and securing equipment in the correct positions • Making mechanical/screwed/clamped connections • Soldering and de-soldering connections • Sealing and protecting cable connections • Crimping (such as tags and pins) • Connecting all input and output devices • Attaching suitable cable identification • Routeing and securing wires and cables • Using heat shrinking devices or boots • Stripping cable insulation/protection • Adding cable end fittings			
		1.12	Develop programmable controller programs, using the appropriate techniques and programming language			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Develop programs which use one of the following, as applicable to the type of controller and programming software: • Ladder and logic diagrams • Function block diagrams • Statement/instruction lists • Structured text • Sequential function charts • Other specific programming language			
		1.14	Use appropriate test methods and equipment to check and prove the program integrity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Prove and edit the programmable logic controller program, using five of the following: • Single block run • Program save/store facilities • Search facilities • Program override controls • Taking test measurements • Using monitoring mode • Using process simulation techniques (forcing contacts on/off) • Edit facilities • Data input facilities • Program full run • Graphic displays • Counter and timer settings			
		1.16	Wire up and test programmable controllers, in accordance with one or more of the following standards: • Equipment manufacturer's specification/operation range • BS7671/IET wiring regulations • Other BS and/or ISO standards • Company standards and procedures			
		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
		1.18	Use three of the following diagnostic techniques, tools and aids: • Visual checks (such as signs of damage, missing parts, wear/deterioration) • Movement checks (such as loose fittings and connections) • Fault finding techniques (such as input/output, half-split, unit substitution) • Diagnostic aids (such as manuals, flow charts, logic diagrams, troubleshooting guides) • Test instrumentation measurement (such as continuity, voltage, resistance, current) • Controller error warning lights/displays			
		1.19	Carry out all of the following on completion of the programming activity: • Check and review program format and content • Edit programs using the correct procedure (where appropriate) • Check that the program is correctly titled and referenced • Ensure that programs are stored safely and correctly in the correct format • Create a separate backup copy of the program in case of file corruption			
		1.20	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 wire and test programmable controller based systems	2.1	Describe the health and safety requirements, and safe working practices and procedures required when wiring and testing programmable controller equipment			
		2.2	Describe the hazards associated with wiring and testing programmable controller equipment, and with the tools and equipment used (such as live electrical components, process controller interface, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down procedures), and how they can be minimised			
		2.3	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy			
		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	Explain what constitutes a hazardous voltage and how to recognise victims of electric shock			
		2.7	Explain how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)			
		2.8	Describe the interpretation of circuit and wiring diagrams, and specifications used for the wiring and testing activities (including BS and ISO schematics, wiring regulations, symbols and terminology)			
		2.9	Describe the basic principles of operation of the programmable controller equipment/circuits being connected and tested, and the purpose of the individual modules/components used (such input and output devices)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Describe the techniques used to connect programmable controller equipment (such as plugs, soldering, screwed, clamped and crimped connections) and if the controller is sinking or sourcing the required current to operate the input/output devices			
		2.11	Describe the use of BS 7671/IET wiring, and other regulations, when selecting wires and cables, and when carrying out tests on systems			
		2.12	Explain how to conduct any necessary checks to ensure the accuracy and quality of the wiring (such as visual checks for completeness and freedom from damage to conductors or components, mechanical checks for security of components and connections, ingress protection, electrical checks for electrical continuity and earth continuity, insulation resistance and polarity checks)			
		2.13	Describe the main programmable controller types that are available, and the importance of understanding that a different programmable controller may use completely different codes for similar functions			
		2.14	Describe the programming languages commonly used with programmable controller based systems (such as structured, ladder, statement lists, logic function blocks, Boolean algebra)			
		2.15	Describe the common programmable controller numbering systems (such as binary, octal, decimal, hexadecimal, binary coded decimal (BCD))			
		2.16	Describe the different programming codes used to identify factors such as sensor inputs, actuator and other outputs, process management and auxiliary functions			
		2.17	Describe the information and data required in order to produce a complete and accurate programmable controller program, and how to translate the operating criteria into logic programming format			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Describe the factors to be taken into account when producing programs (including the type of programmable controller (unitary, modular, rack mounted) and its control capabilities); safety considerations and the product/environment being controlled by the process			
		2.19	Describe the methods and procedures used to check that the completed program will control the required parameters safely, accurately and efficiently (such as checking the program for errors against expected performance with regard to sequence of operations; checking that programmed instructions cover all operational requirements; 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 failsafe devices and system emergency stops are operating correctly)			
		2.20	Explain how to identify system errors, and how to search a program within the programmable controller for specific elements and rectify the causes of the errors			
		2.21	Explain how to save the completed programs in the appropriate format and the need to store the program safely and correctly, away from contaminants and possible corruption			
		2.22	Explain how to back up completed or edited programs, and the implications if this is not carried out effectively			
		2.23	Describe the fault-finding techniques to be used when the equipment fails to operate correctly			
		2.24	Describe the problems that can occur with the wiring and testing operations, 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 in a safe and clean condition on completion of the wiring and testing activities (such as returning hand tools and test equipment to is 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 151: Using Wood for Pattern, Modelmaking and Other Engineering Applications

Unit reference number: T/504/6430

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to use wood for pattern, modelmaking and other 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 F.

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 wood for pattern, modelmaking and other 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 cutting and shaping activities: • Obtain all the necessary information to carry out the cutting and shaping activities (drawings, specifications) • Check that the equipment to be used are fit for purpose, and is in a safe, tested and usable condition (such as hand tools, machines and machine cutting tools) • Ensure that the work area is free from hazards • Ensure that all machine guards and safety devices are correctly positioned • Check that dust extraction equipment is functioning correctly • Set and adjust the machines to produce the components to the required specification • Use safe and approved hand and machine shaping techniques at all times • Maintain the cutting tools in a serviceable condition			
		1.3	Plan the pattern, model or engineering woodworking activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Identify and isolate any materials that have defects, to include all of the following: • Structural • Cosmetic • Dimensional • Distortion			
		1.5	Obtain the appropriate tools and equipment for the operations, and check that they are in a safe and usable condition			
		1.6	Mark out the components for the required operations, using appropriate tools and techniques			
		1.7	Use marking out methods and techniques, including: • Direct marking, using instruments Plus one more of the following: • Use of templates • Tracing/transfer methods • Other specific method			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Use a range of marking out equipment, to include all of the following: • Pencil • Marking knife • Rule or tape • Straight edge • Square • Protractor or sliding bevel • Dividers, compass or trammels • Marking gauge			
		1.9	Mark out material, to include all of the following features: • Datum and centre lines • Square/rectangular profiles • Cutting detail • Circles • Hole centring and outlining Plus two more from the following: • Angles • Joints • Curved profiles • Assembly positions			
		1.10	Cut and shape the materials to the required specification, using appropriate tools and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Use hand tools to cut and shape materials, to include all of the following: • Rip saws • Tenon saws • Chisels/gouges • Jack or smoothing planes • Drills/braces • Sanding blocks/paper Plus two more from the following: • Fret/bow saws • Rebating planes • Spokeshaves • Files/rasps • Portable powered hand tools • Other specific hand tools			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Use fixed and portable machines, to include all of the following: • Circular saw • Planer/thicknesser • Bench or pedestal drill Plus two more from the following: • Band saw • Sander (such as face, belt, bobbin) • Router • Morticer/tenoner • Combing machine • Lathe • Spindle moulder (single or double) • Other special purpose machine			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce components which combine different features and cover all of the following profiles: • Flat faces • Parallel faces • Square faces • Angular/tapered faces • Curved profiles • Drilled holes • Countersunk/counterbored holes Plus six more from the following: • Plain diameters • Stepped diameters • Tapered diameters • Slots/grooves • Rebates • Tenons • Mortices • Half lap joints • Combed joints • Dovetail joints • Concave profiles • Convex profiles • Other specific joints			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Produce components made from four of the following materials: • Soft woods • Hard woods • Plywood • Blockboard • Hardboard • Fibreboard (MDF)			
		1.15	Measure and check that all dimensional and geometrical aspects of the component are to the specification			
		1.16	Use appropriate measuring equipment and tools to check all of the following: • Dimensions • Flatness • Squareness • Angles/taper • Alignment • Position • Profile • Distortion/straightness			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Produce components which meet all of the following requirements: • Components to be free from false tool cuts, and material defects • The shape and general tolerances meet the drawing or specification requirements with some dimensional tolerances within +/- 1mm or +/- 0.040” • Flatness and squareness 0.25mm per 25mm or 0.010" per inch • Angles within +/- 2 degrees • Interlocking components (joints) are secure • Components have an appropriate surface texture			
		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 pattern, modelmaking or engineering woodworking activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to use wood for pattern, modelmaking and other engineering applications	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the pattern, modelmaking or engineering woodworking activities undertaken (including the use of hand tools; working with machinery; operation of machine safety devices; dust extraction; stopping the machine in an emergency; closing the machine down on completion of activities)			
		2.2	Describe the importance of wearing appropriate protective clothing/equipment (PPE), and of keeping the work area safe and tidy			
		2.3	Describe the hazards associated with cutting and shaping wood and composite materials, and with the tools and equipment that is used, (such as use of hand power tools, trailing leads or hoses, dust inhalation, damaged or badly maintained tools and equipment, using tools with damaged or poor fitting handles, handling long or wide lengths of material), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	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			
		2.6	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.7	Explain how to identify the materials that are to be used (to include colour, grain structure, size), and the common defects that occur in the wood to be used			
		2.8	Describe the types of defects that would render the materials unfit for use			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the material characteristics and process considerations to be taken into account when marking out wood (such as the importance of colour matching and grain convention when using wood and wood-based materials)			
		2.10	Describe the principles of marking out, and the types of equipment used (including the range of operations that the various items of marking out equipment are capable of performing)			
		2.11	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, preparing the materials, removing sharp corners and edges)			
		2.12	Describe the use of marking out conventions when marking out the workpiece (including datums, centre lines, cutting guidelines, square and rectangular profiles, joints, circular and curved profiles, angles, holes which are linearly positioned, boxed and on pitch circles)			
		2.13	Explain how to select and establish suitable datums; the importance of ensuring that marking out is undertaken from the selected datums; and the possible effects of working from different datums			
		2.14	Describe the use of geometrical construction methods applied to marking out			
		2.15	Describe the ways of laying out the marking out shapes or patterns to maximise the use of materials			
		2.16	Describe the various hand tools that are used to cut and shape the materials, and the range of operations they are capable of performing (such as rip saws, tenon saws, fret/bow saws; smoothing planes, jack planes, rebating planes; chisels and gouges; spokeshaves)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Explain how to check that the hand cutting tools are in a usable and safe condition; and the procedure for sharpening and adjusting these when required			
		2.18	Describe the various machines that are used in wood machining, and the range of operations they are capable of performing (such as sawing, planing, rebating, profiling)			
		2.19	Describe the importance of checking that the machinery used is complete and working correctly, that the cutting tools are undamaged and are in a safe and sharp condition, and the procedure for changing, sharpening and adjusting these when required			
		2.20	Describe the methods of setting up and operating the equipment and machinery, how to set up and use dust extraction equipment, and the importance of ensuring that this equipment is operating correctly			
		2.21	Describe the importance of ensuring that all machine and portable tools are used correctly, PAT tested and within their permitted operating range			
		2.22	Describe the various methods used to hold the components that are being shaped, formed or dressed by hand			
		2.23	Explain why they need to consider grain direction and construction when cutting and shaping wood and composites			
		2.24	Describe the methods used to cut square, angular and circular/curved profiles			
		2.25	Explain how different materials require changes to the machining methods (such as roughing and finishing cuts, changes in feed or speeds)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.26	Explain how to conduct any necessary checks to ensure the accuracy and quality of the components produced, and the type of equipment that is used			
		2.27	Explain when to act on their own initiative and when to seek help and advice from others			
		2.28	Describe the importance of leaving the work area in a safe and clean condition on completion of the woodworking activities (such as removing and storing power leads, isolating machines, cleaning the equipment, and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 152: Assembling Pattern, Model and Engineering Woodwork Components

Unit reference number: A/504/6431

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to assemble pattern model and engineering woodwork components. 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 F.

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	Assemble pattern, model and engineering woodwork components	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 pattern, model or engineering woodwork assembly activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, assembly drawings and procedures • Ensure that all power tools, cables, extension leads or air supply hoses are in a safe, tested and serviceable condition • Check that tools and measuring instruments to be used are within calibration date • Use lifting and slinging equipment in accordance with health and safety guidelines and procedures (where appropriate) • Ensure that components used are free from damage, material defects, foreign objects, or other contamination • Return all tools and equipment to the correct location on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Plan the assembly activities before they start them			
		1.4	Obtain and prepare the appropriate components, tools and equipment			
		1.5	Use the appropriate methods and techniques to assemble the components in their correct positions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Produce pattern, model or engineering woodwork assemblies, which include three of the following: • Flat backed patterns (with/without cores) • Irregular joint patterns (with/without cores) • Split patterns (with/without cores) • Solid turnout coreboxes • Split coreboxes • Plated patterns (drags) • Plated patterns (copes) • Furniture units without drawers and doors • Furniture units with drawers • Furniture units with doors • Doors and door frames • Storage units • Frames or bulkheads • Structures • Show stands or cases • Transportation units • Consoles • Full-size models • Sectional full-size models • Scale models			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	...continued • Sectional scale models • Jigs or fixtures • Formers • Other specific assemblies			
		1.7	Apply all of the following assembly methods and techniques, as appropriate for the assemblies produced: • Ensuring that correct and undamaged components are used • Ensuring that the correct 'hand' of component is used at the appropriate position (left or right handed) • Ensuring the correct orientation, position and alignment of components • Using cramps and clamps to hold the components during the assembly activities • Drilling and countersinking/counterboring (where appropriate) • Securing components using mechanical fasteners (such as pins, screws, nails, special fasteners, dowels) • Securing components by using prepared joints • Securing components by using adhesives • Fitting of accessories (hinges, locks, handles, catches)			
		1.8	Secure the components, using the specified connectors and securing devices			
		1.9	Check the completed assembly to ensure that all operations have been completed, and that the finished assembly meets the required specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Carry out the required quality checks, to include ten from the following, using appropriate equipment: • Dimensions • Flatness • Squareness • Alignment • Orientation • Positional accuracy • Distortion/straightness • Profile (where appropriate) • Fit/component security • Finish • Completeness • Function (where appropriate) • Freedom from damage			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce pattern, model or engineering woodwork assemblies which meet all of the following: • All components are correctly assembled and aligned in accordance with the specification • Assemblies are dimensionally accurate within specification tolerances • Where appropriate, assemblies meet appropriate geometric tolerances (such as square, straight, angles free from twists) • Interlocking components (joints) are secure • Doors and drawers are correctly aligned and open freely (where applicable) • Moving parts are correctly adjusted and have appropriate clearances			
		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 assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to assemble pattern, model and engineering woodwork components	2.1	Describe the specific safety precautions to be taken whilst carrying out the woodwork assembly activities (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)			
		2.2	Describe the importance of wearing appropriate protective clothing/equipment (PPE) during the woodwork assembly activities, and of keeping the work area safe and tidy			
		2.3	Describe the hazards associated with producing wood and composite assemblies, and with the tools and equipment used, (such as dust inhalation, use of hand power tools, trailing leads or hoses, using adhesives), and how they can be minimised			
		2.4	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			
		2.5	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 identify the components to be used, component identification systems (such as codes and component orientation indicators, left and right handing)			
		2.7	Describe the preparations to be undertaken on the components prior to fitting them into the assembly			
		2.8	Describe the assembly methods and procedures to be used, and the importance of adhering to these procedures			
		2.9	Describe the importance of assembling components in the correct order			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how to mark out the necessary datum lines for the assembly operations			
		2.11	Explain how the components are to be aligned, oriented and positioned prior to securing them, and the tools and equipment that are used for this			
		2.12	Explain why some types of assembly require the use of jigs and gauges to aid the assembly			
		2.13	Describe the various mechanical fasteners that will be used to secure the components, and their method of installation (such as nails, screws and special securing devices)			
		2.14	Describe the application of adhesives within the assembly activities, and the precautions that must be taken when working with them			
		2.15	Explain how to conduct any necessary checks to ensure the accuracy and quality of the assembly produced, and the type of equipment that is used			
		2.16	Explain how to recognise defects, blemishes, poor alignment, ineffective fasteners and damaged components within the assembly			
		2.17	Explain how defects and variations should be dealt with, and what factors determine the actions to be taken (including the relative costs of reworking or discarding the defective item)			
		2.18	Explain how to check that the assembly tools and equipment to be used are in a safe and serviceable condition			
		2.19	Explain why it is important to keep the tools and equipment clean and free from damage, to practice good housekeeping of tools and equipment, and to maintain a clean and unobstructed working area			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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 in a safe and clean condition on completion of the assembly activities (such as removing and storing clamps, isolating equipment, cleaning the equipment, and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 153: Producing Composite Mouldings Using Wet Lay-Up Techniques

Unit reference number: F/504/6432

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce composite moulding using wet lay-up techniques. 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 F.

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 composite mouldings using wet lay-up techniques	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 moulding activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, drawings, process specifications and moulding/lay-up procedures • Ensure that all equipment and tools used are in a safe and serviceable condition • Return all tools and equipment to the correct location on completion of the moulding/lay-up activities			
		1.3	Plan the moulding/laying-up activities before they start them			
		1.4	Prepare the moulds, jigs or formers ready for the manufacturing operations			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Carry out all of the following activities when preparing production tooling: • Check that tooling is correct and complete • Clean the tooling and remove resin build-ups • Check for surface defects • Correctly apply sealers/release agents • Clean and store tooling suitably after use			
		1.6	Mix and prepare the required materials			
		1.7	Carry out all of the following activities to prepare materials for production: • Obtain the correct materials for the activity • Check that materials are fit for purpose and in life • Cut materials to correct size and shape • Check correct quantity of resin is available • Calculate the correct resin to fibre ratios • Check correct measure and mix of resin/catalyst • Identify and protect materials in the work area			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Carry out all of the following activities to prepare materials for production: • Obtain the correct materials for the activity • Check that materials are fit for purpose and in life • Cut materials to correct size and shape • Check correct quantity of resin is available • Calculate the correct resin to fibre ratios • Check correct measure and mix of resin/catalyst • Identify and protect materials in the work area			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Produce a range of mouldings using one of the following types of production tool: • Pattern • Mandrel • Metallic • Tooling block • Wet lay-up • Infused mould • Glass pre-preg • Carbon pre-preg • Female tooling • Male tooling • Multi-part tools • Matched tooling • Closed tooling			
		1.10	Carry out the moulding or laying-up activities, using the correct methods and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce a range of mouldings using two of the following application techniques: • Spray application of fibre/resin • Spray application of a gel coat • Brush application of a gel coat • Brush application of fibre/resin • Roller application of fibre/resin • Removal of voids and air pockets • Brush/roller consolidation • Use of vacuum bagging • Use of bleed plies			
		1.12	Produce a range of mouldings incorporating two of the following in the lay-up: • Feathered joins • Staggered joins • Overlap joins • Orientated plies • Inserts • Fixtures • Butt joins			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce a range of mouldings incorporating four of the following shape features: • Internal corner • External corner • Horizontal surface • Vertical surface • Return surfaces • Double curvature • Concave surface • Convex surface • Joggle details • Nett edges			
		1.14	Produce a range of mouldings using one type of resin from: • Bio resin • Acrylic • Polyester • Vinyl ester • Epoxy • Phenolic • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Produce a range of mouldings using techniques for one type of fibre from: • Natural fibre • Thermoplastic • Glass • Aramid • Carbon • Hybrid • Other (to be specified)			
		1.16	Produce a range of mouldings using techniques for two types of reinforcement from: • Uni-directional • Roving • Braids • Tapes • Chopped strand • Continuous filament • Tissues/veils • Bonded fabrics • Woven • Multi axis/stitched • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Produce a range of mouldings using techniques for one of the following types of core material from: • Solid timber • Coremat • Rigid foam • Expanding foam • Skinned honeycomb • End grain balsa • Other (to be specified)			
		1.18	Remove the mouldings from the formers and trim/finish them to specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	Remove the moulding and carry out all of the following: • Visually check that the moulding is complete and free from defects • Use appropriate equipment/gauges to check for dimensional accuracy (such as overall dimensions, thickness of material/moulding, geometric features) • Mark out the mouldings for trimming of excess material • Cut/trim the mouldings, using appropriate tools and equipment (such as cutting wheels/discs, routers, saws) • Carry out repairs (where appropriate) • Finish the mouldings, using appropriate tools and equipment (such as rubbing blocks, diamond files, disc or belt sanders, pencil grinders) • Polish the mouldings, using appropriate tools and equipment (such as wet sanding, cutting compounds)			
		1.20	Check that all the required operations have been completed to specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.21	Produce composite mouldings which comply with one of the following standards: • Components are dimensionally accurate within specification requirements • Finished components meet the required shape/geometry (such as squareness, straightness, angularity and being free from twists) • Completed components are free from defects, sharp edges or slivers • Components meet company standards and procedures			
		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	Leave the work area in a safe and tidy condition on completion of the moulding activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce composite mouldings using wet lay-up techniques	2.1	Describe the health and safety precautions to be taken and procedures to be used when working with composite materials, consumables, tools and equipment in the specific work area			
		2.2	Describe the hazards associated with using composite materials, consumables, tools and equipment, and how to minimise these and reduce any risks			
		2.3	Describe the protective equipment (PPE) that is needed for personal protection and, where required, the protection of others			
		2.4	Describe the application of COSHH regulations in relation to the storage, use and disposal of composite materials and consumables			
		2.5	Describe the specific environmental conditions the must be observed when producing composite mouldings (such as temperature, humidity, styrene levels to threshold limits, fume/dust extraction systems and equipment)			
		2.6	Explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken			
		2.7	Explain how to interpret drawings/lay up manuals, imperial and metric systems of measurement, workpiece reference/datum points and system of tolerancing			
		2.8	Describe the quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the conventions and terminology used for wet lay-up techniques (such as resin and fibre weights/volumes, material orientation, material identification, material tailoring, mixing ratios, gel times, exotherm, bleed plies)			
		2.10	Describe the different types of resins, reinforcement, catalysts, accelerators and additives used, and their applications			
		2.11	Describe the different types of fibre materials, fabrics, orientations, their combinations and applications			
		2.12	Describe the different core, insert and filler materials, and their applications			
		2.13	Describe the visual identification of both raw and finished composite materials			
		2.14	Describe the different types of production tooling used for producing composite mouldings, and their applications			
		2.15	Describe the identification and rectification of defects in production tooling			
		2.16	Describe the methods of preparation for patterns, moulds and tooling, (including the correct use of surface sealers and release agents)			
		2.17	Describe the methods for handling and preparing the reinforcing fibres			
		2.18	Explain how to estimate/calculate resin volume/weight required to wet-out the reinforcing fibres			
		2.19	Describe the mixing ratios for gel coats, resins, accelerators and catalysts, and the associated working times			
		2.20	Describe the methods used in the application of the resin/fibre during the lay-up activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Describe the tools and equipment used in the lay-up activities, and their care, preparation and control procedures			
		2.22	Describe the problems that can occur during the lay-up process (including defects such as contamination, resin/fibre rich areas, and distortion)			
		2.23	Explain how defects can be overcome during the lay-up activity			
		2.24	Describe the different methods and techniques used to cure composite mouldings including cure cycles and the need for monitoring			
		2.25	Describe the methods and techniques used to trim mouldings prior to release (green trimming)			
		2.26	Describe the procedures and methods used for removing mouldings from production tooling			
		2.27	Describe the identification of defects in the composite moulding (such as de-lamination, voids, contaminants)			
		2.28	Describe the care and safe handling of production tooling and composite mouldings throughout the production cycle			
		2.29	Describe the production controls used in the work area, and actions to be taken for unaccounted items			
		2.30	Explain how the composite moulding relates to its own quality documents and the production tooling used			
		2.31	Describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 154: Producing Composite Mouldings Using Pre-Preg Techniques

Unit reference number: L/504/6434

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce composite mouldings using pre-preg techniques. 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 F.

