

Level 3 NVQ Diploma in Mechanical Manufacturing Engineering (Composite Manufacture Engineering) (1712-35)

August 2011 Version 1.0



Qualification at a glance

Subject area	Mechanical Manufacturing Engineering
City & Guilds number	1712
Age group approved	16+
Entry requirements	None
Assessment	Portfolio of evidence
Automatic approval	Available
Support materials	Centre handbook
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	City & Guilds number	Accreditation number
Level 3 NVQ Diploma in Mechanical Manufacturing Engineering – Composite Manufacturing Engineering	1712-35	501/1803/1



Contents

1	Introduction	4
	Structure	5
2	Centre requirements	7
	Approval	7
	Resource requirements	7
	Candidate entry requirements	9
3	Delivering the qualification	11
	Initial assessment and induction	11
	Recommended delivery strategies	11
	Recording documents	11
4	Assessment	13
	Assessment of the qualification	13
	Recognition of Prior Learning (RPL)	15
5	Units	16
Unit 201	Complying with statutory regulations and organisational safety requirements	17
Unit 202	Using and interpreting engineering data and documentation	21
Unit 303	Working efficiently and effectively in engineering	26
Unit 381	Producing composite mouldings using pre-preg laminating techniques	31
Unit 382	Producing composite mouldings using wet lay-up techniques	38
Unit 383	Producing composite assemblies	43
Unit 384	Bonding composite mouldings	48
Unit 385	Repairing composite mouldings	53
Unit 386	Applying finishes to composite mouldings	58
Unit 387	Trimming composite mouldings using hand tools	63
Unit 388	Identifying defects in composite mouldings	68
Appendix 1	Relationships to other qualifications	73
Appendix 2	Sources of general information	74



1 Introduction

This document tells you what you need to do to deliver the qualification:

Area	Description
Who is the qualification for?	It is for candidates who work or want to work as mechanical manufacturing engineers – composite manufacturing engineers in the mechanical manufacturing engineering sector
What does the qualification cover?	It allows candidates to learn, develop and practise the skills required for employment and/or career progression in the mechanical manufacturing engineering sector.
Is the qualification part of a framework or initiative?	It serves as a competence qualification, in the Engineering Apprenticeship framework.
What opportunities for progression are there?	It allows candidates to progress into employment or to the following City & Guilds qualifications: <ul style="list-style-type: none">• Level 3 NVQ Extended Diploma in Mechanical Manufacturing Engineering

Structure

To achieve the **Level 3 NVQ in Mechanical Engineering (Composite Manufacture)**, learners must achieve **15** credits from the mandatory units and a minimum of **86** credits from the optional units available in group A and a minimum of **30** credits from the optional units available in group B.

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Mandatory			
A/601/5013	Unit 201	Complying with statutory regulations and organisational safety requirements	5
Y/601/5102	Unit 202	Using and interpreting engineering data and documentation	5
K/601/5055	Unit 303	Working efficiently and effectively in engineering	5
Optional group A			
D/600/5574	Unit 381	Producing composite mouldings using pre-preg laminating techniques	86
T/600/5578	Unit 382	Producing composite mouldings using wet lay-up techniques	86
M/600/5580	Unit 383	Producing composite assemblies	86
Optional group B			
D/600/5574	Unit 381	Producing composite mouldings using pre-preg laminating techniques	86
T/600/5578	Unit 382	Producing composite mouldings using wet lay-up techniques	86
M/600/5580	Unit 383	Producing composite assemblies	86

F/600/5583	Unit 384	Bonding composite mouldings	30
Y/600/5587	Unit 385	Repairing composite mouldings	77
D/600/5588	Unit 386	Applying finishes to composite mouldings	46
K/600/5593	Unit 387	Trimming composite mouldings using hand tools	46
A/600/5596	Unit 388	Identifying defects in composite mouldings	30



2 Centre requirements

Approval

Centres currently offering the City & Guilds Level 3 NVQ in Mechanical Manufacturing Engineering (1682) will be automatically approved to run this new qualification.

To offer this qualification new centres will need to gain both centre and qualification approval. Please refer to the *Centre Manual - Supporting Customer Excellence* for further information.

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

Resource requirements

Centre staffing

Staff delivering this qualification must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area for which they are delivering training and/or have experience of providing training. This knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Centre staff may undertake more than one role, e.g. tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Assessors and internal verifier

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 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.

Continuing Professional Development (CPD)

Centres must support their staff to ensure that they have current knowledge of the occupational area, that delivery, mentoring, training, assessment and verification is in line with best practice, and that it takes account of any national or legislative developments.

Candidate entry requirements

City & Guilds does not set entry requirements for this qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualification successfully so should have the opportunity to gather work based evidence.

The SEMTA Engineering Manufacture apprenticeship framework suggests that employers would be interested in candidates that:

- Are keen and motivated to work in an engineering environment
- Are willing to undertake a course of training both on-the-job and off-the-job and apply this learning in the workplace
- Have previous work experience or employment in the sector
- Have completed a 14 to 19 Diploma in Engineering or Manufacturing
- Have completed a Young Apprenticeship in Engineering or other related area
- Have GCSEs in English, Maths and Science
- Have completed tests in basic numeracy, literacy and communication skills and have spatial awareness.

As a guide, the Engineering Manufacturing framework is suitable for applicants who have five GCSEs grades D to E in English, Maths and Science. The selection process on behalf of employers may include initial assessment where applicants will be asked if they have any qualifications or experience that can be accredited against the requirements of the apprenticeship. They may also be required to take tests in basic numeracy and literacy, communications skills and spatial awareness. There may also be an interview to ensure applicants have selected the right occupational sector and are motivated to become an apprentice, as undertaking an apprenticeship is a major commitment for both the individual and the employer.

Assessment Environment (extract from SEMTA QCF Unit Assessment Strategy 1 January 2011)

The evidence put forward for this qualification 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 centres' City & Guilds external verifier/qualification consultant 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 takes the same form as in the workplace.

Age restrictions

City & Guilds cannot accept any registrations for candidates under 16 as this qualification is not approved for under 16s.

Legal restrictions apply to candidates under the age of 18 working unsupervised with children. Centres and candidates should be fully aware of minimum age requirements in their home nation and any implications for completing assessments.



3 Delivering the qualification

Initial assessment and induction

An initial assessment of each candidate should be made before the start of their programme to identify:

- if the candidate has any specific training needs,
- support and guidance they may need when working towards their qualification.
- any units they have already completed, or credit they have accumulated which is relevant to the qualification.
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the candidate fully understands the requirements of the qualification, their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

Recommended delivery strategies

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualifications before designing a course programme.

Centres may design course programmes of study in any way which:

- best meets the needs and capabilities of their candidates
- satisfies the requirements of the qualification.

When designing and delivering the course programme, centres might wish to incorporate other teaching and learning that is not assessed as part of the qualification. This might include the following:

- literacy, language and/or numeracy
- personal learning and thinking
- personal and social development
- employability.

Where applicable, this could involve enabling the candidate to access relevant qualifications covering these skills.

Recording documents

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds endorses several ePortfolio systems. Further details are available at: www.cityandguilds.com/eportfolios.

City & Guilds has developed a set of *Recording forms* including examples of completed forms, for new and existing centres to use as appropriate.

Recording forms are available on the City & Guilds website.

Although new centres are expected to use these forms, centres may devise or customise alternative forms, which must be approved for use by the external verifier, before they are used by candidates and assessors at the centre.

Amendable (MS Word) versions of the forms are available on the City & Guilds website.



4 Assessment

Assessment of the qualification

Candidates must have a completed portfolio of evidence for each unit chosen

Evidence requirements

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 may be 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 outcomes.

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 a combination of:

- 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
- 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 (qualifications consultant) 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 (the Sector Skills Council) 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.

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.

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.

Recognition of Prior Learning (RPL)

Recognition of Prior Learning means using a person's previous experience or qualifications which have already been achieved to contribute to a new qualification. RPL is allowed and is also sector specific.



