

Specification

Edexcel NVQ/competence-based
qualification

**Edexcel Level 2 NVQ Diploma in Materials Processing
and Finishing (QCF)**

For first registration April 2011



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Contents

Qualification title covered by this specification	1
Key features of the Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing (QCF)	2
What is the purpose of this qualification?	2
Who is this qualification for?	2
What are the benefits of this qualification to the learner and employer?	2
What are the potential job areas for those working towards this qualification?	2
What progression opportunities are available to learners who achieve this qualification?	3
What is the qualification structure for the Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing (QCF)?	4
How is the qualification graded and assessed?	7
Assessment Strategy	7
Types of evidence (to be read in conjunction with the Assessment Strategy in <i>Annexe D</i>)	8
Centre recognition and approval	9
Centre recognition	9
Approvals agreement	9
Quality assurance	9
What resources are required?	9
Unit format	10
Units	11
Unit 1: Complying with statutory regulations and organisational safety requirements	13
Unit 2: Using and interpreting engineering data and documentation	21
Unit 3: Working efficiently and effectively in engineering	31
Unit 4: Producing sand moulds manually	39
Unit 5: Producing sand cores manually	49
Unit 6: Producing sand moulds or cores with mechanical assistance	57
Unit 7: Producing sand moulds or cores automatically	67
Unit 8: Producing ceramic moulds or cores	77
Unit 9: Producing shells or moulds for investment casting	87
Unit 10: Preparing materials for moulding and coremaking	95

Unit 11: Assembling, core setting and closing sand/ceramic moulds	105
Unit 12: Assembling and preparing investment shells for casting	113
Unit 13: Melting metal for casting	121
Unit 14: Casting metal by manual means	131
Unit 15: Casting metal using mechanical means	141
Unit 16: Preparing furnace and ladle linings for melting and pouring metal	151
Unit 17: Controlling and treating molten metal in readiness for casting	161
Unit 18: Producing metallic castings using the gravity die process	171
Unit 19: Producing metallic castings using pressure die processes	181
Unit 20: Inspecting metallic castings visually	191
Unit 21: Knocking out and de-coring metallic castings	201
Unit 22: Fettling metallic castings	211
Unit 23: Operating plastic injection moulding machines	221
Further information	231
Useful publications	231
How to obtain National Occupational Standards	231
Professional development and training	232
Annexe A: Progression pathways	233
The Edexcel qualification framework for the engineering sector	233
Annexe B: Quality assurance	239
Key principles of quality assurance	239
Quality assurance processes	239
Annexe C: Centre certification and registration	241
What are the access arrangements and special considerations for the qualification in this specification?	241
Annexe D: Assessment Strategy	243
Annexe E: Additional requirement for qualifications that use the term 'NVQ' in a QCF qualification title	245

Qualification title covered by this specification

This specification gives you the information you need to offer the Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing (QCF):

Qualification title	Qualification Number (QN)	Accreditation start date
Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing (QCF)	600/0731/X	01/04/2011

This qualification has been accredited within the Qualifications and Credit Framework (QCF) and is eligible for public funding as determined by the Department for Education (DfE) under Sections 96 and 97 of the Learning and Skills Act 2000.

The qualification title listed above features in the funding lists published annually by the DfE and the regularly updated website. It will also appear on the Learning Aims Database (LAD), where relevant.

You should use the QCF Qualification Number (QN), when you wish to seek public funding for your learners. Each unit within a qualification will also have a unique QCF reference number, which is listed in this specification.

The QCF qualification title and unit reference numbers will appear on the learners' final certification document. Learners need to be made aware of this when they are recruited by the centre and registered with Edexcel.

Key features of the Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing (QCF)

This qualification:

- is nationally recognised
- is based on the Semta National Occupational Standards (NOS). The NOS, Assessment Strategy and qualification structure are owned by Semta.

The Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing (QCF) has been approved as a component for the Semta Apprenticeship framework.

What is the purpose of this qualification?

This qualification is appropriate for employees in the engineering sector working across a broad range of areas. It is designed to assess occupational competence in the workplace where learners are required to demonstrate skills and knowledge to a level required in the engineering sector.

Who is this qualification for?

This qualification is for all learners aged 16 and above who are capable of reaching the required standards.

Edexcel's policy is that the qualification should:

- be free from any barriers that restrict access and progression
- ensure equality of opportunity for all wishing to access the qualification.

What are the benefits of this qualification to the learner and employer?

This qualification allows learners to demonstrate competence against National Occupational Standards which are based on the needs of the engineering sector as defined by Semta, the Sector Skills Council. As such it contributes to the development of skilled labour in the sector. The qualification may contribute towards the competence element of an Apprenticeship.

What are the potential job areas for those working towards this qualification?

- Materials processing
- Finishing activities

What progression opportunities are available to learners who achieve this qualification?

This qualification allows learners to demonstrate competence in materials processing and finishing at a level required by the engineering industry. Learners can progress across the level and size of the engineering competence and knowledge qualifications and into other occupational areas such as team leading and management.

Further information is available in *Annexe A*.

What is the qualification structure for the Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing (QCF)?

Individual units can be found in the *Units* section. The QCF level and credit value are given on the first page of each unit.

To achieve the **Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing (QCF)** learners must complete a minimum of 38 credits.

Learners must complete all mandatory units in Group A (15 credits) and then choose one of the following pathways:

Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing – Mould and Core Making (QCF) Learners must complete a minimum of two units in Group B1, for a minimum total of 30 credits.

Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing – Melting and Casting Metal (QCF) Learners must complete a minimum of two units in Group C1, for a minimum total of 36 credits.

Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing – Fettling and Finishing (QCF) Learners must complete the unit in Group D1 and a minimum of one unit in Group D2, for a minimum total of 23 credits.

Edexcel Level 2 NVQ Diploma in Materials Processing and Finishing – Injection Moulding (QCF) Learners must complete the unit in Group E1, for a minimum total of 28 credits.

A – Mandatory units

Learners must complete all the units in Group A.

- A/601/5013 – Complying with statutory regulations and organisational safety requirements
- Y/601/5102 – Using and interpreting engineering data and documentation
- Y/601/5052 – Working efficiently and effectively in engineering

B – Mould and Core Making

Learners must complete a minimum of two units in Group B1.

B1 – Optional units

- Y/502/9457 – Producing sand moulds manually
- J/502/9437 – Producing sand cores manually
- R/502/9439 – Producing sand moulds or cores with mechanical assistance
- J/502/9440 – Producing sand moulds or cores automatically
- L/502/9441 – Producing ceramic moulds or cores
- R/502/9442 – Producing shells or moulds for investment casting
- Y/502/9443 – Preparing materials for moulding and coremaking
- D/502/9444 – Assembling, core setting and closing sand/ceramic moulds
- H/502/9445 – Assembling and preparing investment shells for casting

C – Melting and Casting Metal

Learners must complete a minimum of two units in Group C1.

C1 – Optional units

- K/502/9446 – Melting metal for casting
- M/502/9447 – Casting metal by manual means
- T/502/9448 – Casting metal using mechanical means
- A/502/9449 – Preparing furnace and ladle linings for melting and pouring metal
- M/502/9450 – Controlling and treating molten metal in readiness for casting
- T/502/9451 – Producing metallic castings using the gravity die process
- A/502/9452 – Producing metallic castings using pressure die processes

D – Fettling and Finishing

Learners must complete the unit in Group D1 and a minimum of one unit in Group D2.

D1 – Mandatory unit

Learners must complete the unit in Group D1.

- L/502/9455 – Inspecting metallic castings visually

D2 – Optional unit

Learners must complete a minimum of one unit in Group D2.