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 composite mouldings using pre-preg laminating techniques	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 activities during the moulding activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations • Follow job instructions, drawings, process specifications and moulding/laminating procedures • Ensure that all equipment and tools used are in a safe and serviceable condition • Return all tools and equipment to the correct location on completion of the moulding/laminating activities			
		1.3	Plan the moulding/laminating activities before they start them			
		1.4	Prepare the moulds, jigs or formers ready for the manufacturing operations			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Carry out all of the following activities when preparing production tooling: • Check that tooling is correct and complete • Clean the tooling and remove resin build-ups • Check for surface defects • Correctly apply sealers/release agents • Clean and store tooling suitably after use			
		1.6	Carry out all of the following activities to prepare materials for production: • Obtain correct materials for the activity • Thaw material removed from freezer storage • Identify defects in pre-preg materials • Check that materials are fit for purpose and in life • Check availability of ancillary materials required • Cut materials to the correct shape and orientation • Check the materials when provided in kit form • Identify and protect materials in the work area			
		1.7	Mix and prepare the required materials			
		1.8	Carry out the moulding/laminating activities, using the correct methods and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Produce a range of mouldings, using one of the following types of production tool: • Pattern • Mandrels • Metal • Tooling block • Glass pre-preg • Carbon pre-preg • Female tooling • Male tooling • Multi-part tools • Matched tooling • Closed tooling			
		1.10	Produce a range of mouldings, incorporating two of the following in the lay-up: • Butt joins • Overlap joins • Staggered joins • Orientated plies • Inverted plies • Balancing plies • Inserts • Fixtures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce a range of mouldings incorporating four of the following shape features: • Internal corners • External corners • Horizontal surface • Vertical surface • Double curvature • Concave surface • Convex surfaces • Return surfaces • Joggle details • Nett edges			
		1.12	Produce a range of mouldings using one type of resin from: • Bio resin • Thermoplastic • Epoxy • Phenolic • Bismaleimide • Cyanate ester • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce a range of mouldings using techniques for one type of fibre from: • Natural fibre • Thermoplastic • Glass • Aramid • Carbon • Hybrid • Other (to be specified)			
		1.14	Produce a range of mouldings using one type of reinforcement from: • Continuous • Uni-directional • Tissues/veils • Braids • Woven • Multi-axis • Tapes			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Produce a range of mouldings, using one type of core material (where applicable to the sector or process): • Solid timber • End grain balsa • Thermoplastic core • Rigid foam • Syntactic core • Expanding core • Fibrous honeycomb • Aluminium honeycomb • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Use one of the following methods when using core materials (where applicable to the Sector or process): • Core templates • Pre-shaping core • Core chamfers • Core splicing • Peel plies • Bonding paste • Edge filling • Adhesive/resin films • Potting/filler compound • Single stage curing • Multi-stage curing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Prepare the moulding for temperature curing using one of the following methods: • Oven • Heat mats • Heated press • Curing lamps • Autoclave • Infrared heating • UV curing • Electro-magnetic inductance • Micro-wave • Other (to be specified)			
		1.18	Preparing the moulding for pressure consolidation using one of the following methods: • Vacuum bags • Hot de-bulk • Pressure de-bulk • Pressure bags • Thermal mould expansion • Fibre tensioning • Press • Autoclave			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	Remove the mouldings from the formers and trim/finish them to specification			
		1.20	Remove composite moulding and carry out all of the following: • Visually check that the moulding is complete and free from defects • Use appropriate equipment/gauges to check for dimensional accuracy (such as overall dimensions, thickness of material/moulding, geometric features) • Mark out the mouldings for trimming of excess material • Cut/trim the mouldings using appropriate tools and equipment (such as cutting wheels/discs, routers, saws) • Carry out repairs (where appropriate) • Finish the mouldings, using appropriate tools and equipment (such as rubbing blocks, diamond files, disc or belt sanders, pencil grinders) • Polish the mouldings using appropriate tools and equipment (such as wet sanding , cutting compounds)			
		1.21	Check that all the required operations have been completed to specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.22	Produce composite mouldings which comply with one of the following: • Components are dimensionally accurate, within specification requirements • Finished components meet the required shape/geometry (such as square, straight, angle, free from twists) • Completed components are free from defects, sharp edges or slivers • Components meet company standards and procedures			
		1.23	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			
		1.24	Leave the work area in a safe and tidy condition on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce composite mouldings using pre-preg laminating techniques	2.1	Describe the health and safety precautions to be taken, and procedures to be used, when working with composite materials, consumables, tools and equipment in the specific work area			
		2.2	Describe the hazards associated with carrying out pre-preg laminating techniques, and with the composite materials, consumables, tools and equipment used, and how to minimise these and reduce any risks			
		2.3	Describe the protective equipment (PPE) that is needed for personal protection and, where required, the protection of others			
		2.4	Describe the application of COSHH regulations in relation to the storage, use and disposal of composite materials and consumables			
		2.5	Describe the specific environmental conditions that must be observed when producing composite mouldings (such as temperature, humidity, fume/dust extraction systems and equipment)			
		2.6	Explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO BSEN standards) in relation to work undertaken			
		2.7	Explain how to interpret drawings/lay up manuals, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.8	Describe the quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents			
		2.9	Describe the conventions and terminology used for pre-preg laminating techniques (such as material orientation, material identification, material templates, ply lay-up, pressure plates, vacuum bagging, cure cycles, exotherm)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Describe the different types of resins, reinforcement, catalysts, accelerators and additives used, and their applications			
		2.11	Describe the different types of fibre materials, fabrics, orientations, their combinations and applications			
		2.12	Explain how to build up laminates (including orientation and balance of plies) to minimise spring and distortion in composite mouldings			
		2.13	Describe the different core, insert and filler materials, and their applications			
		2.14	Describe the visual identification of both raw and finished composite materials			
		2.15	Describe the identification of materials by product codes			
		2.16	Describe the Different types of production tooling used for producing composite mouldings, and their applications			
		2.17	Describe the identification and rectification of defects in production tooling			
		2.18	Describe the methods of preparation for patterns, moulds and tooling, including the correct selection and use of surface sealers and release agents			
		2.19	Describe the correct methods of storage, thawing and handling of pre-preg materials (including monitoring temperature, storage life and out-life)			
		2.20	Describe the methods used in the application of pre-preg materials to tooling surfaces (including methods of tailoring and cutting)			
		2.21	Describe the correct methods of storage and handling of ancillary and consumable materials			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.22	Describe the selection and use of ancillary and consumable materials (such as release films, breather fabrics, bagging films, tapes) to meet performance requirements (such as temperature and compatibility)			
		2.23	Describe the tools and equipment used in the pre-preg laminating activities, and their care, preparation and control procedures			
		2.24	Describe the problems that can occur during the lay-up process (including modifications to the ply lay-up, and defects such as contamination and distortion)			
		2.25	Describe the cure cycles (including temperature and pressure ramps, dwell times, post curing)			
		2.26	Describe the need for monitoring the cure cycle (using thermocouples, probes, chart recorders and data logs)			
		2.27	Describe the procedures and methods used for removing mouldings from production tooling			
		2.28	Describe the identification of defects in the composite moulding (such as de-lamination, voids, contaminants)			
		2.29	Describe the care and safe handling of production tooling and composite mouldings throughout the production cycle			
		2.30	Describe the production controls used in the work area, and actions to be taken for unaccounted items			
		2.31	Explain how the composite moulding relates to its own quality documents, and the production tooling used			
		2.32	Describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 155: Producing Composite Mouldings Using Resin Flow Infusion Techniques

Unit reference number: R/504/6435

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce composite mouldings using resin flow infusion techniques. 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 F.

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 Composite Mouldings using Resin Flow Infusion Techniques	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 moulding activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, drawings, process specifications and moulding/laminating procedures • Ensure that all equipment and tools used are in a safe and serviceable condition • Return all tools and equipment to the correct location on completion of the moulding activities			
		1.3	Plan the resin infusion activities before they start them			
		1.4	Prepare the moulds, jigs or formers ready for the manufacturing operations			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Prepare the tooling for production, to include carrying out all of the following: • Check that tooling is correct and complete • Clean tooling and remove resin build-ups • Check for surface defects • Correctly apply sealers/release agents • Clean and store tooling suitably after use			
		1.6	Check materials are fit for purpose and in life			
		1.7	Prepare the materials for production, to include carrying out all of the following: • Obtain the correct materials for the activity • Check that materials are fit for purpose and in life • Cut materials to the correct size, shape and orientation • Calculate the correct resin to fibre ratios • Check correct quantity of resin is available • Check the availability of required ancillary materials • Identify and protect materials in the work area • Obtain the correct infusion media and layout for the activity			
		1.8	Carry out the resin flow infusion activities, using the correct methods and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Produce composite mouldings, using one of the following: • Test panel trials/tracking • Partial trial runs/tracking • Full scale trial runs/tracking • Production runs • Staged resin entry • Dry area rectification • Vacuum regulation • Resin flow regulation			
		1.10	Produce composite mouldings incorporating two of the following: • Butt joins • Overlap joins • Staggered joins • Feathered joins • Orientated plies • Inverted plies • Balancing plies • Inserts • Fixtures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce composite mouldings incorporating four of the following shape features: • Internal corners • External corners • Horizontal surface • Vertical surface • Double curvature • Concave surface • Convex surfaces • Return surfaces • Joggle details • Nett edges			
		1.12	Produce composite mouldings, using techniques for one type of resin from: • Bio resin • Acrylic • Polyester • Vinyl ester • Epoxy • Phenolic • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Produce composite mouldings, using techniques for one type of fibre from: • Natural fibre • Thermoplastic • Glass • Aramid • Carbon • Hybrid • Other (to be specified)			
		1.14	Produce composite mouldings, using techniques for one type of reinforcement from: • Uni-directional • Chopped strand • Tissues/veils • Woven • Braids • Multi m axis/stitched • Knitted • Tapes • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Produce composite mouldings, using techniques for one type of core materials from: • Solid timber • End grain balsa • Coremat • Rigid foam • Expanding foam • Skinned honeycomb • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Produce composite mouldings using techniques for three types of resin distribution media: • Mould surface entry • Interlaminar • Surface meshes • Infusion mats/fabrics • Channelled core • Perforated core • Perforated hose • Spiral wrap • Peel ply • Braid • Flow channels • Manifolds • Networks • Bleed plies • Moulded vacuum bags			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Use three of the following vacuum bagging processes/methods: • Check vacuum integrity • Surface bagging • Envelope bagging • Internal bagging • Pleats and tucks • Reusable bagging • Leak detection • Leak rectification • Catch pots/tanks • Localised resin injection • Use of reusable vacuum fittings			
		1.18	Remove the mouldings correctly and trim/finish them to specification			
		1.19	Remove the composite mouldings and carry out all of the following: • Visually check that the moulding is complete and free from defects • Use appropriate equipment/gauges to check for dimensional • Accuracy (such as overall dimensions, thickness of • Material/moulding, geometric features) • Carry out repairs (where appropriate) • Finish the mouldings, using appropriate tools and equipment			
		1.20	Check that all the required operations have been completed to specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.21	Produce composite mouldings in compliance with one of the following: • Components are dimensionally accurate within specification requirements • Finished components meet the required shape/geometry (such as square, straight, angle, free from twists) • Completed components are free from defects, sharp edges or slivers • Components meet company standards and procedures			
		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	Leave the work area in a safe and tidy condition on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce Composite Mouldings using Resin Flow Infusion Techniques	2.1	Describe the Health and safety precautions to be taken, and procedures used, when working with composite materials, consumables, tools and equipment in the specific work area			
		2.2	Describe the hazards associated with carrying out resin flow infusion techniques, and with the composite materials, consumables, tools and equipment used, and how to minimise these and reduce any risks in the work area			
		2.3	Describe the Protective equipment (PPE) that is needed for personal protection and, where required, the protection of others			
		2.4	Describe the application of COSHH regulations in relation to the storage, use and disposal of composite materials and consumables			
		2.5	Describe the specific workshop environmental conditions that must be observed when producing composite mouldings using resin flow infusion techniques (such as temperature, humidity, styrene levels to threshold limits, fume/dust extraction systems and equipment)			
		2.6	Explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken			
		2.7	Explain how to interpret drawings/ lay up manuals, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.8	Describe the quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification), and the completion of such documents			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the conventions and terminology used for resin flow infusion techniques (such as material orientation, material identification, distribution media, resin viscosity, flow paths, ply lay-up, vacuum bagging, resin and fibre weights/volumes, gel times, exotherm, bleed plies)			
		2.10	Describe the different types of resins, reinforcement, catalysts, accelerators and additives used, and their applications			
		2.11	Describe the different types of fibre materials, fabrics, orientations, their combinations and applications			
		2.12	Describe the different core and insert materials, and their merits			
		2.13	Describe the different types of resin distribution media, and their merits			
		2.14	Describe the visual identification of both raw and finished composite materials			
		2.15	Describe the different types of production tooling used for producing composite mouldings, and their applications			
		2.16	Describe the identification and rectification of defects in production tooling			
		2.17	Describe the building up laminates (including orientation and balance of plies), to minimise spring and distortion in composite mouldings			
		2.18	Describe the methods of preparation for patterns, moulds and tooling (including the correct selection and use of surface sealers and release agents)			
		2.19	Describe the methods for handling, preparation and application of the reinforcing fibres and fabrics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Describe the correct methods of storage and handling of ancillary and consumable materials			
		2.21	Describe the methods used in the positioning and application of the resin distribution media			
		2.22	Explain how to estimate/calculate resin volume/weight required to saturate the reinforcing fibres			
		2.23	Describe the mixing ratios for gel coats, resins and catalysts, and the associated working times			
		2.24	Describe the tools and equipment used in the resin flow infusion activities, and their care, preparation and control procedures			
		2.25	Describe the operation and importance of a vacuum check before the infusion starts			
		2.26	Describe the problems that can occur during the resin flow infusion process (including defects such as contamination, incomplete wet out, vacuum leaks, flow restrictions)			
		2.27	Describe the different methods and techniques used to cure composite mouldings including cure cycles and the need for monitoring			
		2.28	Describe the procedures and methods used for removing mouldings from production tooling			
		2.29	Describe the identification of defects in the composite mouldings (such as de-lamination, voids, contaminants)			
		2.30	Describe the care and safe handling of production tooling and composite mouldings throughout the production cycle			
		2.31	Describe the production controls used in the work area, and actions to be taken for unaccounted items			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.32	Explain how the composite component relates to its own quality documents and the production tooling used			
		2.33	Describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 156: Producing Composite Assemblies

Unit reference number: Y/504/6436

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce composite assemblies. 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 F.

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 composite assemblies	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 assembly activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations • Follow job instructions, assembly drawings and procedures • Ensure that all power tool cables, extension leads or air supply hoses are in a safe and serviceable condition • Check that tools and measuring instruments to be used are within calibration date • Use lifting and slinging equipment in accordance with health and safety guidelines and procedures (where appropriate) • Ensure that the components used are free from foreign objects, dirt or other contamination • Return all tools and equipment to the correct location on completion of the assembly activities			
		1.3	Plan the composite assembly activities before they start them			
		1.4	Obtain and prepare the appropriate components, tools and equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Carry out all of the following when preparing for the assembly activity: • Check that mouldings are correct and complete • Check for any defects in the mouldings • Check that components are correct and complete • Select the correct equipment for the activity • Check availability of ancillary materials required • Check that equipment is suitable for use • Identify and protect the moulding and components in the work area			
		1.6	Use the appropriate methods and techniques to assemble the components in their correct positions			
		1.7	Produce one of the following types of composite assembly: • Trial assemblies • One-off assemblies • Batch assemblies • Assembly line			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Produce composite assemblies that incorporate two of the following features: • Loose fit tolerances • Close fit tolerances • Non-permanent fixing • Permanent fixing • Shape location • Return joins • Overlap joins • Joggle joins • Strap joins			
		1.9	Produce composite assemblies that require two of the following: • Fettling • Pinning • Clamping • Trial fitting • Aligning • Tongue and groove • Assembly jigs • Assembly sequences • Datum points • Orientation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Produce composite assemblies, using two of the following mechanical joining methods: • Thread inserts • Quick-release fasteners • Mechanical fasteners • Blind fasteners • Adhesive bonding • Anchor nuts • Pinning • Rivets • Thermo welding • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce composite assemblies that must include two of the following composite components: • Trim • Closing panels • Body panels • Tubes • Structural • Aerodynamic • Core materials • Sections • Castings/covers • Housings • Inserts • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Produce composite assemblies that must include two of the following non-composite components: • Brackets • Fixtures • Fittings • Metal components • Non metallic components • Trim • Finishing tapes • Memory foam • Labels/decals • Surface films • Edge bands • Other (to be specified)			
		1.13	Secure the components, using the specified methods and securing devices			
		1.14	Check the completed assembly to ensure that all operations have been completed, and that the finished assembly meets the required specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Produce a range of assemblies which comply with all of the following standards: • Assemblies are dimensionally accurate within specification requirements • All components are correctly assembled and aligned, in accordance with the specification • All fastenings are correctly fitted and are secure (where applicable) • Moving parts are correctly adjusted and have appropriate clearances (where applicable) • Finished assemblies meet the required shape/geometry, and are free from defects (such as square, straight, angle, free from twists)			
		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 composite assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce composite assemblies	2.1	Describe the health and safety precautions to be taken, and procedures to be used, when working with composite materials, consumables, tools and equipment in the specific work area			
		2.2	Describe the hazards associated with carrying out composite assembly activities, and with the composite materials, consumables, tools and equipment, and how to minimise these in the work area			
		2.3	Describe the protective equipment (PPE) that is needed for personal protection and, where required, the protection of others			
		2.4	Describe the application of COSHH regulations in relation to the storage, use and disposal of composite materials and consumables			
		2.5	Describe the specific environmental conditions that must be observed when producing composite mouldings (such as temperature, humidity, fume/dust extraction systems and equipment)			
		2.6	Explain how to use and extract information from drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken			
		2.7	Explain how to interpret drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.8	Describe the quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents			
		2.9	Describe the conventions and terminology used for assembly activities (such as types metric and imperial threads, rivet specifications, clearances, types of fittings)			
		2.10	Describe the types of component trimming/cutting methods and preparation methods available			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Describe the visual identification of cured composite materials			
		2.12	Describe the assembly operations and their sequence			
		2.13	Describe the methods for handling composite assemblies throughout the assembly activities			
		2.14	The identification and rectification of defects in composite assemblies			
		2.15	Describe the tools and equipment used in assembly activities, and their care, preparation and control procedures			
		2.16	Describe the problems that can occur with the production of the composite assemblies			
		2.17	Describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 157: Producing Components by Rapid Prototyping Techniques

Unit reference number: D/504/6437

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 components by rapid prototyping techniques. 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 F.