5 Units

Availability of units

The following units can also be obtained from The Register of Regulated Qualifications: <http://registerofqual.gov.uk/Unit>

Structure of units

These units each have the following:

- City & Guilds unit number
- Title
- Unit Accreditation Number (UAN)
- Level
- Credit value
- Recommended Guided Learning Hours (GLH)
- Relationship to National Occupational Standards (NOS), other qualifications and frameworks
- Endorsement by a sector or other appropriate body
- Unit aim(s)
- Learning outcomes which are comprised of a number of assessment criteria

Unit 201

Complying with statutory regulations and organisational safety requirements

UAN:	A/601/5013
Level:	2
Credit value:	5
GLH:	35
Relationship to NOS:	This unit has been derived from Semta national occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to deal with statutory regulations and organisational safety requirements. It does not deal with specific safety regulations or detailed requirements, it does, however, cover the more general health and safety requirements that apply to working in an industrial environment.

The learner will be expected to comply with all relevant regulations that apply to their area of work, as well as their general responsibilities as defined in the Health and Safety at Work Act. The learner will need to be able to identify the relevant qualified first aiders and know the location of the first aid facilities. The learner will have a knowledge and understanding of the procedures to be adopted in the case of accidents involving injury and in situations where there are dangerous occurrences or hazardous malfunctions of equipment, processes or machinery. The learner will also need to be fully conversant with their organisation's procedures for fire alerts and the evacuation of premises.

The learner will also be required to identify the hazards and risks that are associated with their job. Typically, these will focus on their working environment, the tools and

equipment that they use, the materials and substances that they use, any working practices that do not follow laid-down procedures, and manual lifting and carrying techniques.

The learner's responsibilities will require them to comply with all relevant statutory and organisational policy and procedures for health and safety in the workplace. The learner must act in a responsible and safe manner at all times, and present themselves in the workplace suitably prepared for the activities to be undertaken. The learner will be expected to report any problems with health and safety issues, to the relevant authority.

The learner's knowledge will provide a good understanding of the relevant statutory regulations and organisational requirements associated with their work, and will provide an informed approach to the procedures used. The learner will need to understand their organisation's health and safety requirements and their application, in adequate depth to provide a sound basis for carrying out their activities in a safe and competent manner.

Learning outcome
The learner will: 1. comply with statutory regulations and organisational safety requirements
Assessment criteria
The learner can: 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: <ul style="list-style-type: none">• 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:<ul style="list-style-type: none">- 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
1.5	comply with emergency requirements, to include: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • lifting alone • with assistance of others • with mechanical assistance
1.10	apply safe working practices and procedures to include: <ul style="list-style-type: none"> • 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 outcome	
The learner will:	
2.	know how to comply with statutory regulations and organisational safety requirements
Assessment criteria	
The learner can:	
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)
- 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.

Unit 202

Using and interpreting engineering data and documentation

UAN:	Y/601/5102
Level:	2
Credit value:	5
GLH:	25
Relationship to NOS:	This unit has been derived from Semta national occupational standard: Using and interpreting engineering data and documentation (Suite 2).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to make effective use of text, numeric and graphical information, by interpreting and using technical information extracted from documents such as engineering drawings, technical manuals, reference tables, specifications, technical sales/marketing documentation, charts or electronic displays, in accordance with approved procedures. The learner will be required to extract the necessary information from the various documents, in order to establish and carry out the work requirements, and to make valid decisions about the work activities based on the information extracted.</p>

The learner's responsibilities will require them to comply with organisational policy and procedures for obtaining and using the documentation applicable to the activity. They will be expected to report any problems with the use and interpretation of the documents that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions if necessary, with an appropriate level of supervision or as a member of a team, and take personal responsibility for their own actions and for the quality and accuracy of

the work that they carry out.

The learner's underpinning knowledge will provide a good understanding of the types of documentation used, and will provide an informed approach to applying instructions and procedures. They will be able to read and interpret the documentation used and will know about the conventions, symbols and abbreviations, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

Learning outcome
The learner will: 1. use and interpret engineering data and documentation
Assessment criteria
The learner can: 1.1 use the approved source to obtain the required data and documentation 1.2 use the data and documentation and carry out all of the following: <ul style="list-style-type: none">• check the currency and validity of the data and documentation used• exercise care and control over the documents at all times• correctly extract all necessary data in order to carry out the required tasks• seek out additional information where there are gaps or deficiencies in the information obtained• deal with or report any problems found with the data and documentation• make valid decisions based on the evaluation of the engineering information extracted from the documents• return all documents to the approved location on completion of the work• complete all necessary work related documentation such as production documentation, installation documentation, maintenance documentation, planning documentation 1.3 correctly identify, interpret and extract the required information 1.4 extract information that includes three of the following: <ul style="list-style-type: none">• materials or components required• dimensions• tolerances• build quality• installation requirements• customer requirements• time scales• financial information• operating parameters• surface texture requirements

- location/orientation of parts
 - process or treatments required
 - dismantling/assembly sequence
 - inspection/testing requirements
 - number/volumes required
 - repair/service methods
 - method of manufacture
 - weld type and size
 - operations required
 - connections to be made
 - surface finish required
 - shape or profiles
 - fault finding procedures
 - safety/risk factors
 - environmental controls
 - specific data (such as component data, maintenance data, electrical data, fluid data)
 - resources (such as tools, equipment, personnel)
 - utility supply details (such as electricity, water, gas, air)
 - location of services, including standby and emergency backup systems
 - circuit characteristics (such as pressure, flow, current, voltage, speed)
 - protective arrangements and equipment (such as containment, environmental controls, warning and evacuation systems and equipment)
 - other specific related information
- 1.5 use the information obtained to ensure that work output meets the specification
- 1.6 use information extracted from documents to include one from the following:
- drawings (such as component drawings, assembly drawings, modification drawings, repair drawings, welding/fabrication drawings, distribution and installation drawings)
 - diagrams (such as schematic, fluid power diagrams, piping, wiring/circuit diagrams)
 - manufacturers manuals/drawings
 - approved sketches
 - technical illustrations
 - photographic representations
 - visual display screen information
 - technical sales/marketing documentation
 - contractual documentation
 - other specific drawings/documents
- 1.7 use information extracted from related documentation, to include two from the following:
- instructions (such as job instructions, drawing instructions, manufacturers instructions)

	<ul style="list-style-type: none"> • specifications (such as material, finish, process, contractual, calibration) • reference materials (such as manuals, tables, charts, guides, notes) • schedules • operation sheets • service/test information • planning documentation • quality control documents • company specific technical instructions • national, international and organisational standards • health and safety standards relating to the activity (such as COSHH) • other specific related documentation
1.8	deal promptly and effectively with any problems within their control and report those which cannot be solved
1.9	report any inaccuracies or discrepancies in documentation and specifications.

Learning outcome	
The learner will:	
2. know how to use and interpret engineering data and documentation	
Assessment criteria	
The learner can:	
2.1	explain what information sources are used for the data and documentation that they use in their work activities
2.2	explain how documents are obtained, and how to check that they are current and valid
2.3	explain the basic principles of confidentiality (including what information should be available and to whom)
2.4	describe the different ways/formats that data and documentation can be presented (such as drawings, job instructions product data sheets, manufacturers' manuals, financial spreadsheets, production schedules, inspection and calibration requirements, customer information)
2.5	explain how to use other sources of information to support the data (such as electronic component pin configuration specifications, reference charts, standards, bend allowances required for material thickness, electrical conditions required for specific welding rods, mixing ratios for bonding and finishing materials, metal specifications and inspection requirements, health and safety documentation)
2.6	describe the importance of differentiating fact from opinion when reviewing data and documentation
2.7	describe the importance of analysing all available data and documentation before decisions are made
2.8	describe the different ways of storing and organising data and documentation to ensure easy access
2.9	describe the procedures for reporting discrepancies in the data or documentation, and for reporting lost or damaged documents
2.10	describe the importance of keeping all data and documentation up

to date during the work activity, and the implications of this not being done

- 2.11 explain the care and control procedures for the documents, and how damage or graffiti on documents can lead to scrapped work
- 2.12 explain the importance of returning documents to the designated location on completion of the work activities
- 2.13 explain what basic drawing conventions are used and why there needs to be different types of drawings (such as isometric and orthographic, first and third angle, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)
- 2.14 explain what types of documentation are used and how they interrelate (such as production drawings, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)
- 2.15 explain the imperial and metric systems of measurement; tolerancing and fixed reference points
- 2.16 describe the meaning of the different symbols and abbreviations found on the documents that they use (such as surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure and flow characteristics)
- 2.17 describe the extent of their own responsibility, when to act on their own initiative to find, clarify and evaluate information, and to whom they should report if they have problems that they cannot resolve.