F/502/9453 – Knocking out and de-coring metallic castings

J/502/9454 – Fettling metallic castings

E – Injection Moulding

Learners must complete the unit in Group E1.

E1 – Mandatory unit

R/502/9456 – Operating plastic injection moulding machines

How is the qualification graded and assessed?

The overall grade for the qualification is a 'pass'. The learner must achieve all the required units within the specified qualification structure.

To pass a unit the learner must:

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

The qualification is designed to be assessed:

- in the workplace or
- in conditions resembling the workplace, as specified in the Assessment Strategy for the sector, or
- as part of a training programme.

Assessment Strategy

The Assessment Strategy for this qualification has been included in *Annexe D*. It has been developed by Semta in partnership with employers, training providers, awarding organisations and the regulatory authorities. The Assessment Strategy includes details on:

- criteria for defining realistic working environments
- roles and occupational competence of assessors, expert witnesses, internal verifiers and standards verifiers
- quality control of assessment
- evidence requirements.

Evidence of competence may come from:

- **current practice** where evidence is generated from a current job role
- a **programme of development** where evidence comes from assessment opportunities built into a learning/training programme whether at or away from the workplace
- the **Recognition of Prior Learning (RPL)** where a learner can demonstrate that they can meet the assessment criteria within a unit through knowledge, understanding or skills they already possess without undertaking a course of learning. They must submit sufficient, reliable and valid evidence for internal and standards verification purposes. RPL is acceptable for accrediting a unit, several units or a whole qualification
- a **combination** of these.

It is important that the evidence is:

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

Types of evidence (to be read in conjunction with the Assessment Strategy in *Annexe D*)

To successfully achieve a unit the learner must gather evidence which shows that they have met the required standard in the assessment criteria. Evidence can take a variety of different forms including the examples below. Centres should refer to the Assessment Strategy for information about which of the following are permissible.

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

The abbreviations may be used for cross-referencing purposes.

Learners can use one piece of evidence to prove their knowledge, skills and understanding across different assessment criteria and/or across different units. It is, therefore, not necessary for learners to have each assessment criterion assessed separately. Learners should be encouraged to reference the assessment criteria to which the evidence relates.

Evidence must be made available to the assessor, internal verifier and Edexcel standards verifier. A range of recording documents is available on the Edexcel website www.edexcel.com. Alternatively, centres may develop their own.

Centre recognition and approval

Centre recognition

Centres that have not previously offered Edexcel qualifications need to apply for and be granted centre recognition as part of the process for approval to offer individual qualifications. New centres must complete both a centre recognition approval application and a qualification approval application.

Existing centres will be given 'automatic approval' for a new qualification if they are already approved for a qualification that is being replaced by the new qualification and the conditions for automatic approval are met. Centres already holding Edexcel approval are able to gain qualification approval for a different level or different sector via Edexcel online.

Approvals agreement

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

Quality assurance

Detailed information on Edexcel's quality assurance processes is given in *Annexe B*.

What resources are required?

Each qualification is designed to support learners working in the engineering sector. Physical resources need to support the delivery of the qualifications and the assessment of the learning outcomes and must be of industry standard. Centres must meet any specific resource requirements outlined in *Annexe D: Assessment Strategy*. Staff assessing the learner must meet the requirements within the overarching assessment strategy for the sector.

Unit format

Each unit in this specification contains the following sections.

Unit title:					The unit title is accredited on the QCF and this form of words will appear on the learner's Notification of Performance (NOP).
Unit reference number:					This code is a unique reference number for the unit.
QCF level:					All units and qualifications within the QCF have a level assigned to them, which represents the level of achievement. There are nine levels of achievement, from Entry level to level 8. The level of the unit has been informed by the QCF level descriptors and, where appropriate, the NOS and/or other sector/professional.
Credit value:					All units have a credit value. The minimum credit value is one, and credits can only be awarded in whole numbers. Learners will be awarded credits when they achieve the unit.
Guided learning hours:					A notional measure of the substance of a qualification. It includes an estimate of the time that might be allocated to direct teaching or instruction, together with other structured learning time, such as directed assignments, assessments on the job or supported individual study and practice. It excludes learner-initiated private study.
Unit summary:					This provides a summary of the purpose of the unit.
Assessment requirements/evidence requirements:					The assessment/evidence requirements are determined by the SSC. Learners must provide evidence for each of the requirements stated in this section.
Assessment methodology:					This provides a summary of the assessment methodology to be used for the unit.
Learning outcomes:	Assessment criteria:	Evidence type:	Portfolio reference:	Date:	
			The learner should use this box to indicate where the evidence can be obtained eg portfolio page number.	The learner should give the date when the evidence has been provided.	
Learning outcomes state exactly what a learner should know, understand or be able to do as a result of completing a unit.		The assessment criteria of a unit specify the standard a learner is expected to meet to demonstrate that a learning outcome, or a set of learning outcomes, has been achieved.		Learners must reference the type of evidence they have and where it is available for quality assurance purposes. The learner can enter the relevant key and a reference. Alternatively, the learner and/or centre can devise their own referencing system.	

Units

Unit 1: Complying with statutory regulations and organisational safety requirements

Unit reference number: A/601/5013

QCF level: 2

Credit value: 5

Guided learning hours: 35

Unit summary

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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Comply with statutory regulations and organisational safety requirements</p>	<p>1.1 Comply with their duties and obligations as defined in the Health and Safety at Work Act</p> <p>1.2 Demonstrate their understanding of their duties and obligations to health and safety by:</p> <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 time <p>1.3 Present themselves in the workplace suitably prepared for the activities to be undertaken</p> <p>1.4 follow organisational accident and emergency procedures</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.5 comply with emergency requirements, to include:</p> <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 <p>1.6 recognise and control hazards in the workplace</p> <p>1.7 identify the hazards and risks that are associated with the following:</p> <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 <p>1.8 use correct manual lifting and carrying techniques</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.9 demonstrate one of the following methods of manual lifting and carrying:</p> <ul style="list-style-type: none"> - lifting alone - with assistance of others - with mechanical assistance <p>1.10 apply safe working practices and procedures to include:</p> <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 outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to comply with statutory regulations and organisational safety requirements</p>	<p>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)</p> <p>2.2 describe the specific regulations and safe working practices and procedures that apply to their work activities</p> <p>2.3 describe the warning signs for the seven main groups of hazardous substances defined by Classification, Packaging and Labelling of Dangerous Substances Regulations</p> <p>2.4 explain how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>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)</p> <p>2.6 describe their responsibilities for identifying and dealing with hazards and reducing risks in the workplace</p> <p>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)</p> <p>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)</p> <p>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</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.10 explain what constitute dangerous occurrences and hazardous malfunctions, and why these must be reported even if no-one is injured</p> <p>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</p> <p>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</p> <p>2.13 describe the protective clothing and equipment that is available for their areas of activity</p> <p>2.14 explain how to safely lift and carry loads, and the manual and mechanical aids available</p> <p>2.15 explain how to prepare and maintain safe working areas; the standards and procedures to ensure good housekeeping</p> <p>2.16 describe the importance of safe storage of tools, equipment, materials and products</p> <p>2.17 describe the extent of their own authority, and to whom they should report in the event of problems that they cannot resolve</p>			

Learner name: _____
Learner signature: _____
Assessor signature: _____
Internal verifier signature: _____
(if sampled)