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 components by rapid prototyping techniques	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Prepare the system and data for operation by carrying out all of the following: • Check that all the equipment is in a safe and usable working condition (such as undamaged, safety devices in place and operational) • Obtain sufficient quantities of all required materials and checking use by dates • Obtain all the necessary data, documentation and specifications for the components to be produced • Download the correct build files to produce the components • Check that data files are suitable for the application • Apply safe working practices and procedures at all times			
		1.3	Select the type of rapid prototyping machine to be used			
		1.4	Identify material specification before they start			
		1.5	Check material availability			
		1.6	Load/input the program file to the machine controller, and check the program for errors using the approved procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Check that all safety mechanisms are in place, and that the equipment is set correctly for the required operations			
		1.8	Set up the rapid prototyping equipment, to include carrying out all of the following: • Powering up the equipment and activating the appropriate software • Importing files from system • Loading materials • Checking/setting equipment operating parameters			
		1.9	Produce the required components, using appropriate manufacturing methods and techniques			
		1.10	Produce components using one of the following types of rapid prototyping equipment: • Stereo lithography apparatus (SLA) • Fused deposition modelling (FDM) • Selective laser sintering (SLS) • Direct metal laser sintering (DMLS) • Selective laser melting (SLM) • 3D printing (thermojet) • Laminated object manufacturing (LOM) • Digital light process (DLP) • Other specific prototyping equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Produce components made from one of the following materials: • Photo-polymer resin • Plastics • Wax • Metal • Laminated paper • Polyurethane			
		1.12	Unload the components from the rapid prototyping equipment, to include carrying out all of the following: • Removing the part from remaining raw material • Removing the part from supports (where applicable) • Pre-cleaning • Infiltrate (when required) • Packing to avoid damage • Storing • Complete all relevant documentation (such as material batch number, CAD file name, date of manufacture, operator's name, quality report)			
		1.13	Produce components which comply with all the following quality and accuracy requirements: • Correctly formed • Checked against model specification • Free from manufacturing defects • Satisfactory visual appearance/finish			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	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			
		1.15	Shut down the equipment to a safe condition on completion of the rapid prototyping activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce components by rapid prototyping techniques	2.1	Describe the safe working practices and procedures to be observed when setting and operating rapid prototyping equipment (such as care when working with laser beams; machine guards; ventilation and fume extraction; machine safety devices)			
		2.2	Explain how to start and stop the machine in normal and emergency situations, and how to close the machine down on completion of activities			
		2.3	Describe the hazards associated with operating rapid prototyping machines (such as dangers from laser beams; live electrical components; materials; fumes/gases), and how they can be minimised			
		2.4	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy			
		2.5	Describe the importance of ensuring that the machine is isolated from the power supply before working with the equipment			
		2.6	Describe the methods and procedures used to minimise the chances of infecting a computer with a virus			
		2.7	Describe the implications if the computer they are using does become infected with a virus and who to contact if it does occur			
		2.8	Describe the basic principles of rapid prototyping relevant to the machine being used			
		2.9	Describe the benefits and limitations of the different types of rapid prototyping equipment			
		2.10	Describe the rapid prototyping techniques used, and how to differentiate between the different processes (including the advantages and disadvantages)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Describe the finishing techniques that are required, and how they are applied to the different rapid prototyping processes			
		2.12	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			
		2.13	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.14	Explain how to import appropriate files (STL) from a data system into the rapid prototyping software			
		2.15	Explain how to set up the rapid prototyping equipment to achieve the component specification (such as electrical and optical conditions; focal distance; forming speed)			
		2.16	Explain how to place the machine in the correct operating mode, and how to access the program edit facility, in order to make minor adjustments for production			
		2.17	Describe the different materials used to produce components by the rapid prototyping process, and how the various materials used will affect the operating conditions that can be applied relevant to the machine being used			
		2.18	Describe the reasons why certain materials are suitable for producing components by the rapid prototyping process			
		2.19	Describe the importance of knowing when components can be unloaded from the machine in relation to the different rapid prototyping processes			
		2.20	Describe the importance of handling and storing materials correctly and linking to the correct documentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.21	Describe the problems and defects that can occur in components produced by rapid prototyping processes, how these can occur, and what preventative actions are needed to overcome them			
		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 machine in a safe condition on completion of the rapid prototyping activities (such as correctly isolated, operating programs closed or removed, cleaning the machine, and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 158: Producing and Preparing Sand Moulds and Cores for Casting

Unit reference number: H/504/6438

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce and prepare sand moulds and cores for casting. 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 F.

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 and prepare sand moulds and cores for casting	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 sand moulding and core making activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions and moulding procedure specifications • Use the correct tools and equipment for the moulding activity • Follow the defined moulding techniques and procedures • Ensure that the moulds produced meet the required specification for quality and accuracy • Return all tools and equipment to the correct location on completion of the moulding and core making activities			
		1.3	Plan the sand moulding and core making activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Prepare sand and produce moulds/cores from two of the following types of sand: • Greensand (naturally or synthetically bonded) • Chemically bonded gas activated • Chemically bonded resin/catalyst • Resin bonded heat activated • Other type of sand (specify)			
		1.5	Prepare the sand for the mould/core making activities, to include carrying out all of the following: • Measuring out the required amounts of sand for the operations being performed • Adding the correct additives in the correct ratios • Performing the mixing and milling operations safely and correctly • Testing that the finished sand meets requirements (such as moisture, permeability, viscosity and strength)			
		1.6	Obtain and prepare the appropriate tools, equipment and materials			
		1.7	Prepare the mould/coremaking equipment for use, to include carrying out both of the following: • Visually inspecting the pattern or core box for damage • Applying release agents to the pattern or core box (as applicable)			
		1.8	Ensure that the patterns are correctly prepared, sited and positioned ready for the moulding process			
		1.9	Ensure that the sand is correctly mixed and milled			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Test the prepared sand to ensure that it meets the specification requirements			
		1.11	Carry out the sand moulding and core making activities, using the correct methods and techniques			
		1.12	Produce moulds and cores to the required specification			
		1.13	Produce full or half cores from both of the following types of core box: • Solid turnout boxes • Split boxes			
		1.14	Produce cores using two of the following techniques: • Hand tucking and ramming • Mechanical assistance with core consolidation • Curing and drying the cores • Inserting reinforcements (such as wire or bars) • Incorporating vents (such as pre-formed, manually applied)			
		1.15	Produce drag and cope mould parts from patterns which are either: • Loose flat back and split type Or • Plated flat type and split type			
		1.16	Produce mould parts, using one of the following methods: • Use of moulding boxes • Boxless, using mould location devices			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Assemble and finish the moulds (which must include at least one core), by carrying out all of the following: • Inserting the cores (such as horizontal or vertical location) • Securing the cores (using print locations, adhesives or mechanical devices) • Forming runner, riser and feeder systems on the mould (such as cut and formed manually, reformed with fixed formers, preformed with loose formers) • Inserting filters, chills or feeder sleeves as necessary • Carrying out any repairs to the moulds/cores (such as patching up greensand moulds or cores, repairing rigid sand moulds or cores using adhesives) • Applying mould coatings/dressings (such as by spray, flood, brush or dry)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Prepare and close the moulds ready for casting, to include carrying out all of the following: • Cleaning and removing foreign bodies and surplus sand from the mould cavity • Carrying out visual checks on moulds for completeness (including all cores and freedom from cracks) • Checking that runner/riser/feeder systems are clean, connected and complete • Applying mould sealant, where appropriate • Locating the moulds (using pins, rebates, diabolos or cores, as appropriate) • Closing moulds manually or by mechanical means • Securing the moulds using clamps/clips and/or weights			
		1.19	Produce sand moulds which meet all of the following quality and accuracy standards: • Complete and free from obvious defects (such as cracks, broken or damaged mould surfaces) • Meet the required specification (such as shape, dimensional accuracy) • Free from soft spots			
		1.20	Dispose of surplus material safely and correctly			
		1.21	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			
		1.22	Leave the work area in a safe condition on completion of the moulding and core making activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce and prepare sand moulds and cores for casting	2.1	Describe the specific safety precautions to be taken when producing and preparing sand moulds for casting (such as wearing full protective clothing and protective equipment; ensuring adequate ventilation/fume extraction and the elimination of slipping or tripping hazards)			
		2.2	Describe the COSHH regulations that apply when dealing with chemically bonded sands, surface coatings, release agents and surface dressings			
		2.3	Describe the hazards associated with producing and preparing sand moulds and cores for casting, including exposure to dust and fumes, and how they can be minimised			
		2.4	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy			
		2.5	Describe the types of sands and sand binder systems used in core and mould making activities (such as silica, olivine, chromite and zircon sands and green sand, and chemically prepared sands such as gas activated, resin/catalyst activated types)			
		2.6	Describe the various types of sand additives which are suitable for the sand and type of metal to be cast (such as chemicals, resins, catalyst, esters, breakdown agents, inhibitors, refractory materials and bentonite)			
		2.7	Describe the methods used to prepare greensand and chemically or resin bonded sands, using manual and machine methods			
		2.8	Explain how to calculate the amount of sand required, and the ratios of sand additives that may be required			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the effects on the prepared materials if the base product is passed the 'use by' date, is added to the mix at the wrong time or at the wrong temperature, too little or too much is added to the mix, or the mixture is over mixed or over milled			
		2.10	Describe the procedures for testing the prepared sand for moisture content, strength, viscosity and freedom from foreign bodies			
		2.11	Describe the various types of core box that are used (such as solid turnout boxes, split boxes, multi-part, strickle and boxes containing loose pieces or prints)			
		2.12	Describe the different pattern types used in the moulding process (such as loose and plated), and the jointing methods that are required for the different pattern types			
		2.13	Describe the methods of positioning the patterns for correct orientation; centralising and supporting the pattern in the moulding box			
		2.14	Describe the application and use of pattern release agents and core coatings or dressings			
		2.15	Describe the methods of filling moulds and core boxes and compacting sands (such as manual filling and compacting and machine filling and compacting), and the precautions to be taken to ensure that the pattern doesn't become displaced during the filling and compacting activities			
		2.16	Describe the methods of reinforcement and venting of the moulds and cores (such as using vent wire and rods, pre-formed shapes, pre-formed wax or nylon) and placement and use of chills and filters			
		2.17	Describe the methods of mould stripping and pattern rapping; removing the pattern without damaging the mould cavity or pattern			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Describe the methods of cutting and forming downsprues, ingates, riser and feeder systems			
		2.19	Describe the various methods of drying and curing cores (such as the use of ovens, CO2 gas and catalytic action)			
		2.20	Explain why it is necessary to check the moulds and cores prior to commencing core setting and mould closing operations			
		2.21	Describe the defects that can occur in the moulds and cores (such as cracked surfaces, exposed reinforcements, friable surfaces, broken or weak mould and core sections, incomplete mould or cores, damaged or broken core prints and core locations, mould location devices missing or distorted, uncoated moulds or cores)			
		2.22	Describe the methods of rectifying defects in moulds or cores, by patching and gluing			
		2.23	Explain how to prepare the moulds, and the methods of locating and setting cores in the moulds (using core prints, chaplets, glues and sprigs)			
		2.24	Describe the methods of closing and securing the moulds (using weights or clamps), and the dangers/effects of using moulds which are incorrectly closed or clamped			
		2.25	Explain why it is important to keep the pattern and core box equipment clean and free from damage, to practice good housekeeping of moulding tools and equipment, and to maintain a clean working area			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.26	Explain when to act on their own initiative and when to seek help and advice from others			
		2.27	Describe the importance of leaving the work area in a safe and clean condition on completion of the sand moulding and core making activities (such as returning tools and 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 159: Producing and Preparing Molten Materials for Casting

Unit reference number: K/504/6439

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce and prepare molten materials for casting. 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 F.

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 and prepare molten materials for casting	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Prepare the furnace for operation, to include all of the following, as appropriate to the equipment used: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, melting specifications and procedures • Ensure that services/power supplies are connected, and operational and start-up procedures are initiated • Check that guards/screens are in position and operational • Check that emergency stop controls are operational • Check that visual display panels are operational • Ensure that supply and discharge outlets are clear and operational • Check that furnace linings and equipment are in a safe and usable condition • Shut down the furnace to a safe condition on completion of the melting activities • Return all tools and equipment to the correct location on completion of the melting activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Plan the material melting activities before they start them			
		1.4	Set up the operating conditions of the melting furnace, making any necessary adjustments to maintain satisfactory operating conditions			
		1.5	Obtain the required charge materials, and check that they are in a suitable condition to use			
		1.6	Prepare the materials used in the casting process, and check that they are to the required specification, to include all of the following: • Selection and preparation of the base charge materials (such as scrap, ingots, returns) • Selection and preparation of any additives and additions (such as fluxes, alloys, trimming additions, inhibitors, de-oxidisers, colour – relevant for plastics and ceramics only) • Selection and preparation of any fuel charge materials			
		1.7	Produce molten materials, using one of the following types of furnace: • Cupola • Induction (high or medium frequency) • Rotary • Bale out • Lift out crucible • Tilting crucible • Direct or indirect arc • Other melting furnaces (specify)			
		1.8	Start up the furnace, using approved procedures, and add the materials at the appropriate time			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Produce molten material from one of the following: • Ferrous alloys • Non-ferrous alloys • Plastic/polymer • Liquid ceramics			
		1.10	Carry out appropriate tests of the molten material at suitable intervals, in order to achieve the material specification			
		1.11	Monitor the melting process, to include all of the following: • Measuring the melt temperature (such as visually, immersion pyrometer, visual display units) • Adjusting the operating conditions of the melting furnace (such as melting rate by changing the power or fuel input) • Making necessary additions to the melt • Where applicable, informing appropriate people of non-conformance of the molten material • Confirming that the melt is ready for casting			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Carry out treatment of the melting/molten material, to include two of the following: • Adding deoxidising agents to charge material • Adding oxidising agents to charge material • Adding alloying elements • Adding nucleants • Deoxidising molten material • Modification of molten material • Adding cover fluxes to charge material • Degassing molten material • Grain refining of molten metal • Removal of slag/oxide skins/impurities			
		1.13	Take samples of the molten material, for one of the following types of test: • Carbon equivalent measurement • Chemical analysis • X-ray fluorescence spectrometry (XRF) • Spark emission spectrometry • Wedge tests • Tensile tests • Hydrogen gas content			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Discharge the molten material from the furnace into one of the following: • Holding furnace • Prepared pouring ladles • Prepared treatment ladles • Other holding/casting vessels/pigs			
		1.15	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			
		1.16	Dispose of waste and excess materials safely and correctly			
		1.17	Leave the work area in a safe and tidy condition on completion of the melting activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce and prepare molten materials for casting	2.1	Describe the specific safety precautions to be taken when working with melting furnaces and molten materials (such as wearing full protective clothing and protective equipment; minimisation of dust and fumes, ensuring adequate ventilation/fume extraction, and the elimination of slipping or tripping hazards)			
		2.2	Describe the COSHH regulations that apply when dealing with charge materials, furnace additions and additives			
		2.3	Describe the hazards associated with working with melting furnaces and molten materials (such as splashes and spills of molten materials; dust and fumes; handling hot and heavy materials), and how they can be minimised			
		2.4	Describe the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy			
		2.5	Describe the emergency procedures to be followed in the event of a malfunction of any melting furnace, holding ladle or pouring vessels in use			
		2.6	Explain why it is important to keep the furnace and melting equipment clean and free from damage, to practice good housekeeping of tools and equipment, and to maintain a clean and unobstructed working area			
		2.7	Describe the importance of following job instructions and defined casting procedures			
		2.8	Describe manual lifting techniques and requirements on acceptable weights to be handled by hand			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the various types and applications of material melting furnace that are used (such as rotary and cupola types; crucible types such as lift out, push up, bale out, and tilting; electric furnaces such as induction arc and resistance)			
		2.10	Explain how to check that the furnace and its linings are in a safe and serviceable condition			
		2.11	Explain how to identify the various charge materials they are to use in producing the cast components			
		2.12	Describe the various forms of materials used in the melting process (such as ingots, granules, powders, bought-in scrap and scrap components for re-melting)			
		2.13	Explain why it is necessary to check the amounts of materials, prior to commencing melting operations			
		2.14	Describe the effects on the melting operation and the molten material if the base materials are out of date, different in content from the specification requirements, added to the furnace/melt at the wrong time or temperature, or when wet or damp, or if too little or too much is added to the melt			
		2.15	Describe the reasons why furnace start-up procedures are performed, and why these must always be adhered to			
		2.16	Describe the methods of charging the furnaces, and the precautions to be taken when adding materials to molten liquids			
		2.17	Describe the reasons for preheating some materials prior to furnace charging			
		2.18	Describe the additions that are made to the material/metals/alloys to aid the melt or produce and/or correct the material specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Explain how to establish melting and pouring temperatures and how to set the furnace/crucible controls to give the required melt conditions			
		2.20	Describe the methods of checking when the molten material is at the required temperature (such as by visual means, by use of fixed and optical pyrometers)			
		2.21	Describe the actions to take if the molten material is outside the specified temperature range			
		2.22	Describe the methods of checking chemical composition by spectrographic or chemical analysis of samples from the melt			
		2.23	Describe the defects in castings which can be directly related to the use of molten material which is outside the specified temperature range, or which is untreated, or is treated but casting is delayed, or to the use of un-skimmed metal/material			
		2.24	Explain when to act on their own initiative and when to seek help and advice from others			
		2.25	Describe the importance of cleaning the furnace/crucible in accordance with the furnace/crucible manufacturer's instructions			
		2.26	Describe the importance of leaving the work area in a safe and clean condition on completion of the melting activities (such as returning tools and 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 160: Producing Cast Components by Manual Means

Unit reference number: D/504/6440

QCF level: 2

Credit value: 13

Guided learning hours: 65

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce cast components by manual means. 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 F.

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 cast components by manual means	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 manual casting activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Ensure that the work area is clear of obvious hazards • Follow job instructions, casting specifications and procedures • Confirm that the required material handling equipment is available, and is in a safe and usable condition • Check that any required ancillary equipment is operational (such as fume extraction equipment, inhibitor gas supply and molten material treatment equipment) • Return all tools and equipment to the correct location on completion of the casting activities			
		1.3	Plan the casting activities before they start them			
		1.4	Ensure that the moulds are correctly prepared, sited and positioned ready for the casting process			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Check that the moulds/dies are complete and ready for casting, to include carrying out all of the following checks: • Appropriate clamps and/or weights are in position • Downsprues are marked, and pouring bushes/basins are in position and free from obstructions • Any necessary filters are in place • Access to the moulds/dies/shells is clear • Containers for surplus molten material are prepared and positioned conveniently in relation to the mould/dies/shells			
		1.6	Prepare the molten material ladles/handling equipment, to include carrying out all of the following: • Checking that the ladle is the correct size for the amount of material to be poured • Checking that the ladle/lining is in a safe condition and is complete and dry • Ensuring that any necessary pre-heating has been carried out			
		1.7	Ensure that the molten material is at the required casting temperature			
		1.8	Ensure that the molten metal conforms to the required specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Collect the molten material and carry out all of the following melt checks/procedures, as appropriate to the melt: • Making temperature checks • Take samples for chemical composition checks • Skimming of the melt to remove slag and other impurities • Applying coagulant material • Using inhibitor materials or gas			
		1.10	Collect and transport the molten material safely and correctly from the furnace			
		1.11	Use the appropriate technique to pour the molten material into the moulds			
		1.12	Transfer and pour the molten material into moulds/dies, using one of the following: • Single operation • Double pour			
		1.13	Produce cast components from one of the following: • Ferrous alloys • Non-ferrous alloys • Plastics/polymers • Liquid ceramics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Produce cast components which contain two of the following features: • Faces that are flat, square or angled to each other • Have round, curved or contoured surfaces • Have slots or holes			
		1.15	Cast molten materials into one of the following: • Sand moulds • Metal moulds/dies • Shells (investment process)			
		1.16	Produce cast components to the required specification			
		1.17	Produce cast components which comply with all of the following: • Complete and free from obvious defects (such as blow holes, impurities, cracks, damaged or deformed surfaces) • Meet the required specification (such as shape, dimensional accuracy) • Meet company standards and procedures			
		1.18	Dispose of surplus material safely and correctly			
		1.19	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			
		1.20	Leave the work area in a safe condition on completion of the casting activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce cast components by manual means	2.1	Describe the specific health and safety precautions with regard to handling and transporting molten materials (such as minimisation of dust and fumes, wearing full personal protective clothing and protective equipment, and the elimination of slipping or tripping hazards)			
		2.2	Describe the hazards associated with pouring molten materials (such as splashes and spills of molten materials; fumes; handling hot and heavy materials), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be used; how to obtain it and check that it is in a safe and usable condition			
		2.4	Describe the importance of ensuring that fume extraction equipment is operating effectively, and that good housekeeping and fire prevention procedures are observed			
		2.5	Describe the importance of following job instructions and defined casting procedures			
		2.6	Describe the emergency procedures to be followed in the event of a furnace failure or malfunction in any vessel used to transport and cast molten materials			
		2.7	Describe manual lifting techniques and requirements on acceptable weights to be handled by hand			
		2.8	Describe the various methods of collecting molten material from the furnace or ladle, and the different types of vessels used to hold ferrous and non-ferrous metal alloys, plastic/polymer or liquid ceramic materials			
		2.9	Explain why it is sometimes necessary for the ladles to be preheated, and the effects of using wet or untreated/cold ladles			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain why it is important to keep the ladles and molten material handling equipment clean and free from damage, to practice good housekeeping of tools and equipment, to maintain a clean and unobstructed working area, and to dispose of surplus molten material into prepared containers or areas			
		2.11	Describe the causes of surface impurities on molten materials			
		2.12	Describe the reasons why some impurities float on some materials and sink in others			
		2.13	Describe the methods of removing impurities from the surface of the molten materials			
		2.14	Describe the effects on the quality of the cast components if impurities are allowed to enter the mould/die cavity			
		2.15	Explain why the temperature of the molten material should be taken prior to the transfer from holding ladle to pouring vessel			
		2.16	Describe the actions they need to take if the molten material is outside the required temperature range			
		2.17	Describe the checks to be carried out on the moulds/dies/shells prior to casting (such as checking that clamps or weights are correctly positioned, downsprues are marked and pouring bushes/basins are in position, necessary filters are in place and access to moulds is clear)			
		2.18	Describe the importance of using the correct pouring techniques and of casting at the correct speed			
		2.19	Describe the methods of pouring molten material for single operations or double pour applications			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Describe the defects in cast components which can be directly related to using the incorrect pouring technique, incorrect material temperature, or untreated molten material			
		2.21	Explain how to dispose of surplus molten material (such as returning material to furnace or receiver; pouring into prepared sand beds or ingot moulds)			
		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 in a safe and clean condition on completion of the casting activities (such as returning tools and 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 161: Fettling, Finishing and Checking Cast Components

Unit reference number: H/504/6441

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 fettle, finish and check cast components. 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 F.