Unit 303

Working efficiently and effectively in engineering

UAN:	K/601/5055
Level:	3
Credit value:	5
GLH:	25
Relationship to NOS:	This unit has been derived from Semta national occupational standard: Working efficiently and effectively in engineering (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to work efficiently and effectively in the workplace, in accordance with approved procedures and practices. Prior to undertaking the engineering activity, the learner will be required to carry out all necessary preparations within the scope of their responsibility. This may include preparing the work area and ensuring that it is in a safe condition to carry out the intended activities, ensuring they have the appropriate job specifications and instructions and that any tools, equipment, materials and other resources required are available and in a safe and usable condition.</p> <p>On completion of the engineering activity, the learner will be required to return their immediate work area to an acceptable condition before recommencing further work requirements. This may involve placing completed work in the correct location, returning and/or storing any tools and equipment in the correct area, identifying any waste and/or scrapped materials and arranging for their disposal, and reporting any defects or damage to tools and equipment used.</p> <p>In order to be efficient and effective in the workplace, the learner will also be required to demonstrate that they can create and maintain effective working relationships with</p>

colleagues and line management. The learner will also be expected to review objectives and targets for their personal development and make recommendations to, and communicate any opportunities for, improvements that could be made to working practices and procedures.

The learner's responsibilities will require them to comply with organisational policy and procedures for the engineering activities undertaken, and to report any problems with the activities, or the tools and equipment that are used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to take personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to working efficiently and effectively in an engineering environment. The learner will understand the need to work efficiently and effectively, and will know about the areas they need to consider when preparing and tidying up the work area, how to contribute to improvements, deal with problems, maintain effective working relationships and agree their development objectives and targets, in adequate depth to provide a sound basis for carrying out the activities safely and correctly.

Learning outcome
The learner will: 1. work efficiently and effectively in engineering
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 prepare the work area to carry out the engineering activity 1.3 prepare to carry out the engineering activity, taking into consideration all of the following, as applicable to the work to be undertaken: <ul style="list-style-type: none">• the work area is free from hazards and is suitably prepared for the activities to be undertaken• any required safety procedures are implemented• any necessary personal protection equipment is obtained and is in a usable condition• tools and equipment required are obtained and checked that

- they are in a safe and useable condition
 - all necessary drawings, specifications and associated documentation is obtained
 - job instructions are obtained and understood
 - the correct materials or components are obtained
 - storage arrangements for work are appropriate
 - appropriate authorisation to carry out the work is obtained
- 1.4 check that there are sufficient supplies of materials and/or consumables and that they meet work requirements
- 1.5 ensure that completed products or resources are stored in the appropriate location on completion of the activities
- 1.6 complete work activities, to include all of the following:
- completing all necessary documentation accurately and legibly
 - returning tools and equipment
 - returning drawings and work instructions
 - identifying, where appropriate, any unusable tools, equipment or components
 - arranging for disposal of waste materials
- 1.7 tidy up the work area on completion of the engineering activity
- 1.8 deal promptly and effectively with problems within their control and report those that cannot be resolved
- 1.9 deal with problems affecting the engineering process, to include two of the following:
- materials
 - tools and equipment
 - drawings
 - job specification
 - quality
 - people
 - timescales
 - safety
 - activities or procedures
- 1.10 contribute to and communicate opportunities for improvement to working practices and procedures
- 1.11 make recommendations for improving to two of the following:
- working practices
 - working methods
 - quality
 - safety
 - tools and equipment
 - supplier relationships
 - internal communication
 - customer service
 - training and development
 - teamwork
 - other
- 1.12 maintain effective working relationships with colleagues to include

two of the following:

- colleagues within own working group
- colleagues outside normal working group
- line management
- external contacts

1.13 review personal training and development as appropriate to the job role

1.14 review personal development objectives and targets to include one of the following:

- dual or multi-skilling
- training on new equipment / technology
- increased responsibility
- understanding of company working practices, procedures, plans and policies
- other specific requirements.

Learning outcome

The learner will:

2. know how to work efficiently and effectively in engineering

Assessment criteria

The learner can:

- 2.1 describe the safe working practices and procedures to be followed whilst preparing and tidying up their work area
- 2.2 describe the correct use of any equipment used to protect the health and safety of themselves and their colleagues
- 2.3 describe the procedure for ensuring that all documentation relating to the work being carried out is available and current, prior to starting the activity
- 2.4 describe the action that should be taken if documentation received is incomplete and/or incorrect
- 2.5 describe the procedure for ensuring that all tools and equipment are available prior to undertaking the activity
- 2.6 describe the checks to be carried out to ensure that tools and equipment are in full working order, prior to undertaking the activity
- 2.7 describe the action that should be taken if tools and equipment are not in full working order
- 2.8 describe the checks to be carried out to ensure that all materials required are correct and complete, prior to undertaking the activity
- 2.9 describe the action that should be taken if materials do not meet the requirements of the activity
- 2.10 explain whom to inform when the work activity has been completed
- 2.11 describe the information and/or documentation required to confirm that the activity has been completed
- 2.12 explain what materials, equipment and tools can be reused
- 2.13 explain how any waste materials and/or products are transferred, stored and disposed of
- 2.14 explain where tools and equipment should be stored and located
- 2.15 describe the importance of making recommendations for improving working practices

- 2.16 describe the procedure and format for making suggestions for improvements
- 2.17 describe the benefits to organisations if improvements can be identified
- 2.18 describe the importance of maintaining effective working relationships within the workplace
- 2.19 describe the procedures to deal with and report any problems that can affect working relationships
- 2.20 describe the difficulties that can occur in working relationships
- 2.21 describe the regulations that affect how they should be treated at work (such as Equal Opportunities Act, Race and Sex Discrimination, Working Time Directive)
- 2.22 describe the benefits of continuous personal development
- 2.23 describe the training opportunities that are available in the workplace
- 2.24 describe the importance of reviewing their training and development
- 2.25 explain with whom to discuss training and development issues
- 2.26 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 381

Producing composite mouldings using pre-preg laminating techniques

UAN:	D/600/5574
Level:	3
Credit value:	86
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 81: Producing Composite Mouldings using Pre-Preg Laminating Techniques (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.

Aim:

This unit covers the skills and knowledge needed to prove the competences required to produce composite mouldings (such as moulds, components, splashes, jigs) using pre-preg laminating techniques, in accordance with approved procedures. The learner will be required to use appropriate drawings, specifications and documentation to produce various mouldings, using the correct pre-preg laminating production techniques.

The learner will be expected to prepare a range of tooling, apply release agents, and prepare composite materials. The learner will produce a range of composite mouldings, incorporating a variety of features and using a range of techniques and processes. Mouldings produced will include laminates and sandwich structures, using a range of resin, fibre and core materials.

The learner's responsibilities will require them to comply with organisational policy and procedures for the production activities undertaken, and to report any problems with the production activities, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of

supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying pre-preg laminating techniques and procedures. The learner will understand the production techniques used, and their application, in adequate depth to provide a sound basis for carrying out the activities, correcting faults, and ensuring the work output is to the required specification.