Date: _____
Date: _____
Date: _____
Date: _____

Unit 2: Using and interpreting engineering data and documentation

Unit reference number: Y/601/5102

QCF level: 2

Credit value: 5

Guided learning hours: 25

Unit summary

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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Use and interpret engineering data and documentation</p>	<p>1.1 use the approved source to obtain the required data and documentation</p> <p>1.2 use the data and documentation and carry out all of the following:</p> <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 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.3 correctly identify, interpret and extract the required information</p> <p>1.4 extract information that includes three of the following:</p> <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 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - 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 <p>1.5 use the information obtained to ensure that work output meets the specification</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.6 use information extracted from documents to include one from the following:</p> <ul style="list-style-type: none"> - 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 <p>1.7 use information extracted from related documentation, to include two from the following:</p> <ul style="list-style-type: none"> - instructions (such as job instructions, drawing instructions, manufacturers instructions) - specifications (such as material, finish, process, contractual, calibration) - reference materials (such as manuals, tables, charts, guides, notes) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - 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 <p>1.8 deal promptly and effectively with any problems within their control and report those which cannot be solved</p> <p>1.9 report any inaccuracies or discrepancies in documentation and specifications</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to use and interpret engineering data and documentation</p>	<p>2.1 explain what information sources are used for the data and documentation that they use in their work activities</p> <p>2.2 explain how documents are obtained, and how to check that they are current and valid</p> <p>2.3 explain the basic principles of confidentiality (including what information should be available and to whom)</p> <p>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)</p> <p>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)</p> <p>2.6 describe the importance of differentiating fact from opinion when reviewing data and documentation</p> <p>2.7 describe the importance of analysing all available data and documentation before decisions are made</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.8 describe the different ways of storing and organising data and documentation to ensure easy access</p> <p>2.9 describe the procedures for reporting discrepancies in the data or documentation, and for reporting lost or damaged documents</p> <p>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</p> <p>2.11 explain the care and control procedures for the documents, and how damage or graffiti on documents can lead to scrapped work</p> <p>2.12 explain the importance of returning documents to the designated location on completion of the work activities</p> <p>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)</p> <p>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)</p> <p>2.15 explain the imperial and metric systems of measurement; tolerancing and fixed reference points</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>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)</p> <p>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</p>			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

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

Unit 3: Working efficiently and effectively in engineering

Unit reference number: Y/601/5052

QCF level: 2

Credit value: 5

Guided learning hours: 25

Unit summary

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 ensuring that any tools, equipment, materials and other resources required are available and in a safe and usable condition.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Work efficiently and effectively in engineering</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guideline</p> <p>1.2 prepare the work area to carry out the engineering activity</p> <p>1.3 prepare to carry out the engineering activity, taking into consideration all of the following, as applicable to the work to be undertaken:</p> <ul style="list-style-type: none"> - the work area is free from hazards and 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 usable 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 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.4 check that there are sufficient supplies of materials and/or consumables and that they meet work requirements</p> <p>1.5 ensure completed products or resources are stored in the appropriate location on completion of the activities</p> <p>1.6 complete work activities, to include all of the following:</p> <ul style="list-style-type: none"> - returning tools and equipment - returning drawings and work instructions - completing all necessary documentation accurately and legibly - identifying, where appropriate, any unusable tools, equipment and components - arranging for the safe disposal of waste materials <p>1.7 tidy up the work area on completion of the engineering activity</p> <p>1.8 deal promptly and effectively with problems within their control and report those that cannot be resolved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.9 deal with problems affecting the engineering process, to include two of the following:</p> <ul style="list-style-type: none"> - materials - tools and equipment - drawings - job specification - quality - people - timescales - safety - activities or procedures <p>1.10 contribute to organisational procedures for identifying opportunities for improvement to one of the following:</p> <ul style="list-style-type: none"> - working practices - working methods - quality - safety - tools and equipment - supplier relationships - internal communication - customer service 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - training and development - teamwork - other <p>1.11 maintain effective working relationships with colleagues to include two of the following:</p> <ul style="list-style-type: none"> - colleagues within their own working group - people outside their normal working group - line management - external contacts <p>1.12 review personal training and development as appropriate to the job role</p> <p>1.13 review personal development objectives and targets to include one of the following:</p> <ul style="list-style-type: none"> - dual or multi-skilling - training on new equipment/technology - increased responsibility - understanding of company working practices, procedures, plans and policies - other specific requirements 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to work efficiently and effectively in engineering</p>	<p>2.1 describe the safe working practices and procedures to be followed while preparing and tidying up their work environment</p> <p>2.2 describe the correct use of any equipment to protect the health and safety of themselves and their colleagues</p> <p>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</p> <p>2.4 describe the action that should be taken if documentation received is incomplete and/or incorrect</p> <p>2.5 describe the procedure for ensuring that all tools and equipment are available prior to undertaking the activity</p> <p>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</p> <p>2.7 describe the action that should be taken if tools and equipment are not in full working order</p> <p>2.8 describe the checks to be carried out to ensure that all required materials are correct and complete, prior to undertaking the activity</p> <p>2.9 describe the action that should be taken if materials do not meet the requirements of the activity</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.10 explain whom to inform when the work activity has been completed</p> <p>2.11 describe the information and/or documentation that others will require to confirm that the activity has been completed</p> <p>2.12 explain what materials, equipment and tools can be re-used</p> <p>2.13 explain how any waste materials and/or products are transferred, stored and disposed of</p> <p>2.14 explain where tools and equipment should be stored and located</p> <p>2.15 describe the importance of maintaining effective working relationships within the workplace</p> <p>2.16 describe the procedures for dealing with and reporting any problems that can affect working relationships</p> <p>2.17 describe the importance of making a contribution to improving working practices</p> <p>2.18 describe the procedure and format for making suggestions for improvements</p> <p>2.19 describe the benefits for the work area if improvements can be identified</p> <p>2.20 describe the difficulties that can occur in working relationships</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>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)</p> <p>2.22 describe the benefits of continuous personal development</p> <p>2.23 describe the training opportunities that are available in the workplace</p> <p>2.24 describe the importance of reviewing their training and development</p> <p>2.25 explain with whom to discuss training and development issues</p> <p>2.26 describe the extent of their own authority and to whom they should report if they have any problems that they cannot resolve</p>			

Learner name: _____ Date: _____

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Assessor signature: _____ Date: _____

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

Unit 4: Producing sand moulds manually

Unit reference number: Y/502/9457

QCF level: 2

Credit value: 28

Guided learning hours: 91

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to produce sand moulds using manual methods, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the type and size of the pattern, the moulding method employed, and the metal to be cast. The moulds to be produced will be for either ferrous or non-ferrous metal, and moulding will take place, using recognised techniques, in jobbing and semi-mechanised foundries.

The learner will be expected to produce the moulds using either greensand, chemically bonded gas activated sand, chemically bonded resin/catalyst activated sand or resin bonded heat activated sand. The patterns used will be loose or boarded, circular, square or irregular in shape, and will have projections and internal cavities. The profiles will be curved and tapered. The moulds will be produced either in boxes or boxless, as appropriate.

The learner's responsibilities will require them to comply with organisational policy and procedures for the moulding activities undertaken, and to report any problems with the patterns, sand or equipment in use, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work to instructions, with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the moulds that they produce. The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying manual sand moulding techniques. They will have an understanding of the manual sand moulding process and its application, and will know about the equipment, materials and consumables in adequate depth to provide a sound background for carrying out the activities to the required specification. Their knowledge will be sufficient to enable them to identify substandard sand, patterns and moulding equipment.