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	Fettle, finish and check cast components	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, in preparation for the fettling and finishing activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Ensure that the work area is clear of obvious hazards • Obtain any necessary personal protective equipment, and check that it is in good order • Follow job instructions, fettling and finishing specifications and procedures • Check that the tools and equipment they need are in a safe, tested and usable condition (such as extension leads, hoses, pneumatic equipment, hand tools) • Ensure that dust extraction and air filtering equipment is functioning correctly • ensure that all guards and screens are in place and in good order • Return all tools and equipment to the correct location on completion of the fettling and finishing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Plan the fettling, finishing and checking activities before they start them			
		1.4	Remove the cast components from the moulds/dies, using appropriate tools and techniques			
		1.5	Remove cast components from moulds, and carry out all of the following, as appropriate to the castings produced: • Knocking castings out of the moulds • Removing castings from the moulding material • De-coring • Removing runner/riser/feeder systems			
		1.6	Clean the cast components and, where appropriate, remove any cores			
		1.7	Fettle and finish the castings to remove excess material			
		1.8	Fettle and finish cast components which have been produced from one of the following materials: • Ferrous alloys • Non-ferrous alloys • Plastics/polymers • Liquid ceramics			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Fettle and finish cast components, to include the use of three of the following: • Hand tools (such as wire brushes, knives, scrapers, saws, files) • Pneumatic chipping hammers • Slitting saw • Linishers • Thermal cutters • Laser cutters • Disc/angle grinder • Pedestal grinders • Band saw • Other methods (specify)			
		1.10	Fettle and finish cast components that have four of the following shapes/profiles: • Circular • Square • Irregular • Projections • Curved or tapered profiles • Internal cavities			
		1.11	Check the casting for visual defects			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Visually check cast components, and identify defects including six of the following: • Incomplete or deformed castings • Variable metal section thickness • Incorrect profiles • Swells • Cross joints • Blow holes • Impurity inclusions • Shrinkage • Cracks • Surface porosity • Misplaced cores • Mis-runs/cold shuts • Undercuts on runners/risers/feeders • Poor ingate or feeder cut-off • Excessive flash			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Complete dimensional checks on cast components, to include checking five of the following features: • Flatness • Squareness • Concentricity • Straightness • Taper • Profiles • Angularity • Roundness			
		1.14	Dispose of waste material safely and correctly, in line with organisational procedures			
		1.15	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			
		1.16	Leave the work area in a safe condition on completion of the fettling and finishing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to fettle, finish and check cast components	2.1	Describe the specific health and safety precautions which must be taken when fettling and finishing cast components (such as wearing full protective clothing and protective equipment, using screens and dust extraction equipment)			
		2.2	Describe the hazards associated with fettling and finishing cast components (such as handling hot castings, airborne sparks and metal particles, sharp edges on components, using power tools and abrasive discs, handling heavy materials, breathing in dust and fumes, noise and vibration), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be used; how to obtain it and check that it is in a safe and usable condition (such as eye and ear protection, overalls, full face masks, breathing equipment)			
		2.4	Describe the importance of ensuring that fume extraction equipment is operating effectively, and that good housekeeping and fire prevention procedures are observed			
		2.5	Describe the importance of following job instructions and defined fettling procedures			
		2.6	Describe manual lifting techniques and requirements on acceptable weights to be handled by hand			
		2.7	Describe the emergency procedures to be followed in the event of a malfunction of any of the equipment that they use			
		2.8	Describe the factors which govern the cooling times of cast components in the moulds, prior to knocking out			
		2.9	Describe the different methods that can be used to knock out and de-core moulds and shells, and how to avoid damaging the moulds and cast components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how to clean the castings and remove any cores, and the tools and equipment that can be used			
		2.11	Describe the casting defects which can be directly related to the use of incorrect methods for the removal of runners/risers/feeders from castings during the knocking out process			
		2.12	Explain how to remove runners and associated systems by braking off or cutting off			
		2.13	Explain how to fettle castings to remove joint line flash, runner and feeder stubs, and the amount of material that should be removed			
		2.14	Describe the various hand and power tools that are used to carry out the fettling activities (such as hammers and chisels, files, grinding machines/discs, linishing equipment, knives and scrapers, thermal or laser cutters)			
		2.15	Describe the checks to be made on the tools and equipment to ensure that they are in a safe and usable condition			
		2.16	Describe the various workholding methods and devices used to hold the cast components during the cleaning and fettling activities			
		2.17	Describe the effect on casting quality of incorrectly fettling of castings (such as under or over-dressing)			
		2.18	Describe the reasons why different types of tools and equipment are used to fettle ferrous, non-ferrous and non-metallic cast components			
		2.19	Explain why it is important to keep the equipment clean and free from damage, to practice good housekeeping of tools and equipment, and to maintain a clean working area			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Describe the different equipment that can be used to assist with the visual inspection of cast components (such as electronic scanning units, shadowgraph units, magnifying glasses or dye-penetrant equipment)			
		2.21	Describe the different types of defects which can be detected through visual inspection (such as incomplete or deformed castings, blow holes, impurity inclusions, mis-runs/cold shuts, shrinkage, surface/sub-surface porosity, cracks, undercuts on runners/risers/feeders, poor ingate or feeder cut-off, swells, cross joints, scabs, misplaced cores, variable metal section thickness and excessive flash)			
		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 in a safe and clean condition on completion of the fettling activities (such as returning tools and 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 162: Finishing Surfaces by Applying Coatings or Coverings

Unit reference number: M/504/6443

QCF level: 2

Credit value: 9

Guided learning hours: 41

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to finish surfaces by applying coatings or coverings. 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 F.

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	Finish surfaces by applying coatings or coverings	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 surface finishing activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions and finishing specifications and procedures • Check that the tools and finishing equipment that they need (such as brushes, rollers spray equipment, hoses, hand tools) are in a safe and usable condition • Where appropriate, ensure that dust extraction and air filtering equipment is functioning correctly • Provide a suitable means for curing the coating (such as heating, or air supply to assist curing)			
		1.3	Plan the surface finishing activities before they start them			
		1.4	Prepare the work surfaces in readiness to receive the appropriate coating or covering			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Prepare the surface to be finished, to include carrying out six of the following: • Stripping old finishes • Cleaning/degreasing • Mechanical surface preparation • Flattening down • Masking up • Filling • Sealing • Pre-surface treatments • Re-activating treatments			
		1.6	Prepare the required coating or covering materials for use			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Prepare the coating or covering materials for application, to include carrying out all of the following: • Obtaining the correct types and quantities of materials • Ensuring that the correct mixing ratios are adhered to • Checking that the prepared coating material is of the correct viscosity/consistency • Ensuring that the prepared material has been left for the required induction period (if applicable) • Ensuring that the prepared material is at the temperature recommended for application Plus one of the following: • Mixing base materials (such as primers, sealers) • Mixing finishing materials (such as final colour, stain, polish) • Preparing adhesives • Preparing cleaning materials (such as degreasing)			
		1.8	Apply the coatings or coverings to the surfaces, using appropriate techniques and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Apply coatings or coverings to two of the following materials: • Wood based • Ferrous material • Non-ferrous material • Composite (such as glass fibre, Kevlar) • Pre-painted surfaces • Ceramic • Plaster/brick/concrete			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Apply liquid coatings such as primer/undercoat and finishing coats, using four of the following finishing materials: • Sanding sealer • Water based paints • Oil/alkyd based paints • Synthetic paints • Two component polyurethane paint • Petroleum based • Polyurethane varnish • Lacquer • Stain • Wax • French polish • Temporary protective coatings • Mastics • Bituminous or rubber paints • Other special finishes (specify)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	...continued Or Apply coverings which are decorative, insulative or protective, to include three of the following: • Paper based • Polymer based • Composite • Metallic • Wood • Ceramic			
		1.11	Apply finishes to a range of surfaces, to include four of the following: • Flat • Horizontal • Vertical • Overhead • Curved or cylindrical • Corners (such as outside corners, edges, 'obscured' corners)			
		1.12	Check that the finished surface achieves the required characteristics and meets the finishing specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Check that the completed surface finishes or coverings comply with all of the following: • The final finish or covering is in line with the specification or job requirements • The final finish achieves acceptable colour match and, where applicable, gloss levels • The finished surface is free from defects (such as runs, drips, bubbles, unevenness) • The finished surface meets customer/company requirements			
		1.14	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			
		1.15	Tidy up the work area on completion of the coating or covering activities, to include carrying out all of the following: • Disposing of excess or unused materials, in accordance with approved procedures • Cleaning containers to be reused • Disposing of non-reusable containers, in accordance with approved procedures • Cleaning and returning all tools and excess materials to their designated location • Disposing of waste materials and used solvents, in accordance with approved procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Dispose of waste material safely and correctly, in line with organisational procedures			
		1.17	Leave the work area in a safe condition on completion of the finishing activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to finish surfaces by applying coatings or coverings	2.1	Describe the specific health and safety precautions which must be taken when preparing surfaces and applying surface coatings and coverings (such as wearing protective clothing and protective equipment, using fume and dust extraction equipment)			
		2.2	Describe the hazards associated with preparing surfaces and applying surface coatings and coverings (such as using chemicals for cleaning activities, dust and fume inhalation, use of power tools and abrasive discs; including the hazard information to be found in manufacturers' data sheets), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be used; how to obtain it and check that it is in a safe and usable condition (such as eye protection, overalls, face masks, breathing equipment)			
		2.4	Describe the requirements for working in confined spaces, and safe systems of work (including required air quantities (RAQs) and local exhaust ventilation (LEV) to maintain safe conditions; the provision of adequate and safe lighting and avoidance of sources of ignition			
		2.5	Describe the importance of ensuring that fume extraction equipment is operating effectively, and that good housekeeping and fire prevention procedures are observed			
		2.6	Describe the importance of following job instructions and defined surface finishing procedures			
		2.7	Describe the surface preparation methods and techniques to be undertaken, prior to applying the coatings or coverings (such as carrying out repairs to the surface or making good any damaged or defective surfaces; stripping off old materials; using solvents to remove dirt and grease; masking surfaces to prevent overspill/spray)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.8	Describe the specific coatings or coverings to be used, and the types of surfaces for which they are best suited (such as liquid coatings, coverings in sheet, roll or tile form)			
		2.9	Explain how to determine quantities of finishing materials required and, where applicable, mixing materials to achieve the required colour, viscosity or adhesive strength			
		2.10	Describe the preparation methods and techniques for mixing paints, varnishes, lacquers, stains and polishes			
		2.11	Describe the various methods of applying the required finishes (such as using brushes, rollers, paint pads, cloths, adhesive spreaders and spray equipment)			
		2.12	Describe the safe operation of spray equipment, and the effects of air pressure variance on the spray quality			
		2.13	Describe the time intervals that are required between coats, and why these must be adhered to			
		2.14	Describe the use of lamps and heaters to aid the drying of the coatings or coverings			
		2.15	Describe the cleaning and maintenance procedures for the tools and equipment that are used (such as brushes, rollers, adhesive spreading tools and spray equipment)			
		2.16	Describe the procedures for dealing with used consumables and surplus coatings or coverings safely and correctly			
		2.17	Explain how to check and assess the finished work (such as for appearance, colour, coating thickness, coverage and adhesion)			
		2.18	Explain how to recognise defects (such as bubbles, contamination, runs and other surface defects)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Describe the problems that can occur with the finishing operations, and how these can be overcome			
		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 and clean condition on completion of the finishing activities (such as returning tools and 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 163: Finishing Surfaces by Applying Treatments

Unit reference number: T/504/6444

QCF level: 2

Credit value: 9

Guided learning hours: 41

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to finish surfaces by applying treatments. 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 F.

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	Finish surfaces by applying treatments	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 surface treatment activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions and surface treatment specifications and procedures. • Ensure that the equipment is correctly prepared for the treatment operations being performed • Carry out handling/jigging of the component (where appropriate) • Clean all tools and equipment on completion of the surface treatment activities • Dispose of waste and excess materials, in line with agreed organisational procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Apply surface treatments to components by carrying out one of the following processes: • Powder coating • Hot dip treatments • Electroplating • Anodising • Chemical treatments • Phosphating			
		1.4	Apply surface treatments to two different substrates from the following: • Mild steel • Stainless steel • Brass • Copper • Zinc based diecastings • Aluminium • Previously plated substrates • Plastics/composite material • Glass • Other materials (specify)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Apply surface treatments to two different types of component from the following: • Irregular components with multiple surfaces • Welded/joined components • Hollow/tubular components • Flat components			
		1.6	Plan the surface treatment activities before they start them			
		1.7	Prepare the work surfaces in readiness to receive the appropriate treatment			
		1.8	Prepare the components for the surface treatment activities, by carrying out three of the following: • Degreasing • Cleaning • Rinsing • Masking • Pre-heating • Pickling			
		1.9	Check that the surface treatment equipment and solutions are set up and maintained at satisfactory operating conditions and levels			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Use one of the following methods for locating the work during the surface treatment process: • Wiring • Specialised jigs • Jigging components, which are masked prior to processing • Jigs with integral masking			
		1.11	Carry out the surface treatment process, using appropriate techniques and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Carry out the surface treatment activities, to include carrying out all of the following: • Start up the surface treatment equipment, using approved procedures • Confirm with the authorised person that the plant is ready for carrying out the surface treatment operations • Ensure that the equipment settings and process solutions are set and adjusted to maintain the correct specification (such as time, levels, temperature, current) • Check that the components are correctly prepared for the required treatment activities (such as dry, at the correct temperature, correctly masked) • Load components safely into the treatment plant/solutions • Ensure that components are left for the required induction period (if applicable) • Remove the components from the plant/solution safely and correctly • Apply appropriate post treatment activities (such as curing, cooling, quenching)			
		1.13	Check that the finished surface achieves the required characteristics and meets the surface treatment specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Carry out checks on the treated surfaces, to include four of the following: • Freedom from damage • Freedom from contamination • Overall coverage/completeness of the coating operations • Thickness of deposit/coating • Appearance of deposits (such as colour, brightness) • Bend test (such as manual or mechanical) • Surface roughness checks • Adhesion of deposit to substrate • Porosity of coating • Deposit hardness • Brittleness of deposit • Abrasion resistance • Corrosion testing			
		1.15	Carry out surface treatment processes which comply with all of the following: • The final surface finish is in line with the specification or job requirements • The finished surface is free from defects • The finished surface meets customer/company requirements			
		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			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Shut down the surface treatment equipment to a safe condition on completion of the activities			
		1.18	Leave the work area in a safe condition on completion of the surface treatment activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to finish surfaces by applying treatments	2.1	Describe the specific health and safety precautions which must be taken when preparing surfaces and applying surface treatment processes (such as wearing protective clothing and protective equipment, using fume extraction equipment)			
		2.2	Describe the hazards associated with preparing surfaces and applying surface treatments (such as using chemicals for cleaning and coating activities, fume inhalation, splashes from hot or corrosive treatment processes), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be used; how to obtain it and check that it is in a safe and usable condition (such as eye protection, overalls, face masks, breathing equipment)			
		2.4	Describe the requirements for working in confined spaces and safe systems of work (including required air quantities (RAQs) and local exhaust ventilation (LEV)) to maintain safe conditions			
		2.5	Describe the importance of ensuring that fume extraction equipment is operating effectively, and that good housekeeping and fire prevention procedures are observed			
		2.6	Describe the importance of following job instructions and defined surface treatment procedures			
		2.7	Describe the surface preparation methods and techniques to be undertaken prior to applying the treatments (such as stripping off old materials; using solvents to remove dirt and grease; masking surfaces to contain the deposits)			
		2.8	Describe the specific surface treatment process to be carried out, and the types of application for which they are best suited (such as powder coating, hot dip treatments, chemical treatments, phosphating, electroplating and anodising)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the basic principles of operation of the specific surface treatment process being carried out			
		2.10	Describe the pre-treatments to be carried out on the components prior to the surface treatment activities (such as cleaning/degreasing, pickling, pre-heating)			
		2.11	Describe the visual checks to be made on the components prior to carrying out the surface treatment activities (such as checking they are dry, have been pre-heated or are correctly masked up)			
		2.12	Describe the need to make certain that all substrates and jigs are completely free of water or other solvents prior to immersing in a hot solution, and the potential consequences of failing to check this			
		2.13	Describe the methods used to hold/secure components during the surface treatment process (such as wires, hooks, jigs)			
		2.14	Describe the setting up of the surface treatment plant and equipment, and the operation and locations of emergency shutdown stops			
		2.15	Describe the importance of monitoring the equipment settings and process solutions during the treatment process			
		2.16	Describe the time intervals that the components need to be immersed, or time required between coats, and why these must be adhered to			
		2.17	Explain how to identify surface treatment processing faults (including blistering, missed deposits, dull deposits, contamination and poor adhesion)			
		2.18	Explain how to check and assess the finished work (such as for appearance, colour, coating thickness, coverage and adhesion)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Describe the problems that can occur with the surface treatment operations, and how these can be overcome			
		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 and clean condition on completion of the surface treatment activities (such as returning tools and equipment to the designated location, cleaning the work area, and removing and disposing of waste)			
		2.22	Describe the importance of ensuring that fume extraction equipment is operating effectively, and that good housekeeping and fire prevention procedures are observed			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 164: Carrying Out Heat Treatment of Engineering Materials

Unit reference number: A/504/6445

QCF level: 2

Credit value: 9

Guided learning hours: 41

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out heat treatment of engineering materials. 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 F.

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 heat treatment of engineering materials	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 heat treatment activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions and heat treatment process specifications and procedures • Ensure that the equipment is correctly prepared for the heat treatment operations being performed • Store all tools and equipment on completion of the heat treatment activities • Dispose of waste and excess materials, in line with agreed organisational procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out three of the following heat treatment processes: • Flame hardening • Case hardening • Carburising • Tempering • Annealing • Normalising/stress relieving			
		1.4	Apply heat treatments to two different types of material from the following: • Low carbon steel • High carbon steel • Silver/tool steel • Chilled cast iron • Welded fabrications • Copper • Other materials (specify)			
		1.5	Plan the heat treatment activities before they start them			
		1.6	Prepare the materials in readiness to receive the appropriate heat treatment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Prepare the components for the heat treatment activities, by carrying out two of the following: • Removing scale • Degreasing/cleaning • Masking • Polishing area to be tempered • Pre-heating			
		1.8	Use two of the following methods of heating the components: • Furnace • Blacksmith's forge • Gas torches • Salt/chemical baths			
		1.9	Check that the heat treatment equipment is set up and maintained at satisfactory operating conditions			
		1.10	Carry out the heat treatment process, using appropriate techniques and procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Carry out the heat treatment activities to include all of the following: • Lighting up the furnace/forge or torch, using approved procedures • Setting the equipment to maintain the correct conditions (such as soak time, temperature) • Checking that the components are correctly prepared for the required heat treatment activities (such as dry, at the correct temperature, correctly polished or masked, packed with carbon enriched material) • Checking that there is sufficient cooling medium (so that it will not overheat or reach flash point) • Loading the components safely into the heat source/solution • Ensuring that components are left for the required induction period • Removing the components from the heat source/solution safely and correctly • Quenching/cooling the components, using the appropriate medium and technique			
		1.12	Use two of the following methods of quenching/cooling the material: • Fresh water • Salt water • Oil • Air • Sand • Leave in the furnace to cool			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Check that the finished material achieves the required characteristics and meets the heat treatment specification			
		1.14	Carry out simple checks on the heat treated components, to include two of the following: • Visual checks for cracks or distortion • NDT tests (such as dye penetrant, magnetic particle, ultrasonic) • Simple physical checks to confirm that hardening or annealing has been achieved (such as grinding wheel spark tests, file test) • Specific hardness tests (such as Vickers, Brinell)			
		1.15	Carry out heat treatment processes which comply with all of the following: • The final heat treated material is in line with the specification or job requirements • The heat treated material is free from defects • The heat treatment process meets customer/company requirements			
		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	Shut down the heat treatment equipment to a safe condition on completion of the activities			
		1.18	Leave the work area in a safe condition on completion of the heat treatment activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to carry out heat treatment of engineering materials	2.1	Describe the specific health and safety precautions which must be taken when carrying out heat treatment processes (such as wearing protective clothing and protective equipment, using fume extraction equipment)			
		2.2	Describe the hazards associated with carrying out heat treatment processes (such as handling hot materials, using heat treatment solutions, fume inhalation, splashes from hot oil or liquids, fire and explosive mixtures), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be used; how to obtain it and check that it is in a safe and usable condition (such as leather aprons, eye protection, overalls, face masks, breathing equipment)			
		2.4	Describe the importance of ensuring that fume extraction equipment is operating effectively, and that good housekeeping and fire prevention procedures are observed			
		2.5	Describe the importance of following job instructions and defined heat treatment procedures			
		2.6	Explain how to obtain the required information on heat treatment temperatures, tempering colours, soak times and quenching/cooling methods to be used			
		2.7	Describe the various types of material that can be flame hardened, case hardened, tempered, normalised and annealed			
		2.8	Describe the material preparation methods and techniques to be undertaken prior to applying the heat treatments (such as removing scale, oil and dirt; masking surfaces to contain the case hardening or carburising deposits; polishing surfaces to be tempered; packing or coating the components with a carbon enriched material; pre-heating before immersion into a salt bath)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.9	Describe the specific heat treatment process to be carried out, and the types of application for which they are best suited (such as flame hardening, case hardening, carburising, annealing, tempering and normalising)			
		2.10	Describe the basic principles of operation of the specific heat treatment process being carried out			
		2.11	Explain how to prepare the equipment for the heat treatment activities (such as setting furnace or salt bath controls to give correct temperature; the procedure for lighting and extinguishing the blacksmith's forge; setting up gas torches; ensuring that suitable tongs/handling devices are available)			
		2.12	Describe the visual checks to be made on the components prior to carrying out the surface treatment activities (such as checking that they are dry, have been pre-heated or are correctly masked up)			
		2.13	Describe the need to make certain that all components and jigs are completely free of water or other solvents prior to immersing them in a hot solution, and the potential consequences of failing to check this			
		2.14	Describe the methods used to hold/secure components in a heat treatment solution (such as wires, hooks, jigs)			
		2.15	Describe the importance of monitoring the equipment settings and process solutions during the heat treatment process			
		2.16	Explain how to heat the components to the correct temperature for the process being carried out (such as hardening temperatures for various carbon contents; soak times at set temperatures for carburising, annealing or normalising; temperatures and colours for various tempering applications), and why these must be adhered too			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Describe the quenching and cooling methods to be used (such as fresh water, salt water, oil, sand, air and leaving the components in the furnace to cool naturally)			
		2.18	Describe the need to maintain quenching oil at a temperature below its flash point			
		2.19	Explain how to check the finished work after heat treatment (such as visual checks for cracks or distortion; using simple file or spark tests to check that hardening or annealing has been achieved; the use of dye penetrant and magnetic particle tests; the use of specialised hardness tests)			
		2.20	Describe the problems that can occur with the heat treatment operations, and how these can be overcome			
		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 heat treatment activities (such as returning tools and 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 165: Carrying Out Hand Forging of Engineering Materials

Unit reference number: F/504/6446

QCF level: 2

Credit value: 9

Guided learning hours: 41

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out hand forging of engineering materials. 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 F.