The learner will understand the safety precautions required when carrying out the moulding activities and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce composite mouldings using pre-preg laminating techniques
Assessment criteria
The learner can: 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 moulding activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, material data sheets, specifications, planning and quality control 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• provide and maintain a safe working environment for the pre-preg laminating activities• check that all tools and equipment to be used are in a safe and usable condition• follow safe practice/approved pre-preg laminating techniques at all times• return all tools and equipment to the correct location on completion of the pre-preg laminating activities• leave the work area in a safe and appropriate condition on completion of the activities 1.3 follow the correct component drawing or any other related specifications for the component to be produced 1.4 determine what has to be done and how this will be achieved

- 1.5 obtain and prepare the appropriate tools, equipment and materials
- 1.6 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
- 1.7 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 pre-preg 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 moulding or laying-up activities using the correct methods and techniques
- 1.9 produce a range of mouldings, using techniques for four of the following types of production tool:
 - metal
 - wet lay-up
 - glass pre-preg
 - tooling block
 - carbon pre-preg
 - female tooling
 - male tooling
 - multi-part tools
 - matched tooling
 - closed tooling
- 1.10 produce a range of mouldings using four of the following methods:
 - production of ply templates
 - nesting of ply templates
 - vacuum de-bulk
 - pressure de-bulk
 - intensifiers
 - shaped locators
 - joining boards
 - loose tooling
 - others
- 1.11 produce a range of mouldings using techniques for one type of resin from:
 - epoxy
 - phenolic
 - bismaleimide

- cyanate ester
- 1.12 produce a range of mouldings using techniques for two types of fibre from:
- polyethylene
 - glass
 - aramid
 - carbon
- 1.13 produce a range of mouldings using techniques for two types of reinforcement from:
- continuous
 - uni-directional
 - braids
 - woven
 - multi-axis
 - tapes
- 1.14 produce a range of mouldings using techniques for two types of core material from:
- wood
 - syntactic core
 - expanding core
 - foam
 - nomex honeycomb
 - aluminium honeycomb
- 1.15 produce a range of mouldings incorporating two of the following in the lay-up:
- butt joints
 - overlap joints
 - staggered joints
 - orientated plies
 - inverted plies
 - inserts
- 1.16 produce a range of mouldings incorporating five of the following shape features:
- internal corners
 - external corners
 - double curvature
 - concave surface
 - convex surfaces
 - return surfaces
 - joggle details
 - nett edges
- 1.17 when using core materials, use three of the following methods:
- core templates
 - pre-shaping core
 - core chamfers
 - peel plies
 - adhesive/resin films

<ul style="list-style-type: none"> • core splicing • edge filling • single stage curing • multi-stage curing <p>1.18 use one of the following for applying temperature during the cure cycle:</p> <ul style="list-style-type: none"> • oven • heated tools/moulds • autoclave • heated press <p>1.19 use one of the following for applying pressure during the cure cycle:</p> <ul style="list-style-type: none"> • pressure bags • vacuum bags • thermal mould expansion • fibre tensioning <p>1.20 where vacuum bags are used, use four of the following processes/methods:</p> <ul style="list-style-type: none"> • check vacuum integrity • use of vacuum fittings • surface bagging • envelope bagging • pleats and tucks • multi-part envelope bags • internal bagging • through-tube bagging • reusable bagging <p>1.21 produce components to the required specification</p> <p>1.22 produce a range of mouldings which comply with one of the following standards:</p> <ul style="list-style-type: none"> • BS, IS or BSEN standards and procedures • customer standards and requirements • company standards and procedures <p>1.23 check that all the required operations have been completed to specification</p> <p>1.24 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

Learning outcome
The learner will: 2. know how to produce composite mouldings using pre-preg laminating techniques
Assessment criteria
The learner can: 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 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 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 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
 - 2.6 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 quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents
 - 2.8 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)
 - 2.9 describe the different types of resin systems, fibres, reinforcements, and their merits
 - 2.10 describe how to build up laminates (including orientation and balance of plies to minimise spring and distortion in composite mouldings)
 - 2.11 describe the different core, insert and filler materials, and their merits
 - 2.12 describe the visual identification of both raw and finished composite materials
 - 2.13 describe the identification of materials by product codes
 - 2.14 describe the different types of production tooling used for producing composite mouldings, and their merits
 - 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 selection and use of surface sealers and release agents
 - 2.17 describe the correct methods of storage, thawing and handling of pre-preg materials (including monitoring temperature, storage life and out-life)
 - 2.18 describe the methods used in the application of pre-preg materials to tooling surfaces (including methods of tailoring and cutting)
 - 2.19 describe the correct methods of storage and handling of ancillary and consumable materials
 - 2.20 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)
 - 2.21 describe the tools and equipment used in the pre-preg laminating activities, and their care, preparation and control procedures
 - 2.22 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)

- 2.23 explain how modifications and defects can be overcome during the pre-preg laminating activity
- 2.24 describe the cure cycles (including temperature and pressure ramps, dwell times, post curing)
- 2.25 describe the need for monitoring the cure cycle (using thermocouples, probes, chart recorders and data logs)
- 2.26 describe the procedures and methods used for removing mouldings from production tooling
- 2.27 explain how to identify 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.

Unit 382

Producing composite mouldings using wet lay-up techniques

UAN:	T/600/5578
Level:	3
Credit value:	86
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 82: Producing Composite Mouldings using Wet Lay-up Techniques (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to produce composite mouldings (such as moulds, components, splashes, jigs) using wet lay-up techniques, in accordance with approved procedures. The learner will be required to use appropriate drawings, specifications and documentation to produce various mouldings using the correct wet lay-up production techniques.

The learner will be expected to prepare a range of tooling, apply release agents and prepare composite materials. The learner will produce a range of composite mouldings, incorporating a range of features and using a range of application methods. Mouldings produced will include laminates and sandwich structures, using a range of resin, fibre and core materials.

The learner's responsibilities will require them to comply with organisational policy and procedures for the production activities undertaken, and to report any problems with the production activities, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility

for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying composite moulding wet lay-up techniques and procedures. The learner will understand the production techniques used, and their application, in adequate depth to provide a sound basis for carrying out the activities, correcting faults, and ensuring the work output is produced to the required specification.

The learner will understand the safety precautions required when carrying out the wet lay-up moulding activities and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce composite mouldings using wet lay-up techniques
Assessment criteria
The learner can: 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 moulding activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, material data sheets, specifications, planning and quality control 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• provide and maintain a safe working environment for the wet lay-up activities• check that all tools and equipment to be used are in a safe and usable condition• follow safe practice/approved wet lay-up moulding techniques at all times• return all tools and equipment to the correct location on completion of the wet lay-up activities• leave the work area in a safe and appropriate condition on completion of the activities 1.3 follow the correct component drawing or any other related specifications for the component to be produced 1.4 determine what has to be done and how this will be achieved

- 1.5 obtain and prepare the appropriate tools, equipment and materials
- 1.6 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
- 1.7 carry out all of the following activities to prepare materials for production:
 - obtain correct materials for the activity
 - check that materials are fit for purpose and in life
 - cut materials to correct size and shape
 - check quantities of resins etc. are available
 - identify and protect materials in the work area
 - check correct measure and mix of resin/catalyst
- 1.8 carry out the moulding or laying-up activities using the correct methods and techniques
- 1.9 produce a range of mouldings using three of the following application techniques:
 - spray application of fibre/resin
 - application of a gel coat
 - brush application of fibre/resin
 - roller application of fibre/resin
 - removal of voids and air pockets
 - use of vacuum bagging
 - use of bleed plies
- 1.10 produce a range of mouldings incorporating two of the following in the lay-up:
 - feathered joins
 - overlap joins
 - orientated plies
 - inserts
 - fixtures
 - butt joins
- 1.11 produce a range of mouldings incorporating three of the following shape features:
 - internal corner
 - external corner
 - double curvature
 - concave surface
 - convex surface
 - vertical surface
- 1.12 produce a range of mouldings using techniques for one type of resin from:
 - polyester
 - vinyl ester

<ul style="list-style-type: none"> • epoxy • phenolic
<p>1.13 produce a range of mouldings using techniques for one type of fibre from:</p> <ul style="list-style-type: none"> • polyethylene • glass • aramid • carbon
<p>1.14 produce a range of mouldings using techniques for two types of reinforcement from:</p> <ul style="list-style-type: none"> • roving • braids • tapes • chopped strand • continuous filament • woven
<p>1.15 produce a range of mouldings using techniques for one type of core material from:</p> <ul style="list-style-type: none"> • wood • coremat • foam • honeycomb
<p>1.16 produce components to the required specification</p>
<p>1.17 produce a range of mouldings which comply with one of the following standards:</p> <ul style="list-style-type: none"> • BS, IS or BSEN standards and procedures • customer standards and requirements • company standards and procedures
<p>1.18 check that all the required operations have been completed to specification</p>
<p>1.19 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