The learner will understand the safety precautions required when carrying out the sand moulding activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout and will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Produce sand moulds manually</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the sand moulding activities:</p> <ul style="list-style-type: none"> - confirm that all the required materials and equipment are available and are in a safe and usable condition - use appropriate personal protective equipment - comply with job instructions, moulding specifications and relevant COSHH sheets and risk assessment documentation - use the correct tools and equipment for the moulding activity - follow the defined moulding procedures and apply safe working practices and procedures at all times - ensure that the moulds produced meet the required specification for quality and accuracy - leave the work area in a safe condition on completion of the moulding activities 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.3 follow the correct component drawing or any other related specifications for the component to be produced</p> <p>1.4 determine what has to be done and how this will be achieved</p> <p>1.5 obtain and prepare the appropriate tools, equipment and materials</p> <p>1.6 prepare the pattern equipment for use, to include both of the following:</p> <ul style="list-style-type: none"> - visually inspecting the pattern for damage - applying release agents to the pattern (as applicable) <p>1.7 carry out the moulding or laying-up activities using the correct methods and techniques</p> <p>1.8 produce drag and cope mould parts from patterns which are either:</p> <ul style="list-style-type: none"> - loose flat back and split type <p>OR</p> <ul style="list-style-type: none"> - plated flat type and split type <p>1.9 produce moulds that include one core, with core locations covering both of the following positions:</p> <ul style="list-style-type: none"> - horizontal - vertical 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 produce mould parts, using one of the following methods:</p> <ul style="list-style-type: none"> - use of moulding boxes - boxless, using mould location devices <p>1.11 produce moulds using one of the following types of sand:</p> <ul style="list-style-type: none"> - greensand (naturally or synthetically bonded) - chemically bonded gas activated - other (specify) - chemically bonded resin/catalyst - resin bonded heat activated <p>1.12 form runner, riser and feeder systems on the mould, using one of the following methods:</p> <ul style="list-style-type: none"> - cut and formed manually - preformed with fixed formers - preformed with loose formers <p>1.13 finish/repair the moulds, using one of the following methods:</p> <ul style="list-style-type: none"> - patching up greensand moulds - repairing rigid sand moulds using adhesives 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.14 apply mould coatings/dressings to the moulds, using one of the following methods:</p> <ul style="list-style-type: none"> - spray - flood - brush - dry <p>1.15 produce components to the required specification</p> <p>1.16 produce sand moulds which meet all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - they are complete and free from obvious defects (cracks, broken or damaged mould surfaces) - they meet the required specification (shape, dimensional accuracy) - they are free from soft spots <p>1.17 check that all the required operations have been completed to specification</p> <p>1.18 sort the finished moulds, to include both of the following:</p> <ul style="list-style-type: none"> - placing acceptable moulds into designated areas - disposing of sub-standard moulds into designated areas <p>1.19 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to produce sand moulds manually</p>	<p>2.1 describe the specific safety precautions to be taken when producing sand moulds manually</p> <p>2.2 describe the hazards associated with producing sand moulds by manual means, and explain how they can be minimised</p> <p>2.3 explain the COSHH regulations that apply when dealing with chemically bonded sands, surface coatings, release agents, surface dressings</p> <p>2.4 explain where to obtain information on COSHH regulations</p> <p>2.5 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.6 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.7 explain what personal protective equipment (PPE) should be used and how to obtain it and check that it is in a safe and usable condition</p> <p>2.8 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.9 describe the different pattern types used in the moulding process (such as loose and plated)</p> <p>2.10 describe the jointing methods that are required for the different pattern types</p> <p>2.11 describe the different types of core print used to locate and secure cores (including drag and cope prints)</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.12 explain the different sand moulding processes used (such as greensand and chemically bonded sand)</p> <p>2.13 explain the various additions and additives that are used when mixing sands, and how these affect the moulding process</p> <p>2.14 explain the effects, on the casting produced, of using incorrect amounts of additions and additives to moulding sands</p> <p>2.15 explain why different types of sand mixes have limited or unlimited life for producing moulds</p> <p>2.16 explain the application and use of release agents and mould coatings</p> <p>2.17 explain how to identify mould defects (such as soft spots, broken/damaged mould surfaces or clagging/sticking)</p> <p>2.18 describe the company quality control procedures for producing and inspecting moulds</p> <p>2.19 explain why it is important to keep the pattern equipment clean and free from damage, to practise good housekeeping of moulding tools and equipment, and to maintain a clean working area</p> <p>2.20 describe the extent of their own authority, and to whom they should report if they have problems that they cannot resolve when making the moulds</p>			

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Unit 5: Producing sand cores manually

Unit reference number: J/502/9437

QCF level: 2

Credit value: 28

Guided learning hours: 91

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to produce sand cores from solid turn out and split core boxes, using manual and semi-mechanised methods, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the type and size of the cores, the coremaking method employed and the metal to be cast. Coremaking will take place, using recognised techniques, in jobbing and semi-mechanised foundries.

The learner will be expected to produce the cores using a range of sand, such as oil sand, chemically bonded gas activated sand, chemically bonded resin/catalyst activated sand or resin bonded heat activated sand. The learner will be expected to gas their own cores and determine the length of time that resin bonded sand cores need to cure prior to stripping.

The core boxes used will be simple in shape, and it is expected that the cores produced will require the use of simple reinforcements and vents. The learner will be informed when the cores need to be produced in halves, and they will need to complete the core joining operations, when this is applicable. Special sands will be used, where applicable, to suit core sections and the metal being cast. Repairs to the cores will be performed where necessary. The learner will make the decisions regarding core coating/dressing, if required, and will mix/approve and apply the coatings/dressings to company standards.

The learner's responsibilities will require them to comply with organisational policy and procedures for the coremaking activities undertaken, and to report any problems with the core boxes, sand or equipment in use, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the cores that they produce.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying manual sand coremaking techniques. They will have an understanding of the different types of sand in use, and the additives and additions used in preparing the sand they use to make the cores. They will also understand the different types of core box and coremaking accessories used, and their application, in adequate depth to provide a sound background for carrying

out the activities to the required specification. Their knowledge will be sufficient to enable them to identify sub-standard sand, core boxes, coremaking equipment and finished cores.

The learner will understand the safety precautions required when carrying out the sand coremaking activities, and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Produce sand cores manually</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the sand coremaking activities:</p> <ul style="list-style-type: none"> - confirm that all the required materials and equipment are available and are in a safe and usable condition - use appropriate personal protective equipment - comply with job instructions, coremaking specifications and relevant COSHH sheets and risk assessment documentation - use the correct tools and equipment for the coremaking activity - follow the defined moulding procedures and apply safe working practices and procedures at all times - ensure that the cores produced meet the required specification for quality and accuracy - leave the work area in a safe condition on completion of the coremaking activities <p>1.3 follow the correct component drawing or any other related specifications for the component to be produced</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.4 determine what has to be done and how this will be achieved</p> <p>1.5 obtain and prepare the appropriate tools, equipment and materials</p> <p>1.6 prepare the core boxes for use, to include both of the following:</p> <ul style="list-style-type: none"> - visually inspecting the core box for damage - applying release agents to the core box (as applicable) <p>1.7 carry out the moulding or laying-up activities using the correct methods and techniques</p> <p>1.8 produce full and half cores from both of the following types of core box:</p> <ul style="list-style-type: none"> - solid turnout boxes - split boxes <p>1.9 produce cores using two of the following techniques:</p> <ul style="list-style-type: none"> - hand tucking and ramming - mechanical assistance with core consolidation - inserting reinforcements (wire or bars) - incorporating vents (pre-formed, manually applied) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 produce cores using one of the following sands:</p> <ul style="list-style-type: none"> - oil sand - chemically bonded gas activated - chemically bonded resin/catalyst - resin bonded heat activated <p>1.11 finish/repair cores using one of the following methods:</p> <ul style="list-style-type: none"> - patching up/repairing oil sand cores - repairing rigid sand cores using adhesives <p>1.12 apply core coatings/dressings using one of the following methods:</p> <ul style="list-style-type: none"> - spray - flood - brush - dry <p>1.13 produce components to the required specification</p> <p>1.14 produce sand cores which meet all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - they are complete and free from obvious defects (cracks, broken or damaged surfaces) - they meet the required specification (shape, dimensional accuracy) - they are free from soft spots 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.15 check that all the required operations have been completed to specification</p> <p>1.16 sort the finished cores, to include both of the following:</p> <ul style="list-style-type: none"> - placing acceptable cores into designated areas - disposing of sub-standard cores into designated areas <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			
<p>2 Know how to produce sand cores manually</p>	<p>2.1 describe the specific safety precautions to be taken when producing sand cores manually</p> <p>2.2 describe the hazards associated with producing sand cores by manual or semi-mechanised means, and how they can be minimised</p> <p>2.3 explain the COSHH regulations that apply when dealing with chemically bonded sands, surface coatings and surface dressings</p> <p>2.4 explain where to obtain information on COSHH regulations</p> <p>2.5 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.6 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.7 explain what personal protective equipment (PPE) should be used, how to obtain it and check that it is in a safe and usable condition</p> <p>2.8 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.9 describe the different core box types used in the core moulding process (such as solid turnout and split)</p> <p>2.10 describe the different types of core box clamping devices</p> <p>2.11 describe the different types of core reinforcement (such as wire, sprigs and bars)</p> <p>2.12 describe the different sand coremaking processes used (such as oil sand, chemically bonded sand gas activated, chemically bonded resin catalyst and resin bonded heat activated)</p> <p>2.13 explain the various additions and additives that are used when mixing sands, and how these affect the coremaking process</p> <p>2.14 explain why different types of sand mixes have limited or unlimited life for producing the cores</p> <p>2.15 explain the application and use of release agents and core coatings or dressings</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.16 explain how to identify core defects (such as soft spots, broken/damaged core surfaces or clagging/sticking or distorted sections)</p> <p>2.17 describe the company quality control procedures for producing and inspecting the cores (such as cleanliness, completeness, freedom from foreign bodies and defects)</p> <p>2.18 explain why it is important to keep the core boxes and equipment clean and free from damage, to practise good housekeeping of coremaking tools and equipment, and to maintain a clean working area</p> <p>2.19 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve when making the cores</p>			