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 hand forging of engineering materials	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 hand forging activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions and hand forging specifications and procedures • Ensure that the material handling equipment and hand tools are in a safe and usable condition • Return all tools and equipment to their correct designation on completion of the hand forging activities • Dispose of waste and excess materials, in line with organisational procedures			
		1.3	Use one of the following methods of heating the components: • Furnace/oven • Blacksmith's forge • Gas torch • Induction heating			
		1.4	Plan the hand forging activities before they start them			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Prepare the materials in readiness for the forging operations			
		1.6	Carry out hand forging operations on two different materials from the following: • Wrought iron • Low carbon steel • High carbon steel • Alloy steel • Brass • Copper • Other materials (specify)			
		1.7	Prepare the forging equipment in readiness for the forging operations			
		1.8	Carry out six of the following hand forging operations: • Bending • Twisting • Drawing down • Upsetting • Swaging • Punching • Cutting off • Flame welding			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Use five of the following during the forging process: • Hand hammers • Pneumatic hammers • Blacksmith's anvil • Formers • Swages • Stakes • Punches • Drifts • Other tools (specify)			
		1.10	Carry out the hand forging activities, to include all of the following: • Lighting up the furnace/forge or torch, using approved procedures • Setting the equipment to maintain the correct conditions (such as temperature), where applicable • Checking that the components are correctly prepared for the required hand forging activities (such as free from scale or excessive rust, heated to the correct colour/temperature) • Using appropriate tools and techniques to forge the required shapes/profiles • Re-heating the forged components at suitable periods during the forging process • Using appropriate tools/gauges to determine when the required shape is achieved			
		1.11	Check that the finished components conform to specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Produce hand forged components which comply with all of the following: • All dimensions are within +/- 3.0mm or +/- 0.125” • Finished components meet the required shape/geometry (such as flat, straight, angles, twists) • Completed components are free from excessive tooling/hammer marks, deformation or cracks			
		1.13	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			
		1.14	Shut down the forging equipment to a safe condition on completion of the activities			
		1.15	Leave the work area in a safe condition on completion of the hand forging activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to carry out hand forging of engineering materials	2.1	Describe the specific health and safety precautions which must be taken when carrying out hand forging processes (such as wearing protective clothing and protective equipment, using fume extraction equipment)			
		2.2	Describe the hazards associated with carrying out hand forging processes (such as handling hot materials, fume inhalation, fire), and how they can be minimised			
		2.3	Describe the personal protective equipment (PPE) to be used (such as leather aprons, eye/ear protection, overalls, face masks, breathing equipment); how to obtain it and check that it is in a safe and usable condition			
		2.4	Describe the importance of ensuring that fume extraction equipment is operating effectively, and that good housekeeping and fire prevention procedures are observed			
		2.5	Describe the importance of following job instructions and defined hand forging techniques and procedures			
		2.6	Explain how to obtain the required information on forging colours/temperatures to be used			
		2.7	Describe the various types of material that can be hand forged			
		2.8	Describe the characteristics of the materials, and how they effect and are affected by the forging process			
		2.9	Describe the meaning of forging terminology (such as drawing down, upsetting, swaging, twisting, punching and flame welding)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how to prepare the equipment for the hand forging activities (such as setting furnace controls to give correct temperature; the procedure for lighting and extinguishing the blacksmith's forge; setting up gas torches; ensuring that suitable tongs/handling devices are available)			
		2.11	Describe the material preparation methods and techniques to be undertaken prior to carrying out the hand forging operations (such as removing scale, oil and dirt; heating the material to the correct forging temperature)			
		2.12	Explain how to determine when the material is ready for the forging operations (by checking the colour of the hot material)			
		2.13	Describe the various hand forging methods used, and the range of tools required (including types of hammers, formers, swages, stakes, punches and drifts)			
		2.14	Describe the use of the various parts of the blacksmith's anvil for the forging operations			
		2.15	Describe the use of various cooling or quenching mediums (such as water, oil, air or sand)			
		2.16	Describe the effect on the materials of plunging them into cooling mediums whilst they are still hot			
		2.17	Explain how to check that the forged components meet the specification requirements (such as visual checks for cracks, scale inclusions or distortion; use of measuring equipment, gauges or templates to check dimensional and geometric features)			
		2.18	Describe the problems that can occur with the hand forging operations, and how these can be overcome			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.19	Explain when to act on their own initiative and when to seek help and advice from others			
		2.20	Describe the importance of leaving the work area and equipment in a safe and clean condition on completion of the forging activities (such as returning tools and 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 166: Stripping and Rebuilding Motorsport Vehicles (Pre-Competition)

Unit reference number: J/504/6447

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to strip and rebuild motorsport vehicles pre-competition. 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 F.

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	Strip and rebuild motorsport vehicles (pre-competition)	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 activities prior to stripping and rebuilding of the motorsport vehicle: • Positioning and securing the vehicle, using the correct equipment • Carrying out all preparatory work (such as removal of wheels, bodywork or fairings, removing dirt, oil and track debris) • Checking for leaks in the braking system, clutch, cooling, steering, lubrication and fuel systems • Checking for play in spherical bearings, bushes, couplings and joints • Checking for excessive wear to bodywork fasteners, brake linings, clutch linings, skid plates, dog rings and gear ratios • Making initial judgements as to the cause of damage and/or wear			
		1.3	Obtain all the information they need for the motorsport vehicle preparation activities to be carried out			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Use three of the following to aid the vehicle preparation: • System diagrams • Equipment manuals • Vehicle telemetry data • Engineer's records • Set-up sheets • Inspection check sheets			
		1.5	Establish and, where appropriate, mark component orientation for re-assembly			
		1.6	Ensure that any stored energy or substances are released safely and correctly			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Carry out the removal and replacement activities, within the limits of their personal authority to include all of the following: • Disconnecting electrical connections • Disconnecting and removing hoses and pipes • Draining and removing fluids • Proof marking/labelling of components to aid reassembly • Separation of components by means of removing mechanical fasteners (such as nuts, bolts, circlips, quick-release fasteners, rivets) • Inspecting components for damage and wear, and identifying all components and fasteners that require replacement • Arranging and storing components in a manner that makes re-assembly as straightforward as possible • Labelling (and storing in the correct location) components that require repair or overhaul • Reassembly of components using mechanical fastening devices (such as nuts, bolts, quick-release fasteners, circlips, rivets) • Replacement of sealing devices (such as 'O' rings, seals, gaskets, sealing compounds) • Positioning, aligning, setting and adjusting replaced components (such as travel, working clearance) • Tightening fastenings to the required torque, and applying bolt locking methods (such as split pins, wire locking, lock nuts) • Making electrical connections and earth bonding • Replacing fluids and bleeding the system			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Remove and replace the required components, using approved tools and techniques			
		1.9	Remove and replace components on one of the following types of motorsport vehicle: • Single seater • Rallying • Sports cars • Karts • Historic • Motorcycles (such as circuit and off-road) • Other specific approved competition vehicle			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Remove and replace motorsport vehicle components from all of the following categories: • 'Lifed' components (such as filters, gaskets, seals, bearings, securing devices, fuel cells) • Pipes and pipe connecting devices (such as rigid pipe, hoses, unions/couplings) • Chassis (such as uprights, suspension systems, steering and brake callipers/discs) • Mechanical controls (such as throttle, brakes, clutch, gear) • Safety equipment (such as seats, belts, fire extinguishers) Plus assist in the removal and replacement of motorsport vehicle components from three of the following categories: • Engine and ancillary components (such as exhaust primaries and silencers, airboxes, engine mounts, filters) • Transmission (such as gear ratios, gear selectors, dog rings, final drives, clutches, oil coolers, drive and prop shafts) • Fuel systems (such as fuel pumps, fuel tanks, fuel collectors) • Cooling systems (such as radiators, heat exchangers, header tanks) • Electrical (such as voltage generation, ignition system components, engine management, data control boxes, ECUs, wiring looms, lighting) • System components (such as sensors, regulators, safety devices, gauges)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Carry out all of the following inspection and testing techniques: • Functional testing • Mechanical measurement • Sensory testing (such as sight, sound smell touch) Plus two more of the following test procedures: • Ferrous metal crack detection • Non-ferrous metal crack detection • Static or dynamic balancing • Brake balance and pressure testing • Cylinder pressure/balance tests • Electrical tests • Damper dynamometer testing • Other specific tests			
		1.12	Remove and replace motorsport vehicle equipment and components, in compliance with one or more of the following standards: • Race Association's (such as FIA, MSA) • BS or ISO standards and procedures • Vehicle manufacturer's specification • Customer standards and requirements • Team/company standards and procedures • Specific system requirements			
		1.13	Take suitable precautions to prevent damage to components and the surrounding structure			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Report any instances where the removal and replacement activities cannot be fully met, or where there are identified defects outside the planned activities			
		1.15	Complete the relevant documentation, in accordance with organisational requirements			
		1.16	Complete the relevant paperwork, to include one from the following, and pass it to the appropriate people: • Job sheets • Computer records • Vehicle preparation sheet • Formal risk assessment			
		1.17	Label and store, in an appropriate location, components that require repair or overhaul			
		1.18	Dispose of waste materials and scrap components, in accordance with safe working practices and approved procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to strip and rebuild motorsport vehicles (pre-competition)	2.1	Describe the specific safety practices and procedures that they need to observe when stripping and rebuilding motorsport vehicles and when using lubricants and fluids (including lifting and handling techniques; safe working practices with regard to dismantling motorsport vehicles; procedures which satisfy current regulations - such as HASAWA, COSHH, PUWER and other related legislation and guidelines)			
		2.2	Describe the hazards associated with removing and replacing motorsport vehicle components, and with the tools and equipment used (such as the safe support of the vehicle at the correct working height and position, the safe release of fuel and other liquids, handling hydraulic fluids, misuse of tools), and how they can be minimised			
		2.3	Describe the protective equipment that they need to use for both personal protection and protection of the vehicle			
		2.4	Describe the importance of good housekeeping within the working area (such as leaving the work area free of debris and used materials, cleaning and maintaining tools and equipment, returning equipment to designated storage area, leaving the work area in a safe and tidy condition), and of good personal presentation to ensure quality representation of the team or organisation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.5	Describe the preparations to be carried out on the vehicle (such as removing bodywork or fairings, cleaning away dirt, dust, oil or track debris; making visual checks of the systems and components for obvious signs of damage or excessive wear - such as bearings, bushes, bodywork, floors, fairings, leaking coolant or oil, chafing, cracks, excessive clearances); ensuring that suitable storage space is readied once the systems have been removed from the vehicle, and providing suitable containers for the storage of fasteners and other small components			
		2.6	Explain how to use and extract information from motorsport vehicle documentation (such as vehicle manuals, system diagrams, telemetry data, engineer's records, set-up sheets, inspection reports)			
		2.7	Describe the importance of ensuring that they use the correct and up-to-date documentation			
		2.8	Describe the techniques used to remove components from vehicle systems without damage to the components or surrounding structure (such as release of spring pressures/force, draining of fluids, proof marking, extraction of components and the need to protect the circuit integrity by fitting blanking plugs to exposed pipes)			
		2.9	Explain how to use a range of hand tools (such as spanners, sockets, screwdrivers, punches, drifts) to remove a range of components (such as studs, pins, circlips, rivets, seals and gaskets, bearings, gears, final drives, wings, floors, skid plates, fairings, seats); and using release agents to help free joined parts where seizure or crash damage may have occurred			
		2.10	Describe the various mechanical fasteners to be removed and replaced, and their method of removal and replacement (such as threaded fasteners, special securing devices)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.11	Describe the various types of electrical connectors that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections			
		2.12	Describe the methods of lifting, and supporting the components/equipment during the removal and replacement activities			
		2.13	Describe the methods of checking the components for damage or wear (using visual methods, measurements, and crack detection techniques)			
		2.14	Describe the need to use new components where checks during dismantling revealed such needs; fitting together new or prototype components, where a degree of initial fitting may be needed (such as filing, fettling, reaming, tapping, shimming, polishing and adjusting to achieve the required assembly specification); sealing and securing components (such as using nuts, bolts and associated fasteners, rivets, circlips, sealants and locking compounds); checking for correctness of fit and accuracy at critical stages during the rebuild and on completion of the assembly			
		2.15	Explain how to make adjustments to components/assemblies to ensure that they function correctly (such as travel and working clearance, timing and sequence)			
		2.16	Explain why securing devices must be tightened to the correct torque and locked, and the different methods that are used			
		2.17	Describe the tools and equipment used in the removal and replacement activities, their calibration/care and control procedures, and the need to control and account for all tools and equipment used during the removal and replacement activity			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.18	Explain how to deal with problems (such as what to do when components are damaged or worn in some way, the correct equipment or parts not available, components do not come apart as readily as expected, when to act on their own initiative and when to seek help from others)			
		2.19	Describe the recording documentation to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation			
		2.20	Describe the procedure for the safe disposal of waste materials, scrap components, hydraulic fluids, contaminated fuel			
		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 vehicle in a safe and clean condition on completion of the stripping and rebuilding activities (such as returning tools and 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 167: Inspecting a Motorsport Vehicle During a Competition

Unit reference number: L/504/6448

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to inspect a motorsport vehicle during a competition. 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 F.

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	Inspect a motorsport vehicle during a competition	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 in preparation for the inspection of the motorsport vehicle: • Ensure that there is enough time available to complete the inspection • Obtain all the required tools and equipment, and check that they are in a safe and usable condition • Ensure that the motorsport vehicle is safely supported on the appropriate stands • Ensure that all bodywork, fairings, covers and hatches have been removed (where appropriate) • Obtain and wear the correct personal protective equipment for the tasks being undertaken • Obtain the appropriate fluids and lubricants • Obtain the correct auxiliary engine starting devices (where appropriate) • Obtain the relevant inspection documentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Inspect one of the following types of motorsport vehicle during a motorsport event or competition: • Single seater • Rallying • Sports cars • Karts • Historic • Motorcycles (such as circuit and off-road) • Other specific approved competition vehicle			
		1.4	Obtain all the information they need for the motorsport vehicle inspection activities to be carried out			
		1.5	Plan the inspection activities before they start them			
		1.6	Obtain and prepare tools and ancillary equipment necessary for the inspection work to be carried out			
		1.7	Carry out the inspection activities, using approved tools and techniques, and within the limits of their personal authority			
		1.8	Take suitable precautions to prevent damage to components and surrounding systems			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Carry out inspections and checks, to include ten of the following, as appropriate to the motorsport vehicle being inspected: • Using a torque wrench to spanner-check wheel nuts, bolts and other critical fastenings • Ensuring that fuel tanks are filled to their correct capacity • Checking that suitable tyres are fitted, that they are free from damage and are at the correct cold pressures • Checking for correct oil pressure prior to engine warm-up • Checking engine temperatures and pressures during warm-up • Pressurising the cooling system after initial start-up • Testing that the throttle operation reaches 100% opening • Checking that power steering fluid levels are correct and free from leaks • Checking that hydraulic brake and clutch fluids are at the correct levels, and that the brake balance is set • Inflating damper bump canisters, using the appropriate gases • Checking that clutch operating clearance is correct, and that gear selection is satisfactory through all gears • Testing that electrical systems are operating correctly • Checking spherical bearings and wheel bearings for play			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Carry out three of the following before the vehicle leaves the 'pit' area: • Checking that all bodywork, fairings, wings, covers and hatches are correctly secured • Checking that the driver is fitted correctly into the seat, and that seat belts are securely fastened • Ensuring that the fire extinguisher bottle is full and the system is armed • Ensuring that wheels are correctly torqued, and locking mechanisms are in place • Ensuring that the driver has the appropriate vehicle information prior to entering the vehicle or competition (such as amount of fuel, type of tyres and pressures, track conditions, vehicle geometry changes, brake balance, brake condition) • Cleaning the bodywork, fairings, windscreen and other relevant areas of the vehicle • Checking that the work area/vehicle track access lane is free from tools, equipment and foreign objects			
		1.11	Report any instances where the inspection activities cannot be fully met, or where there are identified issues outside the planned activities			
		1.12	Record the results of the inspection activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Complete the relevant paperwork and pass it to the appropriate person, to include one from: • Driver/rider • Team manager • Chief mechanic • No.1 mechanic • Other appropriate person			
		1.14	Use the evidence they have gained to during the inspection activities to improve future reliability and performance of the motorsport vehicle			
		1.15	Tidy up on completion of the inspection activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to inspect a motorsport vehicle during a competition	2.1	Describe the specific safety practices and procedures that they need to observe when inspecting motorsport vehicles and when using lubricants and fluids (including lifting and handling techniques; safe working practices with regard to inspecting motorsport vehicles; procedures which satisfy current regulations - such as HASAWA, COSHH, PUWER and other related legislation and guidelines)			
		2.2	Describe the hazards associated with inspecting motorsport vehicles, and with the tools and equipment used, (such as the safe support of the vehicle at the correct working height and position, the safe release of fuel and other liquids, handling hot or damaged components, misuse of tools), and how they can be minimised			
		2.3	Describe the protective equipment that they need to use for both personal protection and protection of the vehicle			
		2.4	Describe the importance of good housekeeping within the working area (such as leaving the work area free of debris and used materials, cleaning and maintaining tools and equipment, returning equipment to designated storage area, leaving the work area in a safe and tidy condition), and of good personal presentation to ensure quality representation of the team or organisation			
		2.5	Describe the need to ensure that suitable storage space is readied for all bodywork, panels, fairings and covers once the vehicle has been stopped after its initial running period and before any checks are made			
		2.6	Describe the preparations to be carried out on the vehicle (such as removing bodywork or fairings, covers and panels, cleaning away dirt, dust, oil or track debris; making visual checks of the systems and components for obvious signs of damage, insecurity and leaks)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.7	Describe the importance of communicating with others and using inspection check sheets or other relevant documentation to ensure that the inspection is carried out in a systematic way, within the times restraints, and determining what consumables and or components may be needed			
		2.8	Explain how the information is recorded and returned to the relevant person, once all inspection work has been completed			
		2.9	Describe the techniques used to check components and systems without damaging the motorsport vehicle or disabling it from immediate use			
		2.10	Explain how to use a range of hand tools (such as spanners, sockets, screwdrivers, torque wrenches, pressure gauges) to check the security of a range of vehicle systems and sub-assemblies (such as engine, transmission, suspension, steering, cooling, lubrication, electrical)			
		2.11	Explain how to pressurise tyres, dampers, cooling systems and fuel systems; how to check for leaks and understand the specifications of fluids, fuels and lubricants to top up the vehicle systems following a leak or other problems			
		2.12	Describe the various mechanical fasteners to be removed and replaced, and their method of removal and replacement (such as threaded fasteners, special securing devices)			
		2.13	Explain how to make adjustments to components/assemblies to ensure that they function correctly (such as travel and working clearance, timing and sequence)			
		2.14	Explain why securing devices need to be tightened to the correct torque and locked, and the different methods used			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Describe the tools and equipment used in the inspection activities, and their calibration/care and control procedures, and the need to control and account for all tools and equipment used during the inspection activities at an event or competition			
		2.16	Explain how to deal with problems (such as what to do when components are damaged or insecure, the correct equipment, fluids or lubricants not available, when to act on their own initiative and when to seek help from others)			
		2.17	Explain how to report any alterations that they have made, or losses of fluids, lubricants, pressures, or abnormally excessive wear of components - to the relevant person			
		2.18	Explain how to complete the relevant documentation, stating the tasks completed and any adjustments made (such as setting of pressures, levels, geometry changes)			
		2.19	Describe the procedure for the safe disposal of waste materials, scrap components, hydraulic fluids, contaminated fuel			
		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 vehicle in a safe and clean condition on completion of the inspection activities (such as returning tools and 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 168: Diagnosing and Rectifying Faults on Motorsport Vehicle Systems During Competition

Unit reference number: R/504/6449

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to diagnose and rectify faults on motorsport vehicle systems during competition. 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 F.

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	Diagnose and rectify faults on motorsport vehicle systems (during competition)	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 fault diagnostic activities: • Carry out all preparatory work (such as removal of bodywork, fairings and covers, removing excessive dust, grease and dirt) • Check for obvious signs of damage (such as impact damage, broken parts) • Check for excessive wear or play (such as on shafts, bearings, spherical joints and drive shafts) • Check for leaks on seals, gaskets, bushes, controls and pipe fittings • Check the condition and security of suspension and drive components • Check the condition of tyres (such as damage, wear, pressures, security) • Check for metallic particles in lubricants			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Assist in diagnosing faults on one of the following types of motor sport vehicle: • Single seater • Rallying • Sports cars • Karts • Historic • Motorcycles (such as circuit and off road) • Other specific approved competition vehicle			
		1.4	Obtain and use all the relevant information on the symptoms and problems associated with the vehicle			
		1.5	Assist in locating faults that have resulted in two of the following breakdown categories: • Intermittent problem • Partial failure (where the vehicle is able to return to the 'pit' area under power) • Complete breakdown (where the vehicle is unable to return to the 'pit' area under power)			
		1.6	Assist in the investigation and help establish the most likely causes of the faults			
		1.7	Assist in the selection and use of appropriate diagnostic techniques, tools and aids to locate the fault			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Assist in the collection of evidence regarding the fault, from three of the following sources: • System diagrams • vehicle/equipment manuals • Data logging • Test instruments • Equipment self-diagnostics • Maintenance/history records • Discussion with user/team member • Monitoring equipment (such as gauges recording devices) • Fault analysis charts (such as flow charts) • Troubleshooting guides			
		1.9	Assist in carrying out three of the following fault diagnostic techniques: • Function testing • Unit substitution • Input/output • Taking measurements and readings • Half-split • Six point technique • Sensory input (such as sight, sound, smell, touch)			
		1.10	Assist in determining which components or units need adjusting or replacing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Where appropriate, ensure that any stored energy or substances are released safely and correctly			
		1.12	Rectify faults in four of the following motorsport vehicle major assemblies or systems: • Engine • Transmission • Chassis • Wheel braking • Suspension • Steering • Fuel • Lubrication • Cooling • Electrical			
		1.13	Remove, replace or refit the required components, using approved tools and techniques, within the limits of their personal authority and without causing damage to components or surrounding areas			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Use a variety of fault rectification activities, to include six of the following: • Removing and replacing electrical connections (such as plugs, sockets, earth straps) • Removing and replacing mechanical fasteners (such as nuts, bolts, circlips, quick-release fasteners, rivets) • Removing and replacing hoses and pipes • Replacing faulty and or worn components with new or reconditioned components • Adjusting components (such as travel, working clearance, torque, electrical values) • Realignment of components • Repairing components (such as brackets, mountings, panels) • Refitting loose/dislodged components • Making temporary repairs to an acceptable standard			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.15	Assist in carrying out four of the following monitoring or testing procedures, to help diagnose and check that the fault has been rectified: • Pressure testing (such as cylinder pressure, hydraulic or pneumatic pressures) • Electrical checks (such as voltage, current, continuity checks) • Noise intensity • Exhaust analysis • Thermal checks (such as bearings, friction surfaces) • Movement checks (such as travel, clearance, operation of levers and links, torque) • Vibration analysis • Functional testing • Visual examination to the required standard			
		1.16	Deal with any difficulties during the fault location, rectification and testing activities			
		1.17	Report any instances where the removal and replacement activities cannot be fully met, or where there are identified defects outside the planned activities			
		1.18	Complete the relevant documentation, in accordance with organisational requirements			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.19	Complete the relevant paperwork, to include one from the following, and pass it to the appropriate people: • Body sheets • Computer records • Vehicle log/report • Corrective action report			
		1.20	Clean the work area and dispose of waste materials and defective components, in accordance with safe working practices and approved procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to diagnose and rectify faults on motorsport vehicle systems (during competition)	2.1	Describe the health and safety requirements of the area in which they are carrying out the fault diagnostic activities, and the responsibility these requirements place on them			
		2.2	Describe the specific safety precautions to be taken when carrying out fault diagnosis on motorsport vehicles			
		2.3	Describe the importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis and rectification activities, and of good personal presentation to ensure quality representation of the team or organisation			
		2.4	Describe the hazards associated with diagnosing and rectifying motorsport vehicle faults, and with the tools and equipment used (such as moving vehicles in a race environment; the safe support of the vehicle at the correct working height and position; hot vehicle components; the safe release of fuel and other liquids; stored pressure/force; handling and using release agents, sealants and adhesives; misuse of tools), and how they can be minimised			
		2.5	Explain how to extract and use information from the relevant areas to assist in the diagnosis and rectification of the fault on the motorsport vehicles (such as from the driver, rider or team member, telemetry data, engineer's records, set-up sheets and inspection reports)			
		2.6	Describe the techniques used to diagnose the faults (such as sensory information (sight, sound, smell, touch); half-split, six point technique, checking inputs and outputs, component substitution, aural, visual, functional, taking measurements and use of equipment self-diagnostics)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.7	Explain how to use a range of fault diagnostic equipment to investigate the problem (such as multimeters, pressure gauges, thermal measuring equipment, Verniers, micrometers and other specialised tools)			
		2.8	Explain how to evaluate the likely risk of running the vehicle with the known fault, and the effects that the fault could have on health and safety, and on the overall vehicle performance			
		2.9	Explain how to remove components from vehicle systems without damage to the components or surrounding structure (such as release of spring pressures/force, draining of fluids, proof marking, extraction of components, and the need to protect the circuit integrity by fitting blanking plugs to exposed pipes)			
		2.10	Explain how to use a range of hand tools (such as spanners, sockets, screwdrivers, pliers, cutters, punches) to remove a range of components, and how to use release agents to help free joined parts where seizure or crash damage may have occurred			
		2.11	Describe the various mechanical fasteners to be removed and replaced, and their method of removal and replacement (such as threaded fasteners and special securing devices)			
		2.12	Explain why securing devices need to be tightened to the correct torque and locked, and the different methods used			
		2.13	Explain why they need to be methodical and lay the removed components out in a logical sequence to aid re-assembly, and methods that can be used to keep component parts together in the order they were removed			
		2.14	Describe the methods of inspecting removed components, and the awareness of what to look for with regard to damage and wear			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.15	Describe the equipment used in the rectification operations (such as alignment tools, torque wrenches, presses)			
		2.16	Explain how to rectify the fault using methods such as component replacement, adjustments, repair and refitting techniques			
		2.17	Explain how to select and carry out visual, aural, functional and measurement tests to ensure the correct operation of the component or system			
		2.18	Describe the expected outcomes of the tests being conducted			
		2.19	Describe the importance of working to the critical timescales relevant to the motorsport industry			
		2.20	Explain how to deal with problems (such as what to do when components do not come apart as readily as expected, when to act on their own initiative)			
		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 vehicle in a safe and clean condition on completion of the activities (such as returning tools and 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 169: Carrying Out Maintenance Activities on Motorsport Vehicle Electrical Equipment