<p>Learning outcome</p>
<p>The learner will:</p> <p>2. know how to produce composite mouldings using wet lay-up techniques</p>
<p>Assessment criteria</p>
<p>The learner can:</p> <p>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</p> <p>2.2 describe the hazards associated with carrying out wet lay-up moulding techniques, and with the composite materials, consumables, tools and equipment used, and how to minimise these and reduce any risks</p> <p>2.3 describe the protective equipment that is needed for personal protection and, where required, the protection of others</p> <p>2.4 describe the application of COSHH Regulations in relation to the</p>

- storage, use and disposal of composite materials and consumables
- 2.5 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
 - 2.6 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 quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents
 - 2.8 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)
 - 2.9 describe the different types of resins, fibres, reinforcement, and their merits
 - 2.10 describe the visual identification of both raw and finished composite materials
 - 2.11 describe the different types of production tooling used for producing composite mouldings
 - 2.12 describe the identification and rectification of defects in production tooling
 - 2.13 describe the methods of preparation for patterns, moulds and tooling (including the correct use of surface sealers and release agents)
 - 2.14 describe the methods for handling and preparing the reinforcing fibres
 - 2.15 explain how to estimate the resin volume/weight required to wet-out the reinforcing fibres
 - 2.16 describe the mixing ratios for gel coats, resins and catalysts, and the associated working times
 - 2.17 describe the methods used in the application of the resin/fibre during the lay-up activity
 - 2.18 describe the tools and equipment used in the lay-up activities and their care, preparation and control procedures
 - 2.19 describe the problems that can occur during the lay-up process (including defects such as contamination, resin/fibre rich areas, and distortion)
 - 2.20 explain how defects can be overcome during the lay-up activity
 - 2.21 describe the procedures and methods used for removing mouldings from production tooling
 - 2.22 describe the identification of defects in the composite moulding (such as de-lamination, voids, contaminants)
 - 2.23 describe the care and safe handling of production tooling and composite mouldings throughout the production cycle
 - 2.24 describe the production controls used in the work area, and actions to be taken for unaccounted items
 - 2.25 explain how the composite moulding relates to its own quality documents and the production tooling used
 - 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 383

Producing composite assemblies

UAN:	M/600/5580
Level:	3
Credit value:	86
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 83: Producing Composite Assemblies (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to produce composite assemblies from composite components and non-composite components, in accordance with approved procedures. The learner will be required to use appropriate drawings, specifications and documentation to produce composite assemblies, using the correct techniques. The learner will produce a range of composite assemblies, incorporating a range of features and using a range of techniques and processes.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying composite assembly techniques and procedures. The learner will understand the composite assembly techniques used, and their application, in adequate depth to provide a</p>

sound basis for carrying out the activities, correcting faults, and ensuring the finished assembly is to the required specification.

The learner will understand the safety precautions required when carrying out the assembly activities and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce composite assemblies
Assessment criteria
The learner can: 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 assembly activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, material data sheets, specifications, planning and quality control 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• provide and maintain a safe working environment for the composite assembly activities• check that all tools and equipment to be used are in a safe and usable condition• follow safe practice/approved composite assembly techniques at all times• return all tools and equipment to the correct location on completion of the assembly activities• leave the work area in a safe and appropriate condition on completion of the activities 1.3 follow the relevant instructions, assembly drawings and any other specifications 1.4 ensure that the specified components are available and that they are in a usable condition 1.5 carry out all of the following activities when preparing for the assembly activity: <ul style="list-style-type: none">• check that mouldings are correct and complete• check for any defects in the mouldings• check that components are correct and complete• check availability of ancillary materials required• select correct equipment for the activity• check that equipment is suitable for use• check for any defects in the components

- 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 two of the following types of composite assembly:
- trial assemblies
 - one-off assemblies
 - batch assemblies
 - assembly line
- 1.8 produce assemblies that incorporate four of the following features:
- loose fit tolerances
 - close fit tolerances
 - non-permanent fixing
 - shape location
 - joggle joints
 - permanent fixing
 - return joints
 - overlap joints
- 1.9 produce composite assemblies that require four of the following methods to be used:
- fettling
 - pinning
 - clamping
 - trial fitting
 - aligning
 - assembly jigs
 - assembly sequences
- 1.10 produce composite assemblies that use three of the following joining methods:
- thread inserts
 - quick-release fasteners
 - mechanical fasteners
 - anchor nuts
 - rivets
- 1.11 produce composite components which include three of the following:
- trim
 - closing panels
 - body panels
 - tubes
 - structural
 - aerodynamic
 - core materials
 - sections
 - inserts
 - housings
- 1.12 produce non-composite components which include three of the

following types:

- brackets
- fixtures
- fittings
- trim
- tapes
- memory foam
- films

- 1.13 secure the components using the specified connectors and securing devices
- 1.14 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
- 1.15 produce a range of assemblies which comply with one of the following standards:
- BS, IS or BSEN standards and procedures
 - customer standards and requirements
 - company standards and procedures
- 1.16 deal promptly and effectively with problems within their control and report those that cannot be solved.

Learning outcome

The learner will:

2. know how to produce composite assemblies

Assessment criteria

The learner can:

- 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 composite assembly activities, 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 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 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
- 2.6 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 quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents
- 2.8 describe the conventions and terminology used for assembly activities (such as metric and imperial threads, rivet specifications, clearances, types of fittings)
- 2.9 describe the types of component trimming/cutting methods and

preparation methods available

2.10 describe the visual identification of cured composite materials

2.11 describe the assembly operations and their sequence

2.12 describe the methods for handling composite assemblies throughout the assembly activities

2.13 describe the identification and rectification of defects in composite assemblies

2.14 describe the tools and equipment used in assembly activities, and their care, preparation and control procedures

2.15 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

UAN:	F/600/5583
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 84: Bonding Composite Mouldings (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to bond composite mouldings (such as cured panels, moulds, components and jigs), in accordance with approved procedures. The learner will be required to use appropriate drawings, specifications and documentation to bond advanced composites materials, using the correct techniques.</p> <p>The learner will produce a range of bonded composite mouldings, incorporating a variety of features and using a range of techniques and processes. Bonded mouldings produced will include a range of resin, fibre and adhesive materials.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the bonding activities undertaken, and to report any problems with the bonding activities, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying composite bonding techniques and procedures. The learner will understand the bonding</p>

techniques used, and their application, in adequate depth to provide a sound basis for carrying out the activities, correcting faults, and ensuring the work produced is to the required specification.

The learner will understand the safety precautions required when carrying out the composite bonding activities and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. bond composite mouldings
Assessment criteria
The learner can: 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 bonding activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, material data sheets, specifications, planning and quality control 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• provide and maintain a safe working environment for the composite bonding activities• check that all tools and equipment to be used are in a safe and usable condition• follow safe practice/approved composite bonding techniques and procedures at all times• return all tools and equipment to the correct location on completion of the bonding activities• leave the work area in a safe and appropriate condition on completion of the activities 1.3 follow the relevant bonding procedure specification and job instructions 1.4 check that the materials to be bonded and bonding agents comply with the specification 1.5 correctly prepare the parent materials and bonding agents in line with the bonding specification 1.6 carry out all of the following activities when preparing for the bonding activity: <ul style="list-style-type: none">• check that mouldings are correct and complete• check for any defects in the mouldings• check that bonding materials are within life

- check availability of ancillary materials required
 - select the correct equipment for the activity
 - check that the equipment is suitable for use
 - identify and protect the moulding and bonding materials in the work area
 - check that bonding materials are correct and complete
- 1.7 prepare bonding surfaces using four of the following methods:
- peel plies
 - templates
 - abrading
 - bead blasting
 - water cleaning
 - solvent cleaning
 - dry fitting
 - acid etching
 - priming
 - surface masks
- 1.8 carry out the bonding operations using the specified processes and techniques to position and bond the materials in their correct locations
- 1.9 bond composite mouldings using techniques for two of the following:
- one-part pastes
 - two-part pastes
 - film adhesives
 - syntactic films
- 1.10 when bonding composite mouldings, use three of the following methods:
- dry fitting
 - bonding sequences
 - shimming materials
 - mixing adhesives
 - wetting-out by brush
 - applicator gun
 - laying film adhesives
 - oven curing
 - heated press
- 1.11 during curing, retain the bond using two of the following:
- weighting down
 - bonding jigs
 - pinning joints
 - clamping
 - press
 - vacuum bagging
- 1.12 bond composite mouldings using techniques for two of the following:
- sandwich panels