Learner name: _____ Date: _____

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Assessor signature: _____ Date: _____

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

Unit 6: Producing sand moulds or cores with mechanical assistance

Unit reference number: R/502/9439

QCF level: 2

Credit value: 28

Guided learning hours: 91

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to produce sand moulds or cores from plated patterns (with and without cores) or split core boxes, using manual and semi-mechanised methods, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the type and size of the pattern or core box, the moulding or coremaking method employed and the metal to be cast. They will be expected to check the machine they use, prior to beginning production, to ensure that it is in a safe and usable condition, and the learner will be expected to shut down the machine to a safe condition on completion of the moulding or coremaking activities. Moulding or coremaking will take place using recognised techniques, in semi-mechanised foundries.

The learner will be expected to produce the moulds or cores using sand mixtures such as greensand, chemically bonded gas activated sand, chemically bonded resin/catalyst activated sand or resin bonded heat activated sand. The learner will be expected to gas/cure their own moulds or cores, either manually or by using the gassing/heating system incorporated in the machine. They will also need to determine the length of time that resin bonded sand moulds or cores need to cure, prior to stripping.

The patterns used will be plated and, either fitted to a moulding machine, or sited on a roller track. The moulding machine will be either the jolt squeeze, jolt/squeeze/rollover or blow/blow squeeze type. Mould stripping will, in general, be performed mechanically. Core boxes will be simple in shape, and it is expected that the cores will be blown. Special sands will be used, where applicable, to suit core sections and the metal being cast. Moulds and cores will be removed from the machine in use, and placed in areas specified for the product. Substandard mould or cores will be scrapped and placed in non-production storage areas for examination by others. The profiles will be curved and tapered. The moulds will be produced either in boxes, or boxless, as appropriate.

The learner's responsibilities will require them to comply with organisational policy and procedures for the moulding or coremaking activities undertaken, and to report any problems with the patterns or core boxes, sand and

equipment in use, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the moulds or cores that they produce.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the semi-mechanised production of sand moulds or cores. They will have an understanding of the different types of sand in use, and the additives and additions used in preparing the sand they are using to make the moulds or cores. They will understand the different types of pattern or core box, and the associated equipment, materials and consumables, in adequate depth to provide a sound background for carrying out the activities to the required specification. Their knowledge will be sufficient to enable them to identify substandard sand, patterns, core boxes and moulding equipment, and finished moulds or cores.

The learner will understand the safety precautions required when carrying out the sand moulding and coremaking activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Produce sand moulds or cores with mechanical assistance</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the sand moulding activities:</p> <ul style="list-style-type: none"> - confirm that all the required materials are available and are in a safe and usable condition - use appropriate personal protective equipment - comply with job instructions, moulding specifications and relevant COSHH sheets and risk assessment documentation - check that the machine and associated equipment is in a safe and usable condition - follow the defined moulding or coremaking procedures, and apply safe working practices and procedures at all times - ensure that the moulds or cores produced meet the required specification for quality and accuracy - shut down the machine and leave the work area in a safe condition on completion of the moulding or coremaking activities 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.3 use one of the following types of machine to produce the moulds or cores:</p> <ul style="list-style-type: none"> - jolt/squeeze - jolt/squeeze/rollover - mixer/slinger - mixer/vibratory table - squeeze - blown - blown/vibratory - blow/blow squeeze - other (specify) <p>1.4 confirm that the equipment is set up correctly and is ready for use, to include checking and ensuring all of the following:</p> <ul style="list-style-type: none"> - safety locks, guards or screens are operational - sand discharge points are clean and operational - pattern plates or core boxes are free from damage, and are correctly mounted and secured - consumables to be used are at the required levels - the gassing systems are connected and operational - emergency stop controls are operational 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.5 manipulate the machine controls safely and correctly in line with operational procedures</p> <p>1.6 produce moulds or cores from one of the following types of sand:</p> <ul style="list-style-type: none"> - greensand (naturally or synthetically bonded) - chemically bonded gas activated - other type of sand (specify) - chemically bonded resin catalyst activated - resin bonded heat activated <p>1.7 produce one of the following:</p> <ul style="list-style-type: none"> - moulds from plated patterns, with mechanical assistance, to include at least one core - cores from split boxes, with mechanical assistance inserting, where appropriate, suitable reinforcements <p>1.8 strip moulds or cores, using one of the following methods:</p> <ul style="list-style-type: none"> - manually - manually, using vibratory action - automatically 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.9 apply mould/core coatings/dressings, where appropriate, using one of the following methods:</p> <ul style="list-style-type: none"> - spray - flood - brush - dry <p>1.10 produce components to the required specification</p> <p>1.11 produce sand moulds or cores which meet all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - they are complete and free from obvious defects (cracks, broken or damaged surfaces) - they meet the required specification (shape, dimensional accuracy) - they are free from soft spots <p>1.12 carry out quality sampling checks at suitable intervals</p> <p>1.13 complete the organisational quality inspection checks, using one of the following methods:</p> <ul style="list-style-type: none"> - visual - using jigs, gauges or templates - using automated techniques 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.14 sort the finished moulds or cores, to include both of the following:</p> <ul style="list-style-type: none"> - placing acceptable moulds or cores into designated areas - disposing of sub-standard moulds or cores into designated areas <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.16 shut down the equipment to a safe condition on conclusion of the machining activities</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to produce sand moulds or cores with mechanical assistance</p>	<p>2.1 describe the specific safety precautions to be taken when producing sand moulds or cores by manual and mechanical methods</p> <p>2.2 describe the hazards associated with producing sand moulds or cores by manual and mechanical means (such as moving parts of machinery, hydraulic systems, damaged equipment, and escapes of air, gas or oil), and explain how they can be minimised</p> <p>2.3 explain the procedure to be followed in the event of a machine malfunction</p> <p>2.4 explain the COSHH regulations that apply when dealing with chemically bonded sands, surface coatings, release agents, surface dressings</p> <p>2.5 explain where to obtain information on COSHH regulations</p> <p>2.6 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.7 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.8 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.9 describe the different plated pattern types used in the moulding process</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.10 describe the methods used to locate mould boxes or frames onto pattern plates</p> <p>2.11 describe the different types of coremaking processes</p> <p>2.12 describe the main types of mould or core reinforcements (such as boxes, frames, cast bars or grids)</p> <p>2.13 explain the different sand moulding/coremaking processes used (such as chemically bonded sand, gas activated, chemically bonded resin catalyst or resin bonded heat activated)</p> <p>2.14 explain the various additions and additives that are used when mixing sands, and how these affect the moulding/coremaking process</p> <p>2.15 explain the effects, on the casting produced, of using incorrect amounts of additions and additives to moulding sands</p> <p>2.16 explain the application and use of release agents and mould coatings</p> <p>2.17 explain why different types of sand mixes have limited or unlimited life for producing moulds</p> <p>2.18 describe the mould/core curing techniques (such as gas, resin catalyst or heat activated)</p> <p>2.19 explain the various core and mould stripping techniques and methods</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.20 explain how to identify mould or core defects (such as soft spots, broken/damaged mould/core surfaces or clagging/sticking)</p> <p>2.21 describe the company quality control procedures for producing and inspecting moulds and cores</p> <p>2.22 explain why it is important to keep the pattern or core box equipment clean and free from damage, to practise good housekeeping of moulding tools and equipment, and to maintain a clean working area</p> <p>2.23 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve when making the moulds or cores</p>			