Unit reference number: J/504/6450

QCF level: 2

Credit value: 15

Guided learning hours: 68

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on motorsport vehicle electrical equipment. 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 F.

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 maintenance activities on motorsport vehicle electrical equipment	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 electrical maintenance activities: • Plan the maintenance activities, in conjunction with others involved, so as to minimise disruption to motorsport vehicle preparation • Use the correct issue of drawings, job instructions and procedures • Adhere to risk assessment, COSHH and other relevant safety standards • Ensure the safe isolation of equipment (such as mechanical, electricity, fuel, air or fluids) • Ensure that safe working arrangements have been provided for the maintenance area (such as pit lane/service point) • Re-connect and return the equipment to service on completion of activities • Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Carry out maintenance of electrical equipment on one of the following types of motorsport vehicle: • Single seater • Rallying • Sports cars • Karts • Historic • Motorcycles (such as circuit and off-road) • Other specific approved competition vehicle			
		1.4	Carry out maintenance activities on five of the following types of motorsport vehicle sub-systems: • Charging systems • Data acquisition system • Direct current power supply system • Auxiliary motorsport vehicle power supply system • Lighting systems • instrumentation, indication and warning systems • Electrical control system • Safety and emergency systems			
		1.5	Obtain all the information they need for the motorsport vehicle electrical maintenance activities to be carried out			
		1.6	Follow the relevant maintenance procedures to carry out the required work			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Maintain motorsport vehicle electrical equipment, in compliance with one or more of the following standards: • Race Associations (such as FIA, MSA) • BS or ISO standards and procedures • Vehicle manufacturer's specification • Customer standards and requirements • Team/company standards and procedures • Specific system requirements			
		1.8	Carry out the maintenance activities, within the limits of their personal authority			
		1.9	Carry out the maintenance activities in the specified sequence, and in an agreed timescale			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Carry out all of the following maintenance activities: • Isolating the equipment • Disconnecting and reconnecting wires and looms • Attaching suitable cable identification markers • Removing electrical units/components • Checking components for serviceability • Replacing damaged/defective components • Removing and replacing damaged wires and looms • Setting and adjusting replaced components • Making 'continuity' checks before powering up • Functionally testing the maintained equipment • Examining wiring looms for chafing, dislodging, correct routeing, protection in hazardous areas			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Replace and/or repair a range of motorsport vehicle electrical components, to include ten of the following: • Looms and connectors • locking and retaining devices • Overload protection devices • Pickup sensor • Relay components • Potentiometers • Capacitors • Circuit boards • Lighting components • Electrical switches or sensors • Manual switches • Transmitter beacons • Batteries • Solenoids • Thermistors or thermocouples • Starter motors • Other specific motorsport related components			
		1.12	Report any instances where the maintenance activities cannot be fully met, or where there are identified defects outside the planned schedule			
		1.13	Use the evidence they have gained to during maintenance activities to improve future reliability and performance of the motorsport vehicle			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Complete the relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person: • Job cards • Computer records • Company specific documentation • Formal risk assessment • Vehicle maintenance logs or reports			
		1.15	Dispose of waste materials, in accordance with safe working practices and approved procedures			
		1.16	Tidy up on completion of the electrical maintenance activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to carry out maintenance activities on motorsport vehicle electrical equipment	2.1	Describe the specific safety practices and procedures that they need to observe when carrying out electrical maintenance activities on motorsport vehicles (including lifting and handling techniques; safe working practices with regard to removing components from motorsport vehicles; procedures which satisfy current regulations - such as HASAWA, COSHH, PUWER and other related legislation and guidelines)			
		2.2	Describe the hazards associated with removing and replacing motorsport vehicle electrical components, and with the tools and equipment used (such as ensuring the safe support of the vehicle at the correct working height and position, ensuring the safe isolation of the circuits/equipment, removal of fuses, misuse of tools), and how they can be minimised			
		2.3	Describe the protective equipment that they need to use for both personal protection and protection of the vehicle			
		2.4	Describe the importance of good housekeeping within the working area (such as leaving the work area free of debris and used materials, cleaning and maintaining tools and equipment, returning equipment to designated storage area, leaving the work area in a safe and tidy condition), and of good personal presentation to ensure quality representation of the team or organisation			
		2.5	Explain how to use and extract information from motorsport vehicle documentation (such as vehicle manuals, system diagrams, telemetry data, engineer's records, set-up sheets, inspection reports)			
		2.6	Describe the importance of ensuring that they use the correct and up-to-date documentation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.7	Describe the basic principles of how the motorsport vehicle electrical equipment functions, its operating sequence, the working purpose of individual units/components and how they interact			
		2.8	Describe the different types of cabling and their application (such as multicore cables, single core cables, screened cables) as used on motorsport vehicles			
		2.9	Describe the care, handling and application of electrical measuring instruments			
		2.10	Describe the techniques used to dismantle/assemble electrical equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections)			
		2.11	Describe the various types of electrical connectors that are used, methods of unlocking, orientation indicators and locating and locking in of the connections			
		2.12	Describe the methods of removing and replacing cables, wires and looms without causing damage to existing cabling or other vehicle components			
		2.13	Describe the use of BS/ISO wiring and other regulations when selecting wires and cables, and when carrying out tests on systems			
		2.14	Describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly			
		2.15	Describe the tools and equipment used in the maintenance activities (such as cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools)			
		2.16	Describe the methods of checking that components are fit for purpose, and the need to replace 'lifed' items (such as seals and gaskets, overload protection devices)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.17	Explain how to make adjustments to components/assemblies to ensure that they function correctly			
		2.18	Explain how to check that tools and equipment are free from damage or defects, are in a safe and usable condition, and are set up correctly for the intended purpose			
		2.19	Describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on			
		2.20	Describe the equipment operating and control procedures to be applied during the maintenance activity			
		2.21	Explain how to use appropriate lifting and handling equipment techniques in the maintenance activity			
		2.22	Describe the problems that can occur during the maintenance activity, and how they can be overcome			
		2.23	Describe the recording documentation to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation			
		2.24	Explain when to act on their own initiative and when to seek help and advice from others			
		2.25	Describe the importance of leaving the work area and vehicle in a safe and clean condition on completion of the maintenance activities (such as returning tools and 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 170: Stripping and Rebuilding Motorsport Engines (Pre-Competition)

Unit reference number: L/504/6451

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to strip and rebuild motorsport engines pre-competition. 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 F.

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	Strip and rebuild motorsport engines (pre-competition)	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 in preparation for the stripping and rebuilding of the motorsport engine: • Remove engine from its transportation container, and remove dirt, oil and track debris from engine externals • Visual check for damage and wear to engine externals • Mount the engine on the correct mounting stand • Drain all coolants and lubricants from the engine • Obtain all stripping and re-building documentation, prior to disassembly • Obtain suitable storage bins for the removed components			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.3	Rebuild engines for one of the following types of motorsport vehicle: • Single seater • Rallying • Sports cars • Karts • Historic • Motorcycles (such as circuit and off-road) • Other specific approved competition vehicle			
		1.4	Obtain all the information they need for the motorsport engine stripping and re-building activities to be carried out			
		1.5	Use three of the following to aid the stripping and rebuilding of the motorsport engine: • System diagrams • Lifting records • Engine strip check sheets • Engineer's records • Engineering drawings • Engine re-build sheets			
		1.6	Establish and, where appropriate, mark component orientation for re-assembly			
		1.7	Ensure that the motorsport engine is correctly mounted in the correct work area			
		1.8	Carry out the engine stripping and re-building activities, within the limits of their personal authority			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Remove and replace the required components, using approved tools and techniques			
		1.10	Remove and refit motorsport engine components from three of the following areas: • Engine ancillary components (such as exhaust primaries and silencers, airboxes, engine mounts, filters) • Clutch (such as clutch covers, driven plates, thrust bearings) • Cam timing (such as pulleys, belts, gears, adjusters) • Electrical (such as generation, ignition, engine management, data control boxes, ECUs, wiring looms) • System components (such as sensors, regulators, safety devices, gauges) Plus assist in the stripping and re-building of motorsport engine components from three of the following areas: • Cylinder head (such as valves, valve springs, valve spring heights, rockers, valve stem seals, spark plugs) • Engine block (such as crankshafts, connecting rods, pistons, rings, main bearings, big end bearings) • Lubrication system (such as oil pumps, oil filters, scavenge pumps, oil tanks, pressure relief valves) • Fuel system (such as carburettors, fuel pumps, fuel filters, metering units, fuel rails, pressure relief valves)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	Carry out eleven of the following stripping and rebuilding activities: • Removing covers and cowlings • Disconnecting electrical connections • Disconnecting and removing hoses and pipes • Proof marking/labelling of components to aid reassembly • Separation of components by means of removing mechanical fasteners (such as nuts, bolts, circlips, quick-release fasteners, rivets) • Inspecting components for damage and wear, and identifying all components and fasteners that require replacement • Arranging and storing components in a manner that makes re-assembly as straightforward as possible • Labelling (and storing in the correct location) components that require repair or overhaul • Replacing damaged/defective and 'lifed' components • Reassembly of components, using mechanical fastening devices (such as nuts, bolts, quick-release fasteners, circlips, rivets) • Checking of bearing clearances (such as using engineer's blue or compressible strip) • Lapping in valves and valve seats • Torque setting cylinder-head bolts, in the correct sequence • Replacement of sealing devices (such as 'O' rings, seals, gaskets, sealing compounds)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.11	...continued • Positioning, aligning, setting, and adjusting replaced components (such as valve spring heights, cam timing, ring gaps, torque angles) • Tightening fastenings to the required torque, and applying bolt locking methods (such as split pins, wire locking, lock nuts, engineering adhesives)			
		1.12	Carry out three of the following inspection and testing techniques: • Ferrous metal crack detection • Non-ferrous crack detection • Mechanical measurements • Sensory testing (such as sight, sound, smell or touch) • Connecting and setting engine to dynamometer installation Plus two more of the following test procedures: • Compression testing • Leak down cylinder leakage testing • Carburettor vacuum testing • Ignition timing • Electrical charging tests • Other specific tests			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Strip and re-build motorsport engine equipment and components, in compliance with one or more of the following standards: • BS or ISO standards and procedures • Vehicle manufacturer's specification • Customer standards and requirements • Team/company standards and procedures • Specific engine system requirements			
		1.14	Take suitable precautions to prevent damage to components and surrounding systems			
		1.15	Report any instances where the engine stripping and re-building activities cannot be fully met, or where there are identified defects outside the planned activities			
		1.16	Complete the relevant documentation, in accordance with organisational requirements			
		1.17	Complete the relevant paperwork, to include one from the following, and pass it to the appropriate people: • Post-competition stripdown sheets • Engineer's/team's records • Engine re-build sheet • Formal risk assessment			
		1.18	Label and store (in an appropriate location) components that require repair or overhaul			
		1.19	Dispose of waste materials and scrap components, in accordance with safe working practices and approved procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to strip and rebuild motorsport engines (pre-competition)	2.1	Describe the specific safety practices and procedures that they need to observe when stripping and rebuilding motorsport engines and when using lubricants and fluids (including lifting and handling techniques; safe working practices with regard to dismantling motorsport vehicles; procedures which satisfy current regulations - such as HASAWA, COSHH, PUWER and other related legislation and guidelines)			
		2.2	Describe the hazards associated with stripping and re-building motorsport engine components, and with the tools and equipment used (such as the safe support of the engine at the correct working height and position, the safe release of fuel and other liquids, misuse of tools), and how they can be minimised			
		2.3	Describe the protective equipment that they need to use for both personal protection and protection of the engine			
		2.4	Describe the importance of good housekeeping within the working area (such as leaving the work area free of debris and used materials, cleaning and maintaining tools and equipment, returning equipment to designated storage area, leaving the work area in a safe and tidy condition), and of good personal presentation to ensure quality representation of the team or organisation			
		2.5	Describe the preparations to be carried out on the engine (such as removing transportation containers, cleaning away dirt, dust, oil or track debris; making visual checks of the systems and components for obvious signs of damage or excessive wear - such as leaking coolant or oil, chafing, cracks, excessive clearances; ensuring suitable storage space is readied once the systems have been removed from the engine and providing suitable containers for the storage of fasteners and other small components)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.6	Explain how to use and extract information from motorsport engine building documentation (such as engine manuals, system diagrams, engineering drawings, engineer's records)			
		2.7	Describe the importance of ensuring that they use the correct and up-to-date documentation			
		2.8	Describe the techniques used to remove components from motorsport engines without damage to the components or surrounding systems (such as release of spring pressures/force, draining of fluids, proof marking, extraction of components and the need to protect the system integrity by fitting blanking plugs to exposed pipes)			
		2.9	Explain how to use a range of hand tools (such as spanners, sockets, screwdrivers, punches, drifts) to remove a range of components (such as studs, pins, circlips, seals and gaskets, bearings, gears), and how to use release agents to help free joined parts where seizure or damage may have occurred			
		2.10	Describe the various mechanical fasteners to be removed and replaced, and their method of removal and replacement (such as threaded fasteners, special securing devices)			
		2.11	Describe the various types of electrical connectors that are used, methods of unlocking, orientation indicators and locating and locking-in of connections			
		2.12	Describe the methods of lifting, handling and supporting the components/equipment during the stripping and re-building activities			
		2.13	Describe the methods of checking the components for damage or wear (using visual methods, measurements, and crack detection techniques)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.14	Describe the need to use new components where checks during stripping revealed such needs; fitting together new or prototype components where a degree of initial fitting may be needed (such as filing, fettling, reaming, tapping, shimming, polishing and adjusting to achieve the required assembly specification); sealing and securing components (such as using nuts, bolts and associated fasteners, rivets, circlips, sealants and locking compounds); checking for correctness of fit and accuracy at critical stages during the rebuild and on completion of the assembly			
		2.15	Explain how to make adjustments to components/assemblies to ensure that they function correctly (such as travel and working clearance, timing and sequence)			
		2.16	Explain why securing devices need to be tightened to the correct torque and locked, and the different methods used			
		2.17	Describe the tools and equipment used in the engine stripping and re-building activities, and their calibration/care and control procedures, and the need to control and account for all tools and equipment used during the stripping and re-building activities			
		2.18	Explain how to deal with problems (such as what to do when components are damaged or worn in some way, the correct equipment or parts not available, components do not come apart as readily as expected)			
		2.19	Describe the recording documentation to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation			
		2.20	Describe the procedure for the safe disposal of waste materials, scrap components, contaminated oil and fuel			

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 stripping and rebuilding activities (such as returning tools and 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 171: 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 F.

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: • 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: • 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: • 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: • 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: • 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: • Surface modelling • Solid modelling • Wire frame modelling			
		1.12	Use all of the following CAD operations to highlight design areas in the modelling environment: • 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: • 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: • Constrained parts and assemblies Plus eight more from the following: • 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: • 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: • 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: • 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: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 172: 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 F.

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: • 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: • 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: • 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: • 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
		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: • Start time of the project • Outcomes to be achieved at milestones • Completion date of the project And an estimate of the likely costs of the project, to include all of the following: • 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: • 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: • 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: • Verbal report Plus one more method from the following: • 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 173: 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 F.

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: • 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
		1.8	Use all of the following software packages: Word-processing: Produce three of the following types of documentation: • Standard letter • Memorandum • Facsimile • Curriculum vitae (CV) • Project report • Instruction manual • Work timetable • Layouts/templates • Macros • Other specific application Database: Create and use a database for two of the following applications: • 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
		1.8	...continued Spreadsheet: Create and use spreadsheets for two of the following applications: • Budgeting • Cost analysis (such as transport, photocopying, materials) • Wages • Project costing • Other specific application Graphics: Use graphics software to produce two of the following types of documentation: • Preparing visual aids for a presentation • Producing advertising material • Producing technical information • Producing logbook entries • Other specific application Electronic communication: Use two of the following methods : • Company e-mail system • Internet e-mail • Mobile text messaging • Web camera chat/conferencing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Carry out all of the following whilst using the software packages: • 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: • 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: • 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 174: 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 F.

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: • 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: • Not right first time • Delivery schedule achievement Plus one more of the following: • 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: • 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: • 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: • Verbal report using visual aids such as flipcharts and white boards Plus one more method from the following: • 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 175: 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 F.

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: • 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 activitie			
		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: • 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, scribers, 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: • 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: • 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: • 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: • 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: • 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: • 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: • 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: • External micrometers • Vernier/digital/dial calliper • Surface finish equipment (such as comparison plates, machines) Plus four more of the following: • 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: • 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)			
		2.21	Explain when to act on their own initiative and when to seek help and advice from others			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 176: 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 F.

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: • 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: • 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, scribers, 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: • 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: • 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: • Guillotine • Pillar or bench drill • Bending machine (hand or powered) Plus two more from the following: • 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: • Straight cuts • Cut-ins (straight and curved) • Notches • External curved contours • Internal curved contours • Round holes • Square holes Plus four of the following: • 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: • 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: • 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: • 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: • 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: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 177: 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 F.

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: • 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
		1.6	Use two of the following test instruments during the wiring and testing activities: • Low reading ohmmeter • Insulation resistance tester • Clamp meter • Voltage indicator Plus three more of the following: • 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: • 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: • 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: • 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: • 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: • 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: • 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 • Oscillations • Attenuation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	...continued • 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: • 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 178: 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 F.

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: • 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
		1.7	Use appropriate dismantling and re-assembly techniques to deal with three of the following technologies: Mechanical equipment: Carry out all of the following: • 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 Electrical equipment: Carry out all of the following: • 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
		1.7	...continued Fluid power equipment: Carry out all of the following: • 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 Programmable controller based equipment: Carry out all of the following: • 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: • Isolating instruments/sensing devices • Disconnecting supply/signal connections • Removing and replacing instruments in the system • Replacing all 'lifed' 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: • 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
		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: • 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) Plus two more from the following: • 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: • 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 'lifed' 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*)

Unit 179: Joining Public Service Vehicle Components by Mechanical Processes

Unit reference number: L/503/4056

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 join public service vehicle components by mechanical processes. 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 F.