- butt joins
 - overlap joins
 - joggle joins
 - return joins
- 1.13 bond composite mouldings using techniques for two of the following:
- flat surfaces
 - shaped surfaces
 - internal surfaces
 - external surfaces
- 1.14 use techniques for bonding three of the following materials to the composite moulding:
- other composites
 - metals
 - ceramics
 - plastics
 - wood-based materials
- 1.15 bond composite mouldings using adhesives suitable for two of the following resin types:
- polyester
 - epoxy
 - phenolic
 - bismaleimide
 - cyanate ester
 - vinyl ester
- 1.16 bond composite mouldings using adhesives suitable for two of the following fibre types:
- polyethylene
 - glass
 - aramid
 - carbon
 - other specific types
- 1.17 ensure that any equipment used to maintain surface contact during the bonding activities is set up and used correctly
- 1.18 achieve bonds of the required quality and within the specified dimensional accuracy
- 1.19 bond a range of mouldings in compliance with one of the following standards:
- BS, IS or BSEN standards and procedures
 - customer standards and requirements
 - company standards and procedures
- 1.20 deal promptly and effectively with problems within their control and report those that cannot be solved.

Learning outcome
The learner will: 2. know how to bond composite mouldings
Assessment criteria
The learner can: 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 composite bonding activities, 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 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 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 2.6 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 quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents 2.8 describe the conventions and terminology used for bonding (such as gel points, cure times, bond thickness, bond strength, peel strength) 2.9 describe the different types of composite resin systems, fibres, reinforcements, and their merits 2.10 describe the different bonding agents, and their merits 2.11 describe the correct methods of storage and handling of bonding agents 2.12 describe the methods of preparation for bonding different materials 2.13 describe the mixing procedures and ratios for two-part pastes, and the associated working times 2.14 describe the methods of application for different bonding agents 2.15 describe the methods of retaining the bond during curing, and their merits 2.16 describe the tools and equipment used in bonding activities, and their care, preparation and control procedures 2.17 describe the identification and rectification of bond defects 2.18 describe the problems that can occur during the bonding process (including defects such as contamination and distortion) 2.19 explain how defects can be overcome during the bonding activity 2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 385

Repairing composite mouldings

UAN:	Y/600/5587
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 85: Repairing Composite Mouldings (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to repair composite mouldings (such as cured panels, moulds, components and jigs), in accordance with approved procedures. The learner will be required to use appropriate drawings, specifications and documentation to bond advanced composites materials, using the correct techniques.</p>

The learner will be expected to identify the method of repair to be used and select suitable repair materials. The learner will repair a range of composite mouldings with various defects using a range of methods. Mouldings repaired will include a range of resin and fibre materials.

The learner's responsibilities will require them to comply with organisational policy and procedures for the repair activities undertaken, and to report any problems with the repair activities, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce.

The learner's knowledge will provide a good

understanding of their work, and will provide an informed approach to applying composite moulding repair procedures. The learner will understand the repair techniques used, and their application, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when carrying out the repair activities and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. repair composite mouldings
Assessment criteria
The learner can: 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 repair activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, material data sheets, specifications, planning and quality control 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• provide and maintain a safe working environment for the composite repair activities• check that all tools and equipment to be used are in a safe and usable condition• follow safe practice/approved composite repair techniques and procedures at all times• return all tools and equipment to the correct location on completion of the composite repair activities• leave the work area in a safe and appropriate condition on completion of the activities 1.3 follow the relevant specifications for the component to be repaired 1.4 prepare the component for repair 1.5 carry out all of the following activities when preparing for the repair activity: <ul style="list-style-type: none">• check that mouldings are correct and complete• identify the method of repair to be used• check availability of ancillary materials required• select the correct equipment for the activity• check that the equipment is suitable for use

- identify what needs to be repaired
 - identify and protect the moulding and repair materials in the work area
- 1.6 carry out the repairs within agreed timescale using approved materials and components and methods and procedures
- 1.7 repair defects in six of the following types of composite moulding:
- trim
 - closing panels
 - housings
 - body panels
 - tubes
 - sections
 - sandwich panels
 - structural
 - aerodynamic
 - moulds
 - jigs
- 1.8 repair defects in composite mouldings using four of the following methods:
- localised curing
 - fettling
 - surface filling
 - relieving distortion
 - separation of bonds
 - bonding
 - resin injection
 - wet-lay patching
 - pre-preg patching
 - core patching
 - insert/core potting
 - repair patches/kits
- 1.9 repair defects using techniques/materials applicable to two of the following resin types:
- polyester
 - epoxy
 - bismaleimide
 - cyanate ester
 - phenolic
 - vinyl ester
- 1.10 repair defects using techniques/materials applicable to two of the following fibre types:
- polyethylene
 - glass
 - aramid
 - carbon
- 1.11 repair eight of the following types of defect in composite mouldings:

<ul style="list-style-type: none"> • incomplete curing • dimensional • tolerances • surface finish • distortion • blisters • bridging • de-lamination • broken fibres • voids • dis-bonds • dents or 'dings' • excessive adhesive • damaged cores • wrong inserts • insert positions • impact damage <p>1.12 ensure that the repaired component meets the specified operating conditions</p> <p>1.13 repair a range of mouldings in compliance with one of the following standards:</p> <ul style="list-style-type: none"> • BS, IS or BSEN standards and procedures • customer standards and requirements • company standards and procedures <p>1.14 produce accurate and complete records of all repair work carried out.</p>

Learning outcome
The learner will:
2. know how to repair composite mouldings
Assessment criteria
The learner can:
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 composite repair activities, 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 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 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
2.6 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 quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents
 - 2.8 describe the conventions and terminology used when repairing composite mouldings (such as dis-bonds, de-lamination, resin injection, resin voids, core potting, repair patches)
 - 2.9 describe the failure modes for various composite mouldings, and what can contribute to these
 - 2.10 describe the different types of composite resin systems, fibres, reinforcements, and their merits
 - 2.11 describe the different methods of production for composite mouldings, and their merits
 - 2.12 describe the different methods of trimming composite mouldings, and their merits
 - 2.13 describe the different methods of producing composite assemblies, and their merits
 - 2.14 describe the different bonding agents, methods used, and their merits
 - 2.15 describe the correct methods of storage and handling of composite materials
 - 2.16 describe the tools and equipment used for various activities associated with repairing composite mouldings
 - 2.17 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 386

Applying finishes to composite mouldings

UAN:	D/600/5588
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 86: Applying Finishes to Composite Mouldings (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to apply finishes to composite mouldings (such as moulds, panels and components), in accordance with approved procedures. The learner will be required to use appropriate drawings, specifications and documentation to apply finishes, using the correct techniques.</p> <p>The learner will apply finishes to composite mouldings using a range of techniques and processes. A variety of finishes will be applied to a range of resin and fibre materials.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the finishing activities undertaken, and to report any problems with the finishing activities, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying finishing techniques and procedures to composite</p>

mouldings. The learner will understand the finishing techniques used, and their application, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is to the required specification.