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(if sampled)

Unit 7: Producing sand moulds or cores automatically

Unit reference number: J/502/9440

QCF level: 2

Credit value: 28

Guided learning hours: 91

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to produce sand moulds or cores, using automatic methods, in accordance with approved procedures. Moulding or coremaking will take place using recognised techniques, in fully mechanised foundries. The learner will be expected to activate the operations at the start of their shift, and to close down the operations when their shift finishes.

Moulds or cores will be produced from either greensand, chemically bonded gas activated sand or chemically bonded resin/catalyst activated sand. The learner will be expected to check the systems that operate the production cycle. This will include safety checks, checking the correct location and security of pattern or core boxes, and the supply of consumables (power, sand, gas (if used), track/conveyors, return belts), and any other special checks made (manually, visually or electronically).

Patterns or core boxes will be fitted to a moulding or coremaking machine. The moulding machines will automatically perform the complete cycle of production. Mould or core stripping will, in general, be performed mechanically. Moulds and cores will be transferred or removed from the machine in use, in some cases by automatic means, and placed in areas or on tracks or conveyors specified for the product.

The learner's responsibilities will require them to comply with organisational policy and procedures for the moulding or coremaking activities undertaken, and to report any problems with the patterns or core boxes, sand and equipment in use, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the moulds or cores that they produce.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the mechanised production of sand moulds or cores. They will have an understanding of the different types of sand in use, and the additives and additions used in preparing the sand they are using to make the moulds or cores. They will also understand the cycle of operations used to produce the moulds or cores, and the associated equipment, materials and consumables

used, in adequate depth to provide a sound background for carrying out the activities to the required specification. Their knowledge will be sufficient to enable them to identify when there are faults highlighted by the checking/production cycles, and to take the necessary actions to solve, rectify or report the fault.

The learner will understand the safety precautions required when carrying out the sand moulding and coremaking activities, and when using fully mechanised moulding equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Produce sand moulds or cores automatically</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the sand moulding activities:</p> <ul style="list-style-type: none"> - confirm that all the required materials and equipment are available and are in a safe and usable condition - use appropriate personal protective equipment - comply with job instructions, moulding specifications and relevant COSHH sheets and risk assessment documentation - follow the defined moulding or coremaking procedures and apply safe working practices and procedures at all times - ensure the moulds or cores produced meet the required specification for quality and accuracy - shut down the machine and leave the work area in a safe condition on completion of the moulding or coremaking activities <p>1.3 use one of the following types of machine to produce the moulds or cores:</p> <ul style="list-style-type: none"> - automatic moulding machine - automatic coremaking machine 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.4 confirm that the equipment is set up correctly and is ready for use, to include checking and ensuring all of the following:</p> <ul style="list-style-type: none"> - safety locks, guards or screens are operational - sand discharge points are clean and operational - pattern plates or core boxes are free from damage and are correctly mounted and secured - consumables to be used are at the required levels - the gassing systems are connected and operational - the machine sequence cycle is correct - emergency stop controls are operational <p>1.5 manipulate the machine controls safely and correctly in line with operational procedures</p> <p>1.6 produce moulds or cores automatically from one of the following types of sand:</p> <ul style="list-style-type: none"> - greensand (naturally or synthetically bonded) - chemically bonded gas activated - chemically bonded resin catalyst activated <p>1.7 produce one of the following:</p> <ul style="list-style-type: none"> - moulds from plated patterns - cores from split boxes 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.8 produce components to the required specification</p> <p>1.9 produce sand moulds or cores which meet all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - they are complete and free from obvious defects (cracks, broken or damaged surfaces) - they meet the required specification (shape, dimensional accuracy) - they are free from soft spots <p>1.10 carry out quality sampling checks at suitable intervals</p> <p>1.11 complete the organisational quality inspection checks, using one of the following methods:</p> <ul style="list-style-type: none"> - visual - using jigs, gauges or templates - using automated techniques <p>1.12 sort the finished moulds or cores, to include both of the following:</p> <ul style="list-style-type: none"> - placing acceptable moulds/cores into designated areas - disposing of sub-standard moulds/cores into designated areas dry <p>1.13 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.14 shut down the equipment to a safe condition on conclusion of the machining activities</p> <p>1.15 complete all of the following operations at shutdown:</p> <ul style="list-style-type: none"> - use the correct procedure to safely close down the machine on completion of the activities - check that all systems are failsafe - complete the operational log, where appropriate - hand over the machine to supervision 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to produce sand moulds or cores automatically</p>	<p>2.1 describe the specific safety precautions to be taken when producing sand moulds or cores using fully automatic methods</p> <p>2.2 describe the hazards associated with producing sand moulds or cores automatically (such as moving parts of machinery, hydraulic systems, damaged equipment, and escapes of air, gas or oil), and explain how they can be minimised</p> <p>2.3 explain the procedure to be followed in the event of a machine malfunction</p> <p>2.4 explain the COSHH regulations that apply when dealing with chemically bonded sands, surface coatings, release agents, surface dressings</p> <p>2.5 explain where to obtain information on COSHH regulations</p> <p>2.6 explain the provision and use of work equipment regulations (PUWER)</p> <p>2.7 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.8 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.9 describe the different plated pattern types used in the moulding process</p> <p>2.10 describe the methods used to locate mould boxes or frames onto pattern plates</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.11 describe the different types of coremaking processes</p> <p>2.12 describe the different sand moulding and coremaking processes used (such as chemically bonded sand, gas activated, chemically bonded resin catalyst)</p> <p>2.13 explain the various additions and additives that are used when mixing sands, and how these affect the moulding and coremaking process</p> <p>2.14 explain the effects, on the casting produced, of using incorrect amounts of additions and additives to moulding and coremaking sands</p> <p>2.15 explain the application and use of release agents and mould coatings</p> <p>2.16 explain why different types of sand mixes have limited or unlimited life for producing moulds</p> <p>2.17 describe the mould/core curing techniques (such as gas, resin catalyst or heat activated)</p> <p>2.18 describe the various core and mould stripping techniques and methods</p> <p>2.19 explain how to identify mould or core defects (such as soft spots, broken/damaged mould/core surfaces or clagging/sticking)</p> <p>2.20 describe the company quality control procedures for producing and inspecting moulds/cores</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.21 explain why it is important to keep the pattern or core box equipment clean and free from damage, to practice good housekeeping of moulding tools and equipment, and to maintain a clean working area</p> <p>2.22 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve when making the moulds or cores</p>			

Learner name: _____ Date: _____

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(if sampled)

Unit 8: Producing ceramic moulds or cores

Unit reference number: L/502/9441

QCF level: 2

Credit value: 28

Guided learning hours: 91

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to produce ceramic moulds or cores, using manual and semi-mechanised methods, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the type and size of the moulds or cores, the moulding or coremaking method employed, and the metal to be cast. Moulding or coremaking will take place, using recognised techniques, in jobbing and semi-mechanised foundries.