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	Join Public Service Vehicle Components by Mechanical Processes	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Plan the activity before starting the joining process			
		1.3	Obtain the appropriate tools and equipment for the joining operations, and check that they are in a safe and usable condition			
		1.4	Carry out all of the following activities during the joining activity: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures • Obtain and use the appropriate documentation (such as job instructions and drawings) • Maintain a safe working environment at all times • Join components in the correct order and sequence using the correct fastening device • Ensure any faces to be joined are clean and prepared correctly • Return all tools and equipment to the correct location on completion of the joining activities • Dispose of waste materials in accordance with approved procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Use all of the following types of equipment: • Riveting guns (appropriate to rivet type) • Hand drills (air and electric) • Hand tools applicable to the type of fastener Plus five of the following during the joining activity: • Drill bits (appropriate to the material) • Clamps • Screw bits (appropriate to the type of fastener) • Templates • Countersinks • Jigs and fixtures			
		1.6	Secure the components, using the correct fastening devices and joining techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Join components and assemblies using all of the following: • Hollow rivets • Snap fit fasteners • Threaded fasteners • Bonding Plus three more from the following: • Nutserts • Drive lock rivets • Self tapping screws • Spring washers • Locking nuts • Other joining/locking devices			
		1.8	Use three of the following methods and techniques in the joining process: • Countersinking • Tapping internal threads • Drilling holes to depth • Drilling holes through components • Dies for external threads • Reaming			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Use fasteners to join components for all of the following: • Sub assemblies • Structural components • Panels/skins			
		1.10	Join components in three of the following positions • Horizontal • Vertical • Overhead • Difficult access/confined spaces			
		1.11	Use three of the following to carry out checks during, and on completion of, the joining activities: • Rules/tapes • Squares/straight edge • Customer specific gauges • Templates • Torque wrench/gauges			
		1.12	Check that all dimensional and geometrical aspects of the assembly are to the specification			
		1.13	Check that the join is complete, and that all components are free from damage			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Ensure joined components comply with all of the following requirements as appropriate to the joining method: • All components are correctly joined and aligned, in accordance with the specification • Bolted and screwed joints are tightened to the correct torque • Riveted joints are free from excessive material deformation and surface marks • Bonded joints are secure, free from contamination and excess adhesive/sealants • Overall dimensions are within specification tolerances • Completed assemblies have secure and firm joints, and are clean and free from burrs/flash, deformation or cracking			
		1.15	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			
		1.16	Leave the work area in a safe and tidy condition on completion of the joining activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to Join Public Service Vehicle Components by Mechanical Processes	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the joining activity			
		2.2	Describe the importance of wearing appropriate protective clothing and equipment, and keeping the work area safe and tidy			
		2.3	Describe the hazards associated with joining components, and with the tools and equipment used (such as use of power tools, trailing leads or hoses, damaged or badly maintained tools and equipment), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	Describe the importance of working to the joining instructions and appropriate specifications			
		2.6	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			
		2.7	Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.8	Describe the process for the control of materials, and the need for component control			
		2.9	Explain how to identify the mechanical fasteners to be used; material identification systems and codes used			
		2.10	Describe the importance of using the correct tools and equipment when joining components			
		2.11	Describe the implications to the fastener and component if incorrect tools and equipment are used			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.12	Describe the importance of using the specified components and joining devices for the assembly, and why they must not use substitutes			
		2.13	Explain where appropriate, the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them			
		2.14	Describe the various types, range and applications of fasteners used and the methods of installing them including any preparation requirements			
		2.15	Describe the advantages and disadvantages of the different forms and types of mechanical join			
		2.16	Describe the procedures to be adopted when removing rivets and other fasteners			
		2.17	Explain how to check that riveting guns, power tools and attachments are in a safe and usable condition, and the action to be taken in the event of identifying defective equipment			
		2.18	Describe the methods used to check the security and torque of joined components			
		2.19	Describe the importance of ensuring that fasteners are tightened to the correct torque			
		2.20	Describe the safety implications for not tightening fasters to the correct specification			
		2.21	Explain how and why tools are calibrated, and how to check that the tools used are using are within calibration dates			
		2.22	Explain how to conduct any necessary checks to ensure the accuracy and quality of the join produced			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.23	Describe the problems that can occur with the installation of the mechanical fasteners, and how these can be overcome			
		2.24	Explain when to act on their own initiative and when to seek help and advice from others			
		2.25	Describe the importance of leaving the work area in a safe and clean condition on completion of the activities (such as removing and storing power leads, isolating equipment, removing and returning drills, cleaning the equipment and removing and disposing of waste)			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 180: Assembling Structural Sub Assemblies to Produce a Public Service Vehicle

Unit reference number: R/503/4057

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to assemble structural sub assemblies to produce a public service vehicle. 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 F.

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	Assemble Structural Sub Assemblies to Produce a Public Service Vehicle	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Plan the assembly activities before they start them			
		1.3	Obtain and prepare the appropriate components, tools and equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.4	Carry out all of the following during the assembly activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures • Obtain and use the appropriate assembly documentation (such as job instructions and drawings) • Maintain a safe working environment at all times • Use lifting and slinging equipment in accordance with health and safety guidelines and procedures (where appropriate) • Fit and secure sub assemblies in the correct order and sequence using the correct assembly method • Ensure any sub assembly faces are clean and prepared correctly • Ensure that any protective wax is removed from threaded holes prior to assembling sub assemblies • Dispose of waste materials in accordance with approved procedures • Ensure that all power tool cables, extension leads are in a safe and serviceable condition • Ensure that the components used are free from foreign objects, dirt or other contamination • Coat components with anti rust paint where applicable • Return all tools and equipment to the correct locations on completion of the assembly activities			
		1.5	Use the appropriate methods and techniques to assemble the components in their correct positions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Assemble public service vehicle sub assemblies using three of the following assembly aids and equipment: • Lifting equipment • Specialised assembly tools/equipment • Jigs/fixtures • Shims and packing • Moving equipment • Supporting equipment			
		1.7	Prepare, fit and secure ten the following structural sub assemblies and ancillary components to produce a public service vehicle: • Side frames • Side plank • Side beading • Side cladding • Mid deck • Roof assembly • Rear framework • Rear bulk head • Front end assembly • Upper deck front dome • Main floor • Support brackets • Insulation			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Secure the components using the specified connectors and securing devices			
		1.9	Secure sub assemblies and ancillary components using all the following: • Nuts and bolts • Rivets • Screws • Adhesives • Sealants			
		1.10	Check the completed assembly to ensure that all operations have been completed and that the finished assembly meets the required specification			
		1.11	Carry out the required quality checks to include all of the following: • Positional accuracy • Security of sub assembly components • Completeness • Dimensions • Orientation • Alignment/distorsion • Freedom from damage or foreign objects • Torque settings			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Produce public service vehicle assemblies which comply with all of the following: • All components are correctly assembled and aligned in accordance with the specification • Sub assemblies are correctly adjusted and have appropriate clearances • Where appropriate, assemblies meet required geometric tolerances (such as square, straight, angles free from twists) • Bonded joints are secure, free from contamination and excess adhesive/sealants • All fastenings have appropriate washers and are tightened to the required torque			
		1.13	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			
		1.14	Leave the work area in a safe and tidy condition on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to Assemble Structural Sub Assemblies to Produce a Public Service Vehicle	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the assembly activities undertaken			
		2.2	Describe the importance of wearing appropriate protective clothing and equipment, and of keeping the work area safe and tidy			
		2.3	Describe the hazards associated with the assembly activities (such as use of power tools, trailing leads or air hoses, damaged or badly maintained tools and equipment, lifting and handling heavy items), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	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			
		2.6	Explain how to interpret drawings and other production documentation, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.7	Explain how to prepare the sub assemblies in readiness for the assembly activities (such as visually checking for defects, cleaning the components, removing burrs and sharp edges)			
		2.8	Describe the general principles of mechanical assembly, and the purpose and function of each sub assembly and materials used (including component identification systems such as codes and component orientation indicators)			
		2.9	Describe the assembly/joining methods, techniques and procedures to be used, and the importance of adhering to these procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how the sub assemblies are to be aligned, adjusted and positioned prior to securing, and the tools and equipment to be used for this			
		2.11	Describe the various mechanical fastening devices that are used (such as nuts, bolts, screws, and rivets)			
		2.12	Describe the importance of using the specified components and joining devices for the assembly, and why they must not use substitutes			
		2.13	Explain where appropriate, the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them			
		2.14	Explain how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the assembly (such as torque settings, dimensions, completeness, security of components, alignment and distortion			
		2.15	Explain how to detect assembly defects, and what to do to rectify them (such as ineffective joining techniques, foreign objects, component damage)			
		2.16	Describe the methods and equipment used to transport, lift and handle components and assemblies			
		2.17	Explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition			
		2.18	Describe the importance of ensuring that all tools are used correctly and within their permitted operating range			
		2.19	Describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Problems that could occur with the assembly operations, and the importance of informing appropriate people of non-conformances			
		2.21	Explain when to act on their own initiative and when to seek help and advice from others			
		2.22	Explain how to leave the work area in a safe and clean condition on completion of the assembly activities (such as removing and storing power leads, returning hand tools and 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 181: Fitting Sub Assemblies and Components to Public Service Vehicles

Unit reference number: Y/503/4058

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to fit sub assemblies and components to public service vehicles. 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 F.

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	Fit Sub Assemblies and Components to Public Service Vehicles	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Plan the fitting and assembly activities before they start them			
		1.3	Obtain and prepare the appropriate components, tools and equipment			
		1.4	Use the appropriate methods and techniques to assemble and fit the components in their correct positions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Carry out all of the following during the assembly activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures • Obtain and use the appropriate assembly documentation (such as job instructions and drawings) • Maintain a safe working environment at all times • Use lifting and slinging equipment in accordance with health and safety guidelines and procedures (where appropriate) • Fit and secure sub assemblies and components in the correct order and sequence using the correct assembly method • Trim components/coverings using the correct tools and equipment (where applicable) • Ensure any sub assembly faces are clean and prepared correctly • Ensure that any protective wax is removed from threaded holes prior to assembling sub assemblies • Dispose of waste materials in accordance with approved procedures • Ensure that all power tool cables, extension leads are in a safe and serviceable condition • Ensure that the components used are free from foreign objects, dirt or other contamination • Coat components with anti rust paint where applicable • Return all tools and equipment to the correct locations on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Assemble public service vehicle sub assemblies using three of the following assembly aids and equipment: • Lifting equipment • Specialised assembly tools/equipment • Jigs/fixtures • Shims and packing • Moving equipment • Supporting equipment			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.7	Prepare, fit and secure eleven the following sub assemblies and components to produce a public service vehicle: • Wheel arches • Seat rails • Tyre guards • Stair assemblies • Side linings • Stringers • Cab floor • Floor/underfloor • Engine doors • Glazing units • Fire suppression unit • Door assembly • Disabled access equipment • Trim components (internal and external) • Mirrors • Seats • Hand poles • Transfers and decals • Other			
		1.8	Secure the components using the specified connectors and securing devices			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Secure sub assemblies and ancillary components using all the following: • Nuts and bolts • Rivets • Screws • Adhesives • Sealants			
		1.10	Check the completed assembly to ensure that all operations have been completed and that the finished assembly meets the required specification			
		1.11	Carry out the required quality checks to include eight of the following: • Positional accuracy • Security of sub assembly components • Freedom of movement • Completeness • Dimensions • Orientation • Operating/working clearances • Alignment/distorsion • Freedom from damage or foreign objects • Torque settings			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Produce public service vehicle assemblies which comply with **all** of the following: • All components are correctly assembled and aligned in accordance with the specification • Fixed sub assemblies are correctly adjusted and have appropriate clearances • Moving parts are correctly adjusted and have the appropriate clearances (where appropriate) • Bolted and screwed joints are tightened to the correct torque • Bonded joints are secure, free from contamination and excess adhesive/sealants • Final assemblies meet required customer specification			
		1.13	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			
		1.14	Leave the work area in a safe and tidy condition on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to fit Sub Assemblies and Components to Public Service Vehicles	2.1	Describe the health and safety requirements, and safe working practices and procedures required for the assembly activities undertaken			
		2.2	Describe the importance of wearing appropriate protective clothing and equipment, and of keeping the work area safe and tidy			
		2.3	Describe the hazards associated with the assembly activities (such as use of power tools, trailing leads or air hoses, damaged or badly maintained tools and equipment, lifting and handling heavy items), and how they can be minimised			
		2.4	Describe the procedure for obtaining the required drawings, job instructions and other related specifications			
		2.5	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			
		2.6	Explain how to interpret drawings and other production documentation, imperial and metric systems of measurement, workpiece reference points and system of tolerancing			
		2.7	Explain how to prepare the sub assemblies in readiness for the assembly activities (such as visually checking for defects, cleaning the components, removing burrs and sharp edges)			
		2.8	Describe the general principles of mechanical assembly, and the purpose and function of each sub assembly and materials used (including component identification systems such as codes and component orientation indicators)			
		2.9	Describe the assembly/joining methods, techniques and procedures to be used, and the importance of adhering to these procedures			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Explain how the sub assemblies are to be aligned, adjusted and positioned prior to securing, and the tools and equipment to be used for this			
		2.11	Describe the various mechanical fastening devices that are used (such as nuts, bolts, screws, and rivets)			
		2.12	Describe the importance of using the specified components and joining devices for the assembly, and why they must not use substitutes			
		2.13	Explain where appropriate, the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them			
		2.14	Explain how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the assembly (such as torque settings, dimensions, completeness, security of components, alignment and distortion			
		2.15	Explain how to detect assembly defects, and what to do to rectify them (such as ineffective joining techniques, foreign objects, component damage)			
		2.16	Describe the methods and equipment used to transport, lift and handle components and assemblies			
		2.17	Explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition			
		2.18	Describe the importance of ensuring that all tools are used correctly and within their permitted operating range			
		2.19	Describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.20	Describe the problems that could occur with the assembly operations, and the importance of informing appropriate people of non-conformances			
		2.21	Explain when to act on their own initiative and when to seek help and advice from others			
		2.22	Explain how to leave the work area in a safe and clean condition on completion of the assembly activities (such as removing and storing power leads, returning hand tools and 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 182: Preparing and Manoeuvring Armoured Fighting Vehicles AFVs for Maintenance and Transportation

Unit reference number: R/503/7198

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to prepare and manoever armoured fighting vehicles (AFVs) for maintenance and transprotation. 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 F.

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	Prepare and Manoeuvre Armoured Fighting Vehicles (AFVs) for Maintenance and Transportation	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines			
		1.2	Obtain all the information and documentation they require to start the vehicle manoeuvring activities			
		1.3	Plan the vehicle manoeuvring activities before they start them			
		1.4	Obtain and prepare any support equipment required to move and secure the vehicle and check that it is in a useable condition			
		1.5	Carry out all of the following prior to commencing the manoeuvring of AFV vehicles: • Ensure the appropriate authorisation to carry out the manoeuvring activities is obtained • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and • Other relevant safety regulations • Check the immediate work area is free from hazards or obstructions • Check the vehicle is free from hazards or obstructions • Provide and maintain safe access and working arrangements for the work to be completed • Position relevant warning signs in a secure and visible location (where applicable)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.6	Prepare the vehicle for the manoeuvring activities to be undertaken			
		1.7	Prepare the AFV for movement by carrying out all of the following: • Visually check the vehicle for signs of leakage, damage, missing parts and wear/deterioration • Remove excessive dirt and grime • Check the fire warning system is operating correctly • Check lighting systems are operational • Check fuel levels • Check fluid levels (such as cooling system, hydraulic fluid reservoirs, oil levels for gearbox, steering unit and final drive) • Check hull drain plugs • Complete operational checks on blackout switches, convoy lights, and infrared lights where fitted • Check gauges and warning lights are operating correctly • Carry out press to test functions to check protected systems are operating correctly • Locate covers/bungs in the appropriate locations to protect components/systems from the ingress of • Foreign objects or other substances			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.8	Prepare the AFV for movement by securing three of the following components/systems: • Hatches • Weapon systems • Turret/cupola • Road wheels • Other items relevant to the vehicle (such as external tool bins, engine covers, mirrors, external light guards)			
		1.9	Start the vehicle following the correct procedures as per vehicle Army Equipment Support Publication (AESPs)			
		1.10	Carry out the manoeuvring activities using the correct procedures and work instructions			
		1.11	Manoeuvre the AFV in all of the following situations: • By day (using hand & verbal communication) • By night (using torch signals) • Abnormal weather conditions • In confined spaces			
		1.12	Manoeuvre, position and secure the AFV onto one of the following methods of transportation: • Lorry/low loader • Train • Aircraft • Boat			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.13	Carry out AFV Manoeuvring Procedures - to include all of the following: • Recovery (un ditching or de bogging) • Prepare for towing cross country • Prepare for tow starting			
		1.14	Use one of the following when manoeuvring the AFV: • A" Frame • Straight bar • Wire tow rope • Kinetic energy rope • D shackles			
		1.15	Simulate carrying out all of the following emergency procedures : • Fire fighting on an AFV • Evacuating casualties from an AFV • Road traffic accident/incident • Vehicle breakdown procedures			
		1.16	Carry out two of the following roles when manoeuvring the AFV: • Driver • Controller • Marshaller			
		1.17	Carry out the manoeuvring activities within the limits of their personal authority			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		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	Report any instances where the vehicle securing and/or manoeuvring activities cannot be fully met			
		1.20	Leave the work area in a safe and tidy condition on completion of the manoeuvring activities			
		1.21	Dispose of waste materials in line with organisational and environmentally safe procedures			
		1.22	Ensure that the vehicle is left in a safe and secure condition on completion of activities			
		1.23	Complete relevant documentation on completion of the manoeuvring activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to prepare and manoeuvre Armoured Fighting Vehicles (AFVs) for Maintenance and Transportation	2.1	Describe the specific health and safety requirements, precautions, and safe working practices and procedures to be observed whilst preparing and manoeuvring AFVs for maintenance and transportation			
		2.2	Describe the types of protective equipment (PPE) they need to use for both personnel protection and protection of the AFV			
		2.3	Describe the importance of wearing appropriate protective clothing and equipment			
		2.4	Describe the procedures to be followed to evacuate personnel from AFVs. Including fire evacuation			
		2.5	Describe the hazards associated with driving and manoeuvring AFVs on the public highway			
		2.6	Describe the procedures to be followed if AFV breaks down			
		2.7	Describe the procedures to be followed in the event of an accident/incident			
		2.8	Describe the authorisation process and documentation required to prepare and manoeuvre the AFV			
		2.9	Describe the AFV system isolation procedures to be followed to secure the vehicle weapons systems and adherence to Army Equipment Support Publication (AESPs)			
		2.10	Describe the methods used to secure components such as hatches, turret and other unsecured items			
		2.11	Describe the checks to be carried out on the AFV before it is stated and manoeuvred including leaks, damage, wear and deterioration or missing parts			
		2.12	Describe the AFV system “start up” and “run down” procedures to be followed before and after use			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.13	Explain how to obtain and interpret manuals and other documents needed in the manoeuvring operation for AFVs			
		2.14	Describe the principles of how the AFV functions, its operating sequence, controls, the working purpose of individual units/components and how they interact			
		2.15	Explain how to operate and secure the vehicles communication system on AFVs			
		2.16	Describe the hazards associated with driving, marshalling, parking AFVs especially in confined area/spaces, and how these hazards can be minimised			
		2.17	Describe the hazards associated with towing AFVs and how these hazards can be minimised			
		2.18	Describe the hazards associated with tow starting AFVs and how these hazards can be minimised			
		2.19	Describe the hazards associated with AFVs recovery and how these hazards can be minimised			
		2.20	Describe the importance of checking that the recovery equipment used to assist in the manoeuvring of AFVs is in a usable and safe condition and the specific checks that need to be made			
		2.21	Describe the range and types of equipment to be used when towing or recovering AFVs to include “A” frames, Straight Bar, Wire Tow Rope, Kinetic energy Rope and “D” Shackles			
		2.22	Describe the factors to take into account when deciding which of the following should be used and why, A frame, straight bar, wire tow rope, kinetic energy rope and D shackles			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.23	Describe the importance of ensuring that the AFV is secured correctly when being prepared for onward transportation and the implications if this is not carried out correctly			
		2.24	Describe the methods used to position and secure the AFV to transport the vehicle by rails, road, air and sea			
		2.25	Describe the problems that can occur with the AFV preparation and manoeuvring activities and how these can be overcome			
		2.26	Describe the duties and responsibilities of the personnel used in the preparation and manoeuvring activities including the driver, controller and marshaller			
		2.27	Describe the AFV driving and control procedures to be used when manoeuvring across country			
		2.28	Describe the AFV driving and control procedures to be used when manoeuvring over obstacles			
		2.29	Describe the procedures to be followed to identify and log faults found on the AFV			
		2.30	Describe the different methods of communication used when manoeuvring and obstacle crossing for AFVs to include hand signals, torch signals and verbal orders			
		2.31	Describe the procedure to be used to dispose of any waste materials safely and in an environmentally friendly manner			
		2.32	Describe the importance of leaving AFVs in a safe condition on completion of the manoeuvring activities, and the correct after use procedures			
		2.33	Describe the extent of their own responsibility and whom they should report to if they have problems that they cannot resolve			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)

Unit 183: Producing Composite Mouldings Using Resin Film Infusion Techniques

Unit reference number: J/504/3404

QCF level: 2

Credit value: 14

Guided learning hours: 64

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to produce composite mouldings using resin film infusion techniques. 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 F.