The learner will understand the safety precautions required when carrying out the finishing operations and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. apply finishes to composite mouldings
Assessment criteria
The learner can: 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 finishing activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, material data sheets, specifications, planning and quality control 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• provide and maintain a safe working environment for the composite finishing activities• check that all tools and equipment to be used are in a safe and usable condition• follow safe practice/approved composite finishing techniques and procedures at all times• return all tools and equipment to the correct location on completion of the finishing activities• leave the work area in a safe and appropriate condition on completion of the activities 1.3 ensure the material surfaces to be treated are suitably prepared for the finishing operations to be carried out 1.4 carry out all of the following activities when preparing for the finishing activity: <ul style="list-style-type: none">• check that mouldings are correct and complete• check for any defects in the mouldings• check availability of ancillary materials required• select the correct equipment for the activity• check that the equipment is suitable for use• identify and protect the moulding in the work area

- 1.5 prepare surfaces of composite mouldings using two of the following methods:
 - abrading
 - bead blasting
 - water cleaning
 - solvent cleaning
 - priming
- 1.6 check that the finishing equipment and treatment solutions are set up and maintained at satisfactory operating conditions and levels
- 1.7 carry out the treatment process in accordance with operating procedures and the component specification requirements
- 1.8 apply finishes to composite mouldings using two of the following techniques:
 - cloth application
 - brush
 - spray
 - laying films
 - roller
- 1.9 apply two types of finish to composite mouldings from:
 - surface sealers
 - primers
 - top coats
 - adhesive films
 - UV coatings
 - heatproof coatings
 - speciality coatings
 - flexible coatings
- 1.10 apply finishes to composite mouldings using three of the following:
 - one-part finishes
 - two-part finishes
 - multiple coatings
 - combination coats
 - solvent based
 - adhesive based
 - water based
 - single coatings
- 1.11 apply finishes to composite mouldings using four of the following consumable materials:
 - abrasives
 - masking tapes
 - masking films
 - polishes
 - thinners
 - solvents
 - stoppers
 - fillers
 - sealers

<ul style="list-style-type: none"> • primers • cutting compounds • cleaning agents <p>1.12 apply finishes to composite mouldings suitable for two of the following resin types:</p> <ul style="list-style-type: none"> • polyester • vinyl ester • epoxy • phenolic • bismaleimide • cyanate ester <p>1.13 apply finishes to composite mouldings suitable for two of the following fibre types:</p> <ul style="list-style-type: none"> • polyethylene • glass • aramid • carbon <p>1.14 ensure that the treated workpiece achieves the required characteristics and meets the finishing specification</p> <p>1.15 apply finishes to a range of mouldings in compliance with one of the following standards:</p> <ul style="list-style-type: none"> • BS, IS or BSEN standards and procedures • customer standards and requirements • company standards and procedures <p>1.16 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.17 dispose of waste and excess materials in line with agreed organisational procedures</p> <p>1.18 shut down the finishing equipment to a safe condition on completion of the processing activities.</p>

Learning outcome
The learner will:
2. know how to apply finishes to composite mouldings
Assessment criteria
The learner can:
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 composite finishing activities, 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 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 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
- 2.6 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
 - 2.7 describe the conventions and terminology used for applying finishes (such as surface keying, finish thickness, matt finish, gloss finish, treatment reactions)
 - 2.8 describe the different types of composite resin systems, fibres, reinforcements, and their merits
 - 2.9 describe the different finishes applied to composites, and their merits
 - 2.10 describe the correct methods of storage, handling and disposal of finishing materials
 - 2.11 describe the methods of preparation for applying different finishes
 - 2.12 describe the mixing ratios for two-part finishes, and the associated working times
 - 2.13 describe the methods of application for different finishes
 - 2.14 describe the problems that can occur during the finishing process, including defects such as contamination
 - 2.15 explain how defects can be overcome during the finishing activity
 - 2.16 describe the tools and equipment used in finishing activities, and their care, preparation and control procedures
 - 2.17 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 387

Trimming composite mouldings using hand tools

UAN:	K/600/5593
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 87: Trimming Composite Mouldings using Hand Tools (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to trim composite mouldings (such as moulds, components, splashes, jigs) using hand tools, in accordance with approved procedures. The learner will be required to use appropriate drawings, specifications and documentation to trim various mouldings, using the correct trimming techniques.

The learner will be expected to select the correct tools and equipment for the trimming activity. The learner will trim a range of composite mouldings incorporating a variety of features, and using cutting, sanding, drilling and polishing techniques and processes. Mouldings trimmed will include a range of resin and fibre materials.

The learner's responsibilities will require them to comply with organisational policy and procedures for the trimming activities undertaken, and to report any problems with the trimming activities, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying composite moulding trimming techniques and procedures. The learner will understand the trimming techniques used, and their application, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when carrying out the trimming activities and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. trim composite mouldings using hand tools
Assessment criteria
The learner can: 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 trimming activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, specifications, planning and quality control 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• provide and maintain a safe working environment for the composite trimming activities• check that all tools and equipment to be used are in a safe and usable condition• follow safe practice/approved composite trimming techniques and procedures at all times• return all tools and equipment to the correct location on completion of the trimming activities• leave the work area in a safe and appropriate condition on completion of the activities 1.3 follow relevant specifications for the component to be produced 1.4 obtain the appropriate tools and equipment for the shaping operations and check they are in a safe and usable condition 1.5 carry out all of the following activities when preparing for the trimming activity: <ul style="list-style-type: none">• check that moulding is correct and complete• check for any defects in the moulding• select the correct equipment for the activity• check that the equipment is suitable for use

- identify and protect the moulding in the work area
- 1.6 mark out mouldings using all of the following methods:
 - scribe
 - height gauge
 - moulded scribe lines
 - centre punch
 - trimming templates
- 1.7 shape the materials using appropriate methods and techniques
- 1.8 cut mouldings using two the following methods:
 - cutting wheels/discs
 - saws
 - routers
 - trim jigs
- 1.9 sand mouldings using three of the following methods:
 - rubbing blocks
 - diamond files
 - pencil grinders
 - disc sanders
 - belt sanders
- 1.10 use a hand drill or pedestal drill to drill mouldings, using three of the following methods:
 - drill jigs
 - hole saws
 - counterbores
 - countersinks
 - drill bits
- 1.11 polish mouldings using four of the following methods:
 - wet sanding
 - cutting compound
 - polishing compound
 - rubbing block
 - orbital sander
 - polisher
- 1.12 trim mouldings using techniques for two of the following resin types:
 - polyester
 - vinyl ester
 - epoxy
 - phenolic
 - bismaleimide
 - cyanate ester
- 1.13 trim mouldings using techniques for two of the following fibre types:
 - polyethylene
 - glass
 - aramid
 - carbon

<p>1.14 trim mouldings that require, or incorporate, eight of the following features:</p> <ul style="list-style-type: none"> • straight edges • curved edges • flat surfaces • polished surfaces • shaped surfaces • radius corners • returns • nett edges • joggle details • removal of join lines • multiple holes • multiple hole sizes • countersinks • counterbores • further lay-up stages • inserts to be drilled • inserts to be tapped • solid cores • honeycomb cores • edge filling <p>1.15 check that all the required shaping operations have been completed to the required specification</p> <p>1.16 trim a range of mouldings in compliance with one of the following standards:</p> <ul style="list-style-type: none"> • BS, IS or BSEN standards and procedures • customer standards and requirements • company standards and procedures <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
--

<p>Learning outcome</p> <p>The learner will:</p> <p>2. know how to trim composite mouldings using hand tools</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>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</p> <p>2.2 describe the hazards associated with carrying out composite trimming activities, and with the composite materials, consumables, tools and equipment used, and how to minimise these and reduce any risks</p> <p>2.3 describe the protective equipment that is needed for personal protection and, where required, the protection of others</p> <p>2.4 describe the application of COSHH Regulations in relation to the storage, use and disposal of composite materials and consumables</p>

- 2.5 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
- 2.6 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 quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents
- 2.8 describe the conventions and terminology used for trimming activities (such as scribe lines, sanding grades, types of cutting tools, speeds)
- 2.9 describe the different types of manual and power tools, and their merits
- 2.10 describe the different types of cutting tools and abrasives, and their merits
- 2.11 describe the different types of materials used in cutting tools and abrasives, and their merits
- 2.12 describe the different types of resins, fibres, reinforcement, and their merits
- 2.13 describe the visual identification of cured composite materials
- 2.14 describe the identification and rectification of defects in composite mouldings
- 2.15 describe the methods used in the trimming of composite mouldings
- 2.16 describe the operations and their sequence when preparing for trimming activities
- 2.17 describe the methods for handling composite mouldings throughout the trimming activities
- 2.18 describe the tools and equipment used trimming activities, and their care, preparation and control procedures
- 2.19 describe the care and safe handling of composite mouldings throughout the trimming cycle
- 2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 388

Identifying defects in composite mouldings

UAN:	A/600/5596
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 88: Identifying Defects in Composite Mouldings (Level 3).
Endorsement by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to identify and deal with defects in composite mouldings (such as moulds, panels, components, jigs), in accordance with approved procedures. The learner will be required to use appropriate drawings, specifications and documentation to identify and deal with defects in composites mouldings.</p> <p>The learner will be able to identify a range of defects in composite mouldings using various methods and techniques. Defects will be identified in a range of mouldings with a variety of resin and fibre materials.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the activities undertaken, and to report any problems with the activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work they carry out.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to identifying defects</p>

in composite mouldings, and to making decisions on what action needs to be taken. The learner will understand composite materials, and their application, and will know about defects in adequate depth to provide a sound basis for dealing with the defects in line with organisation practice and procedures.