The learner will be expected to produce the moulds/cores using chemically bonded refractory materials. The completed moulds or cores will be air/gas torch dried, followed by stoving, to develop a ceramic mould or core. They will be expected to prepare the mainly resin or metal pattern equipment, and to insert any preformed parts to aid casting definition or the stripping properties required. Using pre-mixed slurry, the learner will produce the moulds or cores. In certain circumstances, the slurry will be used to form a shell, which will be backed up using conventional mould forming materials. The learner will follow the laid-down procedure for the stripping times of the moulds or cores, and for the subsequent treatments that will be performed on the products. They will also be expected to carry out any necessary repairs to the moulds or cores, and to apply any required coatings/dressings.

The learner's responsibilities will require them to comply with organisational policy and procedures for the ceramic mould or coremaking activities undertaken, and to report any problems with the patterns or core boxes, slurry or equipment in use, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the moulds or cores that they produce.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying ceramic mould or coremaking techniques. They will have an understanding of the different types of refractories in use, and the additives and additions used in preparing the slurry they use to make the moulds or cores. They will also understand the different types of pattern or core box and associated

accessories used, and their application, in adequate depth to provide a sound background for carrying out the activities to the required specification. Their knowledge will be sufficient to enable them to identify substandard slurry, patterns, core boxes, equipment and finished moulds or cores.

The learner will understand the safety precautions required when carrying out the ceramic moulding or coremaking activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Produce ceramic moulds or cores</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the sand core moulding activities:</p> <ul style="list-style-type: none"> - confirm that all the required materials and equipment are available and are in a safe and usable condition - use appropriate personal protective equipment - comply with job instructions, moulding or coremaking specifications, relevant COSHH sheets and risk assessment documentation - use the correct tools and equipment for the ceramic moulding/coremaking activity - follow the defined moulding/coremaking procedures, and apply safe working practices and procedures at all times - ensure that the moulds or cores produced meet the required specification for quality and accuracy - leave the work area in a safe condition on completion of the moulding/coremaking activities 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.3 follow the correct component drawing or any other related specifications for the component to be produced</p> <p>1.4 determine what has to be done and how this will be achieved</p> <p>1.5 obtain and prepare the appropriate tools, equipment and materials</p> <p>1.6 prepare the patterns or core boxes for use, to include both of the following:</p> <ul style="list-style-type: none"> - visually inspecting the pattern or core box for damage - applying release agents to the pattern or core box (as applicable) <p>1.7 obtain or mix the slurry using one of the following:</p> <ul style="list-style-type: none"> - batch mixer - continuous mixer <p>1.8 carry out the moulding or laying-up activities using the correct methods and techniques</p> <p>1.9 produce moulds, full cores or half cores from one of the following:</p> <ul style="list-style-type: none"> - plated patterns - loose patterns - solid turnout and split core boxes 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 produce moulds or cores which are backed up with conventional refractory material, using two of the following techniques:</p> <ul style="list-style-type: none"> - hand tucking and ramming - inserting preformed sections - mechanical assistance with mould or core consolidation <p>1.11 produce moulds or cores using one of the following processes:</p> <ul style="list-style-type: none"> - Shaw - Unicast - other method (specify) <p>1.12 apply mould or core coatings/dressings, using one of the following methods:</p> <ul style="list-style-type: none"> - spray - flood - brush - dry <p>1.13 produce components to the required specification</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.14 produce ceramic moulds or cores which meet all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - they are complete and free from obvious defects (cracks, broken or damaged surfaces) - they meet the required specification (shape, dimensional accuracy) - they are free from soft spots <p>1.15 check that all the required operations have been completed to specification</p> <p>1.16 sort the finished moulds or cores, to include both of the following:</p> <ul style="list-style-type: none"> - placing acceptable moulds or cores into designated areas - disposing of sub-standard moulds or cores into designated areas <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to produce ceramic moulds or cores</p>	<p>2.1 describe the specific safety precautions to be taken when producing ceramic moulds or cores, manually and with mechanical assistance</p> <p>2.2 describe the hazards associated with producing ceramic moulds/cores by manual and mechanical means (such as handling slurries and refractory materials, using mechanical equipment for mixing and consolidating, using damaged or badly maintained equipment), and explain how they can be minimised</p> <p>2.3 explain the COSHH regulations that apply when dealing with refractory materials, surface coatings and surface dressings</p> <p>2.4 explain where to obtain information on COSHH regulations</p> <p>2.5 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.6 describe manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.7 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.8 explain how to obtain the necessary job instructions, and how to interpret their information</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.9 describe the different types of pattern or core boxes used in the ceramic moulding /coremaking process (such as plated patterns, solid turnout and split core boxes)</p> <p>2.10 describe the different types of pattern or core box clamping devices used</p> <p>2.11 describe the different types of moulding box/frames that are used</p> <p>2.12 explain how the pattern or core box type can determine the production process</p> <p>2.13 describe the different types of inserts that are used; their uses and limitations</p> <p>2.14 describe the different ceramic moulding processes used (such as Shaw, Unicast)</p> <p>2.15 explain the various additions and additives that are used when mixing slurry, and how these affect the moulding/coremaking process</p> <p>2.16 describe the type and application of mould or core coatings/dressings for different metal alloys</p> <p>2.17 explain how to identify mould or core defects (such as soft spots, broken/damaged mould or core surfaces, and clagging/sticking or distorted sections)</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.18 describe the company quality control procedures for producing and inspecting the moulds or cores (such as cleanliness, completeness, freedom from foreign bodies and defects)</p> <p>2.19 explain why it is important to keep the patterns or core boxes and equipment clean and free from damage, to practise good housekeeping of mould or core moulding tools and equipment, and to maintain a clean working area</p> <p>2.20 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve when making the ceramic moulds or cores</p>			

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(if sampled)

Unit 9: Producing shells or moulds for investment casting

Unit reference number: R/502/9442

QCF level: 2

Credit value: 28

Guided learning hours: 91

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to produce shells or moulds on wax assemblies, for investment casting, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the type and size of the wax assemblies, the method of applying the primary and secondary coatings, the method of wax removal, the metal to be cast and the metal casting method to be used. Production of the shells/moulds will take place, using recognised techniques, in specialist foundries.

The learner will be expected to produce the shells/moulds using pre-mixed refractory slurries, on single waxes or wax assemblies that incorporate the runner/riser/feeder system. They will apply the primary and secondary coatings, either manually or using some form of mechanical assistance, or as a combined operation. The completed shells/moulds will be either air-dried or cured using a gas to activate the coatings. The number of both primary and secondary/stucco coatings will be determined by reference to the company procedures. The learner will be expected to check the coatings applied, and to identify any substandard areas of the shell/mould. In certain circumstances, the shell when dried/cured and de-waxed will be backed up in special frames, using refractory materials, prior to casting. On completion of the production of the shells/moulds, the learner will follow the laid-down procedure for their storage or transfer to the next operation. They will also be expected to carry out any necessary repairs to the shells/moulds, and to apply any required coatings/dressings.