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 Composite Mouldings using Resin Film Infusion Techniques	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 moulding activities: • Adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations • Follow job instructions, drawings, process specifications and moulding/laminating procedures • Ensure that all equipment and tools used are in a safe and serviceable condition • Return all tools and equipment to the correct location on completion of the moulding activities			
		1.3	Plan the resin infusion activities before they start them			
		1.4	Prepare the moulds, jigs or formers ready for the manufacturing operations			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.5	Carry out all of the following activities when preparing production tooling: • Check that tooling is correct and complete • Clean tooling and remove resin build-ups • Check for surface defects • Correctly apply sealers/release agents • Clean and store tooling suitably after use			
		1.6	Check materials are fit for purpose and in life.			
		1.7	Carry out all of the following activities to prepare materials for production: • Obtain correct materials for the activity • Thaw material removed from freezer storage • Identifying defects in resin film materials • Check that materials are fit for purpose and in life • Check availability of ancillary materials required • Cut materials to correct shape and orientation • Check materials when provided in kit form • Identify and protect materials in the work area			
		1.8	Carry out the resin film infusion activities, using the correct methods and techniques			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Produce a range of mouldings, using one of the following types of tooling: • Pattern • Mandrels • Metal • Tooling block • Wet lay-up • Infused tooling • Glass pre-preg • Carbon pre-preg • Female tooling • Male tooling • Multi-part tools • Matched tooling • Closed tooling			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.10	Produce a range of mouldings incorporating two of the following: • Butt joins • Overlap joins • Staggered joins • Orientated plies • Inverted plies • Inserts • Balancing plies • Fixtures			
		1.11	Produce a range of mouldings incorporating three of the following shape features: • Internal corners • External corners • Vertical surface • Double curvature • Concave surface • Horizontal surface • Convex surfaces • Return surfaces • Joggle details • Nett edges			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.12	Produce a range of mouldings using two of the following methods: • Production of ply templates • Nesting of ply templates • Material cutting & kitting • Shaped locators • Joining boards • Loose tooling • Intensifiers • Vacuum de-bulk • Moulded datum features • Placement jigs • Laser projection placement • Video feedback placement			
		1.13	Produce a range of mouldings using one type of resin from: • Bio resin • Thermoplastic • Epoxy • Phenolic • Bismaleimide • Cyanate ester • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.14	Produce a range of mouldings using techniques for one type of fibre from: • Natural fibre • Thermoplastic • Glass • Aramid • Carbon • Hybrid • Other (to be specified)			
		1.15	Produce a range of mouldings using one type of reinforcement from: • Continuous • Uni-directional • Tapes • Tissues/veils • Woven • Braids • Multi-axis			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.16	Produce a range of mouldings using one type of core material (where applicable to the Sector or process): • Solid timber • End grain balsa • Thermoplastic core • Syntactic core • Rigid foam • Expanding core • Fibrous honeycomb • Aluminium honeycomb • Other (to be specified)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.17	Use one of the following methods when using core materials (where applicable to the Sector or process): • Core templates • Pre-shaping core • Core chamfers • Core splicing • Peel plies • Bonding paste • Edge filling • Adhesive/resin films • Potting/filler compound • Single stage curing • Multi-stage curing			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.18	Using one of the following for applying temperature during the cure cycle: • Oven • Autoclave • Heated tools/moulds • Heat mats • Heated press • Curing lamps • Infrared heating • Electro-magnetic inductance • Micro-wave • Other (to be specified)			
		1.19	Using one of the following for applying pressure to consolidate the moulding: • Vacuum bags • Pressure bags • Thermal mould expansion • Fibre tensioning • Press • Autoclave			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.20	Where vacuum bags are used, use two of the following processes/methods: • Check vacuum integrity • Surface bagging • Envelope bagging • Multi-part envelope bags • Internal bagging • Through-tube bagging • Pleats and tucks • Reusable bagging • Use of reusable vacuum fittings			
		1.21	Remove the mouldings correctly and trim/finish them to specification			
		1.22	Remove the composite mouldings and carry out all of the following: • Visually check that the moulding is complete and free from defects • Use appropriate equipment/gauges to check for dimensional • Accuracy (such as overall dimensions, thickness of material/moulding, geometric features) • Carry out repairs (where appropriate) • Finish the mouldings, using appropriate tools and equipment			
		1.23	Check that all the required operations have been completed to specification			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.24	Produce a range of mouldings which comply with one of the following standards: • Components are dimensionally accurate within specification requirements • Finished components meet the required shape/geometry (such as square, straight, angle, free from twists) • Completed components are free from defects, sharp edges or slivers • Components meet company standards and procedures			
		1.25	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			
		1.26	Leave the work area in a safe and tidy condition on completion of the assembly activities			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to produce Composite Mouldings using Resin Film Infusion Techniques	2.1	Describe the Health and safety precautions to be taken, and procedures used, when working with composite materials, consumables, tools and equipment in the specific work area			
		2.2	Describe the hazards associated with carrying out resin film infusion techniques, and with the composite materials, consumables, tools and equipment used, and how to minimise these and reduce any risks			
		2.3	Describe the Protective equipment (PPE) that is needed for personal protection and, where required, the protection of others			
		2.4	Describe the application of COSHH regulations in relation to the storage, use and disposal of composite materials and consumables			
		2.5	Describe the specific environmental conditions the must be observed when producing composite mouldings (such as temperature, humidity, fume/dust extraction systems and equipment)			
		2.6	Explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken			
		2.7	Explain how to interpret drawings/lay up manuals, imperial and metric systems of measurement, workpiece reference/datum points and system of tolerancing			
		2.8	Describe the quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents			
		2.9	Describe the conventions and terminology used for resin film infusion techniques (such as material orientation, material identification, material templates, ply lay-up, pressure plates, vacuum bagging, cure cycles, exotherm)			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.10	Describe the different types of resins, reinforcement, catalysts, accelerators and additives used, and their applications			
		2.11	Describe the different types of fibre materials, fabrics, orientations, their combinations and applications			
		2.12	Describe the building up laminates (including orientation and balance of plies) to minimise spring and distortion in composite mouldings			
		2.13	Describe the different core, insert and filler materials, and their applications			
		2.14	Describe the visual identification of both raw and finished composite materials			
		2.15	Describe the identification of materials by product codes			
		2.16	Describe the different types of production tooling used for producing composite mouldings, and their applications			
		2.17	Describe the identification and rectification of defects in production tooling			
		2.18	Describe the methods of preparation for patterns, moulds and tooling, including the correct selection and use of surface sealers and release agents			
		2.19	Describe the correct methods of storage, thawing and handling of resin film infusion materials (including monitoring temperature, storage life and out-life)			
		2.20	Describe the methods used in the application of resin film infusion materials to tooling surfaces (including methods of tailoring and cutting)			
		2.21	Describe the correct methods of storage and handling of ancillary and consumable materials			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		2.22	Describe the selection and use of ancillary and consumable materials (such as release films, breather fabrics, bagging films, tapes) to meet performance requirements (such as temperature and compatibility)			
		2.23	Describe the tools and equipment used in the resin film infusion activities, and their care, preparation and control procedures			
		2.24	Describe the problems that can occur during the lay-up process (including modifications to the ply lay-up, and defects such as contamination and distortion			
		2.25	Explain how modifications and defects can be overcome during the resin film infusion activity			
		2.26	Describe the cure cycles (including temperature and pressure ramps, dwell times, post curing)			
		2.27	Describe the need for monitoring the cure cycle (using thermocouples, probes, chart recorders and data logs)			
		2.28	Describe the procedures and methods used for removing mouldings from production tooling			
		2.29	Describe the identification of defects in the composite moulding (such as de-lamination, voids, contaminants)			
		2.30	Describe the care and safe handling of production tooling and composite mouldings throughout the production cycle			
		2.31	Describe the production controls used in the work area, and actions to be taken for unaccounted items			
		2.32	Explain how the composite moulding relates to its own quality documents, and the production tooling used			
		2.33	Describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

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 NVQs/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 drafted …..in 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 NVQ 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: Engineering NVQ QCF Unit Assessment

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 NVQ units
- promote cost effective assessment plans

This document also provides definitions for:

- the qualifications and experience required for Assessors and Verifiers
- the assessment environment and notes on simulation/replication.
- 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 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.

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 NVQ 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 of this qualification 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 relevant sector/occupation.

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

Technical Requirements for Assessors and Verifiers

Position	Prime activity requirements	Support activity requirements	Technical requirements (see notes)
Assessor	Assessment Skills	IV Systems	Technical *competence* in the areas covered by the QCF units being assessed
Internal Verifier	Verification Skills	Assessment Knowledge	Technical *understanding* of the areas covered by the QCF units being verified
External Verifier	Verification skills	Assessment Understanding	Technical *awareness* 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 portfolio 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 *discuss* the general principles of the competences being assessed	An ability to *describe* the practical aspects of the competence being assessed	An ability to *demonstrate* the practical competences being assessed
Assessor			
Internal Verifier			
External Verifier			

Assessment Environment

The evidence put forward for this unit can only be regarded valid, reliable, sufficient and authentic if achieved and obtained in the working environment and be clearly attributable to the learner. However, in certain circumstances, simulation/replication of work activities may be acceptable.

- The use of high quality, realistic simulations/replication, which impose pressures which are consistent with workplace expectations, should only be used in relation to the assessment of the following:-
  - rare or dangerous occurrences, such as those associated with health, safety and the environment issues, emergency scenarios and rare operations at work;
  - the response to faults and problems for which no opportunity has presented for the use of naturally occurring workplace evidence of learners competence;
  - aspects of working relationships and communications for which no opportunity has presented for the use of naturally occurring workplace evidence of learners competence.
- Simulations/replications will require prior approval from the specific Awarding Organisation and should be designed in relation to the following parameters: -
  - the environment in which simulations take place must be designed to match the characteristics of the working environment;
  - competencies achieved via simulation/replication must be transferable to the working environment
  - simulations which are designed to assess competence in dealing with emergencies, accidents and incidents must be verified as complying with relevant health, safety and environmental legislation by a competent health and safety/environmental control officer before being used;
  - simulated activities should place learners under the same pressures of time, access to resources and access to information as would be expected if the activity was real;
  - simulated activities should require learners to demonstrate their competence using plant and/or equipment used in the working environment;
  - simulated activities which require interaction with colleagues and contacts should require the learner to use the communication media that would be expected at the workplace;
  - for health and safety reason simulations need not involve the use of genuine substances/materials. Any simulations which require the learner to handle or otherwise deal with materials substances/should ensure that the substitute take the same form as in the workplace

Access to Assessment

There are no entry qualifications or age limits required by learners to undertake the NVQ units unless this is a legal requirement of the process or the environment. Assessment is open to any learner who has the potential to achieve the assessment criteria set out in the 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 NVQ 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, 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.

Minimum 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 3 different examples of performance must be provided, and must be sufficient to show that the assessment criteria have been achieved to the prescribed standards. It is possible that some of the bulleted items in the assessment criteria may be covered more than once. The assessor and learner need to devise an assessment plan to ensure that performance evidence is sufficient to cover all the specified assessment criteria and which maximises the opportunities to gather evidence. Where applicable, performance evidence maybe used for more than one unit.

The most effective way of assessing competence, is through direct observation of the learner. Assessors must make sure that the evidence provided reflects the learner's competence and not just the achievement of a training programme.

Evidence that has been produced from team activities, for example, maintenance or installation activities is only valid when it clearly relates to the learners specific and individual contribution to the activity, and not to the general outcome(s).

Each example of performance evidence will often contain features that apply to more than one unit, and can be used as evidence in any unit where appropriate.

Performance evidence must be:

- outputs of the learner's work, such as items that have been manufactured, installed, maintained, designed, planned or quality assured, and documents produced as part of a work activity

together with:

- evidence of the way the learner carried out the activities such as witness testimonies, assessor observations or authenticated learner reports, records or photographs of the work/activity carried out, etc.
- 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 the various features and techniques. Where this is the case, separate fragments of evidence would not provide this combination of features and techniques and will not, therefore, be acceptable as demonstrating competent performance.
- If there is any doubt as to what constitutes valid, authentic and reliable evidence, the internal and/or external verifier should be consulted.

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 learners 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.

Quality Control of Assessment

General

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

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

Approval

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

Must ensure that the prospective Centre:

- Meets any procedural requirements specified by the Awarding Organisation
- 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, assessment and QA for the qualifications

Awarding Organisation's may decide to visit the Centre to view the evidence provided.

The Awarding Body 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, assessor and IV sampling strategy to be deployed and the rationale behind this
- that the Centre's internal quality assurance processes are effective in candidate 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

Awarding Organisations are required to provide to SEMTA, on request, details of the strategies, rationales and reviews detailed above.

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 N/SVQs.

Annexe C: Assessment requirements/strategy: Management Standards Centre

1. Introduction

1.1. The Management & Leadership Assessment Strategy is designed to provide awarding organisations with a robust and flexible approach to deliver assessment for Management & Team Leading NVQs / SVQs and competence based qualifications.

2. External quality control

2.1. Awarding organisations will provide qualifications and quality assurance that support their delivery to all Management & Team Leading NVQs / SVQs and competence-based qualification assessment centres in line with regulatory requirements in England, Scotland, Wales and Northern Ireland.

2.2. Awarding organisations will regularly carry out standard risk assessments in each Management & Team Leading NVQ / SVQ and competence-based qualification assessment centre and manage all identified risks appropriately.

2.3. Awarding organisations will consistently apply external verification processes at all Management & Team Leading NVQ / SVQ and competence-based qualification assessment centres, underpinned by standard risk assessment and risk management processes.

2.4. Awarding organisations will supply the CfA: Business Skills @ Work (CfA) with quarterly reports on:

- Registration and achievement data at qualification level, and unit level where available

3. Assessing performance

3.1. Assessment of all units at any level of Management & Team Leading NVQs / SVQs and competence-based qualifications may be based on either candidate performance at work or through simulation, as necessary (See Section 4 below).

3.2. Units which have been imported by the CfA in their Management & Team Leading NVQs / SVQs and competence-based qualifications will be assessed in compliance with the imported assessment strategies.

4. Simulation of NVQ / SVQ units

4.1. Simulation must not be used, except in exceptional circumstances where natural work evidence is unlikely to occur. Agreement must be gained from the awarding organisation for the use of any simulation. If simulation is used, it should be used sparingly and should only form a small part of the evidence for the qualification.

5. Occupational expertise to assess performance, and moderate and verify assessments

5.1. Candidates work achievements must be assessed, moderated or verified at work by:

a) **Assessors**, **moderators** or **verifiers** who have achieved or are working towards achievement of the appropriate regulatory body approved qualifications for assessment, moderation or verification;

OR

b) A **trainer**, **supervisor** or **manager**, elected by an employer, who must either:

1. Have achieved or be working towards achieving regulatory body approved unit qualifications for assessment, moderation or verification;

OR

2. Seek guidance and approval from their awarding organisation to demonstrate that the;

- Organisation has appropriate processes in place to facilitate assessment, moderation or verification functions
- Trainer, supervisor or manager is able to map their assessment, moderation or verification skills and knowledge 100% to the National Occupational Standards upon which the qualifications above are based. This is known as the employer direct model in Scotland

5.2. **Assessors** must be occupationally competent to make Management & Team Leading assessment judgements about the level and scope of individual candidate performance at work; and occupationally competent to make assessment judgements about the quality of assessment and the assessment process.

5.3. **External Moderators / Verifiers or Internal Moderators / Verifiers** must be occupationally competent to make Management & Team Leading moderation and verification judgements about the quality of assessment and the assessment process.

5.4. **Awarding** organisations will supply information on the requirements for internal and external moderation / verification activities to Management & Team Leading assessment centres.

5.5. **The** CfA and awarding organisations requires all assessors, moderators and verifiers to maintain current Management & Team Leading competence to deliver these functions. The CfA recognises this can be achieved in many ways but must be recorded in individual continual professional development (CPD) records that are maintained in Management & Team Leading assessment centres.

Annexe D: Assessment requirements/strategy: Council for Administration

1. Introduction

1.1. The Business & Administration Assessment Strategy is designed to provide awarding organisations with a robust and flexible approach to deliver assessment for Business & Administration NVQs / SVQs and competence based qualifications.

2. External quality control

2.1. Awarding organisations will provide qualifications and quality assurance that support their delivery to all Business & Administration NVQs / SVQs and competence-based qualification assessment centres in line with regulatory requirements in England, Scotland, Wales and Northern Ireland.

2.2. Awarding organisations must use independent assessment for competence based qualifications.

2.3. Awarding organisations will supply SkillsCFA (CFA) with reports:

- Quarterly: provide registration and achievement data at unit and qualification levels

3. Assessing performance

3.1. Assessment of all units at any level of Business & Administration NVQs / SVQs and competence- based qualifications may be based on either candidate performance at work or through simulation, as necessary (See Section 4 below).

4. Simulation of NVQ / SVQ units

4.1. If a unit or part of a unit at any level is simulated, it must be undertaken in a 'realistic working environment' (RWE).

4.2. Awarding organisations will provide guidance for centres on RWEs. Awarding organisations will make sure RWEs, "provide an environment which replicates the key characteristics of the workplace in which the skill to be assessed is normally employed".

4.3. Units which have been imported by the CFA in their Business & Administration NVQs / SVQs and competence-based qualifications will be assessed in compliance with their relevant assessment strategies.

5. Occupational expertise to assess performance, and moderate and verify assessments

5.1. Candidates can be assessed, moderated or verified at work either by:

a) **Assessors**, **moderators** or **verifiers** who have achieved or are working towards achievement of the appropriate regulatory body approved unit qualifications for assessment, moderation or verification;

OR

b) A **trainer**, **supervisor** or **manager**, employed by an organisation, who must either:

1. Have achieved or be in the process of achieving the appropriate regulatory body approved unit qualifications for assessment, moderation or verification; or,
2. Seek guidance and approval from an awarding organisation to demonstrate that the;
   - Organisation has appropriate processes in place to facilitate assessment, moderation or verification functions
   - Trainer, supervisor or manager is able to map their assessment, moderation or verification skills and knowledge 100% to the NOS upon which the qualifications above are based.

5.2. **Assessors** must be occupationally competent to make Business & Administration assessment judgements about the level and scope of individual candidate performance at work or in RWEs; and, occupationally competent to make assessment judgements about the quality of assessment and the assessment process.

5.3. **External Moderators / Verifiers or Internal Moderators / Verifiers** must be occupationally competent to make Business & Administration moderation and verification judgements about the quality of assessment and the assessment process.

5.4. Awarding organisations will supply full information on the requirements for internal and external moderation / verification activities to Business & Administration assessment centres.

5.5. The sector requires all assessors, moderators and verifiers to maintain current Business & Administration competence to deliver these functions. The CFA recognises this can be achieved in many ways but must be recorded in individual continual professional development (CPD) records that are maintained in Business & Administration assessment centres.

Annexe E: Assessment requirements/strategy: Business Improvement Techniques Level 4 Unit Assessment

Introduction

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

- assist those undertaking assessment, internal and external quality assurance of occupational competence
- encourage and promote consistent assessment of B-IT NVQ units
- promote cost effective assessment plans

This document also provides definitions for:

- the scope of activities and the characteristics of typical learners undertaking B-IT NVQ units at Level 2, 3 and 4
- the qualifications and experience required for Assessors and Verifiers
- the assessment environment and notes on simulation/replication.
- 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 B-IT 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 Bodies/Organisations.

Learners undertaking Level 2, 3 and 4 QCF NVQ Units

The Business-Improvement Techniques NVQ units at Level 2 have been designed for those learners who are making a contribution to the identification and implementation of business improvements such as:

- employees involved in business improvement within a team who wish to have their business improvement competencies assessed for certification purposes
- new employees who have undertaken business improvement training and are now acquiring experience within a team and wish to demonstrate their competencies for assessment purposes

The Business-Improvement Techniques NVQ units at Level 3 have been designed for those learners who will be applying business improvement activities where they are:

- employed as supervisors, team leaders or facilitators and are responsible for carrying out business improvement activities
- people who through Continuous Professional Development are being prepared to take on staff responsibilities in a Business Improvement environment

The Business-Improvement Techniques NVQ units at Level 4 have been designed for those learners who will be leading/managing business improvement projects and where applicable carrying out business improvement activities where they are:

- employed as managers, supervisors, team leaders or facilitators that have overall responsibility for leading/managing business improvement projects
- people who through Continuous Professional Development are being prepared to take on staff and project management responsibilities in a Business Improvement environment

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 B-IT 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 Body/Organisation assessment recording documentation used for the B-IT NVQ units against which the assessments and verification are to be carried out, other relevant Awarding Body's/Organisation's documentation and system and procedures to support the Quality Assurance process.

Internal and External Quality Assurance Roles (formally Internal and External Verification)

Internal quality assurance (Internal Verification) must be carried out by competent persons 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 persons 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.

Persons carrying out the role of Internal or External Quality Assurance 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).

Persons carrying out the role of Internal or External Quality Assurance, will also be expected to be fully conversant with the terminology used in the QCF NVQ 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 persons undertaking the role of Internal or External Quality Assurance

Persons undertaking the role of Internal or External Quality Assurance of the B-IT NVQ qualification or individual units must be able to demonstrate that they have verifiable, sufficient and relevant business experience in the occupational area, and must have a working knowledge of the processes, techniques and procedures that are being used where the business improvement has been implemented.

The tables below shows the recommended levels of technical competence for Assessors and those undertaking Internal and External Quality Assurance;

Technical Requirements for Assessors and Verifiers

role	Prime activity requirements	Support activity requirements	Technical requirements (see notes)
Assessment	Assessment of Occupational Competence	Quality Assurance Systems	Technical *competence* in the areas covered by the QCF units being assessed
Internal Quality Assurance	Quality Assurance	Assessment Knowledge	Technical *understanding* of the areas covered by the qualifications
External Quality Assurance	Quality Assurance	Assessment Understanding	Technical *awareness* of the areas covered by the qualifications

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 portfolio evidence are reliable, and that relevant Health and Safety requirements have been complied with.
4. The competence required by persons undertaking assessment, internal and external quality assurance, 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 / Job Role:	An ability to *discuss* the general principles of the competences being assessed	An ability to *describe* the practical aspects of the competence being assessed	An ability to *demonstrate* the practical competences being assessed
Assessor			
Internal Quality Assurance			
External Quality Assurance			

Assessment Environment

The evidence put forward by the learner B-IT NVQ units can only be regarded valid, reliable, sufficient and authentic if demonstrated in a real working environment, where work activities or work outcomes assessed are the learners own work/contribution and provides evidence of improvements to the business e.g. Quality, Cost and Delivery, etc. As with all aspects of assessment, assessors must obtain agreement with internal and/or external verifiers before assessing any learners and determine what constitutes acceptable performance evidence.

Assessment using **Simulation or replication** of the working environment is **only** acceptable in the following unit;

Unit: 1: Complying with Statutory Regulations and Organisational Safety Requirements Assessment Criteria 1.5 in relation to;

- Following organisational procedures in the event of fire and the evacuation of premises

Assessment Criteria 1.8 in relation to;

- Use correct manual lifting and carrying techniques

Performance Evidence must be the main form of evidence gathered to prove learner competence and MUST come from the working environment.

Simulation of any form will **ONLY** be regarded as a means for providing Underpinning Knowledge for B-IT qualifications apart for the area identified in Unit 1.

Access to Assessment

There are no entry qualifications or age limits required by learners to undertake the B-IT NVQ units unless this is a legal requirement of the process or the environment. Assessment is open to any learner who has the potential to achieve the assessment criteria set out in the 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 B-IT NVQ 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, 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.

Assessment of Individual NVQ Units

It should be noted that whilst unit certification is acceptable, it is unlikely that the achievement of individual units will lead to the implementation of sustainable business improvements in quality, cost and delivery targets.

Due to the nature of the B-IT units and their direct relationship to overall business performance, Semta recommends that: the achievement of groups of units such as the qualification and pathway mandatory units set out in the relevant QCF NVQ Level 2, 3 and 4 Rules of Combination, would as a minimum provide evidence to support sustainable improvement activities within organisations.

Minimum 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 various 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 person responsible for internal and/or external quality assurance should be consulted.

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 learner's 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 this qualification. 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 Bodies/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.

Note:

It is recognised that some Awarding Organisations/Bodies provide supplementary guidance and documentation to centres to support the quality of assessment and verification practice of N/SVQs

Annexe F: 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 NVQ 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 *competence* in the areas covered by the QCF units being assessed
Internal Verifier	Verification Skills	Assessment Knowledge	Technical *understanding* of the areas covered by the QCF units being verified
External Verifier	Verification skills	Assessment Understanding	Technical *awareness* 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 *discuss* the general principles of the competences being assessed	An ability to *describe* the practical aspects of the competence being assessed	An ability to *demonstrate* 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

For more information on Edexcel and BTEC qualifications please visit our website: www.edexcel.com