The learner will understand the safety precautions required when working with the composite mouldings and when using associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. identify defects in composite mouldings
Assessment criteria
The learner can: 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 activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, material data sheets, specifications, planning and quality control 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• provide and maintain a safe working environment for the composite moulding inspection activities• check that all tools and equipment to be used are in a safe and usable condition and, where appropriate, are within current calibration/certification dates• follow safe practice/approved composite bonding techniques and procedures at all times• return all tools and equipment to the correct location on completion of the bonding activities• leave the work area in a safe and appropriate condition on completion of the activities 1.3 identify defects with regard to the product or asset specification 1.4 identify defects in composite mouldings using four of the following methods: <ul style="list-style-type: none">• touch• sound• visual• measurement

- mechanical tests
 - stage inspection
 - non-destructive testing (NDT)
 - coordinate measuring machines (CMM)
- 1.5 identify defects in six of the following types of composite moulding:
- trim
 - closing panels
 - housings
 - body panels
 - tubes
 - sections
 - sandwich panels
 - structural
 - aerodynamic
 - moulds
 - jigs
- 1.6 identify defects applicable to two of the following resin types:
- polyester
 - vinyl ester
 - epoxy
 - phenolic
 - bismaleimide
 - cyanate ester
- 1.7 identify defects applicable to two of the following fibre types:
- polyethylene
 - glass
 - aramid
 - carbon
- 1.8 identify eight of the following types of defect in composite mouldings:
- incomplete curing
 - dimensional
 - tolerances
 - ply orientation
 - wrong join type
 - surface finish
 - distortion
 - blisters
 - bridging
 - de-lamination
 - wrinkles
 - broken fibres
 - splintering
 - voids
 - dents or 'dings'
 - dis-bonds

<ul style="list-style-type: none"> • resin rich areas • incorrect material • excessive adhesive • damaged cores • wrong inserts • insert positions • impact damage <p>1.9 assess the defects and determine action required to return the products and assets to specified condition</p> <p>1.10 ensure actions recommended to rectify the defect comply with one of the following standards:</p> <ul style="list-style-type: none"> • BS, IS or BSEN standards and procedures • customer standards and requirements • company standards and procedures <p>1.11 report recommendations for action to the appropriate people promptly and in accordance with organisational procedures</p> <p>1.12 record details of defects in accordance with quality assurance and control systems and procedures.</p>

<p>Learning outcome</p> <p>The learner will:</p> <p>2. know how to identify defects in composite mouldings</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>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</p> <p>2.2 describe the hazards associated with carrying out inspections on composite mouldings, and with the composite materials, consumables, tools and equipment used, and how to minimise these and reduce any risks</p> <p>2.3 describe the protective equipment that is needed for personal protection and, where required, the protection of others</p> <p>2.4 describe the application of COSHH Regulations in relation to the storage, use and disposal of composite materials and consumables</p> <p>2.5 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</p> <p>2.6 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing</p> <p>2.7 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</p> <p>2.8 describe the conventions and terminology used when identifying and rectifying defects (such as dis-bonds, de-lamination, resin injection, resin voids, core potting, repair patches)</p> <p>2.9 describe the failure modes for various composite mouldings, and what can contribute to these</p> <p>2.10 describe the different types of composite resin systems, fibres,</p>

reinforcements, and their merits

- 2.11 describe the different methods of production for composite mouldings, and their merits
- 2.12 describe the different methods of trimming composite mouldings, and their merits
- 2.13 describe the different methods of producing composite assemblies, and their merits
- 2.14 describe the different bonding agents, methods used, and their merits
- 2.15 describe the correct methods of storage and handling of composite materials
- 2.16 describe the tools and equipment used for various activities associated with composite mouldings
- 2.17 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.



Appendix 1 Relationships to other qualifications

Links to other qualifications

Mapping is provided as guidance and suggests areas of commonality between the qualifications. It does not imply that candidates completing units in one qualification have automatically covered all of the content of another.

Centres are responsible for checking the different requirements of all qualifications they are delivering and ensuring that candidates meet requirements of all units/qualifications.

This qualification has connections to the Level 3 NVQ in Mechanical Manufacturing Engineering (1682).

Literacy, language, numeracy and ICT skills development

This qualification can develop skills that can be used in the following qualifications:

- Functional Skills (England) – see www.cityandguilds.com/functionalskills
- Essential Skills (Northern Ireland) – see www.cityandguilds.com/essentialskillsni
- Essential Skills Wales – see www.cityandguilds.com/esw



Appendix 2 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on www.cityandguilds.com.

Centre Manual - Supporting Customer Excellence contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:

- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance

Our Quality Assurance Requirements encompasses all of the relevant requirements of key regulatory documents such as:

- Regulatory Arrangements for the Qualifications and Credit Framework (2008)
- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

and sets out the criteria that centres should adhere to pre and post centre and qualification approval.

Access to Assessment & Qualifications provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

The **centre homepage** section of the City & Guilds website also contains useful information such on such things as:

- **Walled Garden:** how to register and certificate candidates on line
- **Qualifications and Credit Framework (QCF):** general guidance about the QCF and how qualifications will change, as well as information on the IT systems needed and FAQs
- **Events:** dates and information on the latest Centre events
- **Online assessment:** how to register for e-assessments

City & Guilds
Believe you can



www.cityandguilds.com

Useful contacts

UK learners General qualification information	T: +44 (0)844 543 0033 E: learnersupport@cityandguilds.com
International learners General qualification information	T: +44 (0)844 543 0033 F: +44 (0)20 7294 2413 E: intcg@cityandguilds.com
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: centresupport@cityandguilds.com
Single subject qualifications Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 F: +44 (0)20 7294 2404 (BB forms) E: singlesubjects@cityandguilds.com
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: intops@cityandguilds.com
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: walledgarden@cityandguilds.com
Employer Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 E: business@cityandguilds.com
Publications Logbooks, Centre documents, Forms, Free literature	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413

Every effort has been made to ensure that the information contained in this publication is true and correct at the time of going to press. However, City & Guilds' products and services are subject to continuous development and improvement and the right is reserved to change products and services from time to time. City & Guilds cannot accept liability for loss or damage arising from the use of information in this publication.

If you have a complaint, or any suggestions for improvement about any of the services that we provide, email: **feedbackandcomplaints@cityandguilds.com**

About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

The City & Guilds Group operates from three major hubs: London (servicing Europe, the Caribbean and Americas), Johannesburg (servicing Africa), and Singapore (servicing Asia, Australia and New Zealand). The Group also includes the Institute of Leadership & Management (management and leadership qualifications), City & Guilds Land Based Services (land-based qualifications), the Centre for Skills Development (CSD works to improve the policy and practice of vocational education and training worldwide) and Learning Assistant (an online e-portfolio).

Copyright

The content of this document is, unless otherwise indicated, © The City and Guilds of London Institute and may not be copied, reproduced or distributed without prior written consent. However, approved City & Guilds centres and candidates studying for City & Guilds qualifications may photocopy this document free of charge and/or include a PDF version of it on centre intranets on the following conditions:

- centre staff may copy the material only for the purpose of teaching candidates working towards a City & Guilds qualification, or for internal administration purposes
- candidates may copy the material only for their own use when working towards a City & Guilds qualification.

The *Standard Copying Conditions* (see the City & Guilds website) also apply.

Please note: National Occupational Standards are not © The City and Guilds of London Institute. Please check the conditions upon which they may be copied with the relevant Sector Skills Council.

Published by City & Guilds, a registered charity established to promote education and training.

City & Guilds
1 Giltspur Street
London EC1A 9DD
T +44 (0)844 543 0000
F +44 (0)20 7294 2413
www.cityandguilds.com

WW-07-1712