The learner's responsibilities will require them to comply with organisational policy and procedures for the shell/mould making activities undertaken, and to report any problems with the slurries, coatings or equipment in use, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the shells/moulds that they produce.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying shell moulding techniques for investment casting. They will have an understanding of the different types of refractory slurries in use, and the

additives and additions used in preparing the slurry they use to make the shells/moulds. They will also understand the different types of waxes in use, the associated accessories used and their application, in adequate depth to provide a sound background for carrying out the activities to the required specification. Their knowledge will be sufficient to enable them to identify any substandard slurry, waxes, equipment and finished shells/moulds.

The learner will understand the safety precautions required when carrying out the shell moulding activities, and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Produce shells or moulds for investment casting</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the moulding activities:</p> <ul style="list-style-type: none"> - confirm that all the required materials and equipment are available and are in a safe and usable condition - use appropriate personal protective equipment - comply with job instructions, shell moulding specifications, relevant COSHH sheets and risk assessment documentation - use the correct tools and equipment for the shell moulding activity - follow the defined shell moulding procedures, and apply safe working practices and procedures at all times - ensure that the shells/moulds produced meet the required specification for quality and accuracy - leave the work area in a safe condition on completion of the moulding activities <p>1.3 follow the correct component drawing or any other related specifications for the component to be produced</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.4 determine what has to be done and how this will be achieved</p> <p>1.5 obtain and prepare the appropriate tools, equipment and materials</p> <p>1.6 prepare the wax patterns for use, to include both of the following:</p> <ul style="list-style-type: none"> - visually inspecting the wax pattern for damage - applying release agents to the pattern (as applicable) <p>1.7 obtain the slurry supply, and check it using one of the following:</p> <ul style="list-style-type: none"> - visual inspection - electronic read-outs - reference to technician <p>1.8 carry out the moulding or laying-up activities using the correct methods and techniques</p> <p>1.9 produce shells/moulds using one of the following methods:</p> <ul style="list-style-type: none"> - manually - automatically - combined manual and semi-automatic means 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 mount waxes on one of the following attachments:</p> <ul style="list-style-type: none"> - handles - bars - hangers <p>1.11 produce, on single waxes or wax assemblies, both of the following:</p> <ul style="list-style-type: none"> - primary coatings (by successive applications of refractory slurry using the dip process) - an outer, coarser, stuccoed coating (using a raining cabinet or fluidised bed) <p>1.12 cure green primary and secondary shells/moulds, using one of the following methods:</p> <ul style="list-style-type: none"> - air (by natural draught or forced draught) - gas activated cabinets/areas <p>1.13 produce components to the required specification</p> <p>1.14 produce shells/moulds which meet all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - they are complete and free from obvious defects (cracks, broken or damaged surfaces) - they meet the required specification (shape, dimensional accuracy) - they have the correct shell thickness 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to produce shells or moulds for investment casting	<p>1.15 check that all the required operations have been completed to specification</p> <p>1.16 sort the finished shells/moulds, to include both of the following:</p> <ul style="list-style-type: none"> - placing acceptable shells/moulds into designated areas - disposing of sub-standard shells/moulds into designated areas <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			
	<p>2.1 describe the specific safety precautions to be taken when producing ceramic shells/moulds or cores, manually and with mechanical assistance</p> <p>2.2 describe the hazards associated with producing ceramic shells/moulds by manual and mechanical means (such as handling slurries and refractory materials, using mechanical equipment for mixing and dipping, using damaged or badly maintained equipment), and explain how they can be minimised</p> <p>2.3 explain the COSHH regulations that apply when dealing with refractory materials, solvents, surface coatings, release agents and adhesives</p> <p>2.4 explain where to obtain information on COSHH regulations</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.5 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.6 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.7 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.8 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.9 describe the different types of wax pattern used in the ceramic moulding process</p> <p>2.10 explain how the wax pattern type can determine the production process to be used</p> <p>2.11 describe the different types of slurry tanks that are used in the ceramic moulding process</p> <p>2.12 describe the type and application of refractory slurries for different metal alloys</p> <p>2.13 describe the main types of attachment devices, their uses and limitations</p> <p>2.14 describe the different processes used (such as unsupported and supported shells)</p> <p>2.15 explain the various additions and additives that are used when mixing slurry, and how these affect the moulding process</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.16 describe the application and use of shell/mould coatings or dressings</p> <p>2.17 describe the different methods that are used for curing shells/moulds, and why</p> <p>2.18 explain how to identify shell/mould defects (such as incomplete shells/moulds, broken/damaged surfaces, thin sections or distorted sections)</p> <p>2.19 describe the company quality control procedures for producing and inspecting the shells/moulds (such as cleanliness, completeness, freedom from foreign bodies and defects)</p> <p>2.20 explain why it is important to keep the waxes and equipment clean and free from damage, to practise good housekeeping of shell/moulding tools and equipment, and to maintain a clean working area</p> <p>2.21 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve when making the ceramic shells/moulds</p>			

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

Unit 10: Preparing materials for moulding and coremaking

Unit reference number: Y/502/9443

QCF level: 2

Credit value: 12

Guided learning hours: 63

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to prepare materials used in the production of sand moulds and cores, for a range of processes. Manual and mechanised methods will be used, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the type and amount of the processed materials needed. Both continuous and batch production methods are included in this unit. The materials covered include sands, refractory slurries, additives and additions.

The learner will be required to perform simple tests on the materials processed, in accordance with the company control procedures. The tests may be performed manually, or by using in-built continuous monitoring equipment, which provides information visually or as a print out. For the manually performed tests, the learner will be expected to record the results obtained, on control charts.

From the information contained in the learner's test results they will, if necessary, be expected to adjust equipment mechanisms to correct any deficiencies. Following tests performed manually, they will be expected to adjust the properties of the prepared mixes by physically adding further materials. In extreme cases, the learner will notify supervision of non-conformance or, for batch-produced amounts, they will dispose of the batch in accordance with procedures. The learner will maintain an adequate amount of the materials they use, and notify supervision when stocks reach re-ordering levels. They will also respond to requests for additional material mixes as required.

The learner's responsibilities will require them to comply with organisational policy and procedures for the preparation and control of the activities undertaken, and to report any problems with the materials, equipment or mixing procedures that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with minimal supervision, and take personal responsibility for the quality and accuracy of the materials they prepare.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying material preparation and control procedures. They will have an

understanding of the different types of materials in use, and the associated machinery that is used to prepare the materials. They will also understand the different methods of preparing materials, such as continuous or batch processing, and the tests which are used to confirm that the mixing process is being carried out to the required specification.

The learner will understand the safety precautions required when working with the machinery and its associated equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Prepare materials for moulding and coremaking</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the material preparation activities:</p> <ul style="list-style-type: none"> - confirm that the machine/equipment is ready for material production - where appropriate, seek any necessary instruction/training on the operation of the machine - comply with job instructions, material preparation specifications, relevant COSHH sheets and risk assessment documentation - follow the defined operating procedures, and apply safe working practices and procedures at all times - ensure that machine settings are adjusted, where necessary, to maintain the required material quality - ensure the mixtures produced meet the required specification for quality and accuracy - leave the work area in a safe condition on completion of the activities 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.3 check that correct amounts of materials are available prior to processing, to include all of the following:</p> <ul style="list-style-type: none"> - sand - additives - additions - refractory material <p>1.4 obtain the required materials and check them for quantity and quality</p> <p>1.5 check the quality of the materials prior to mixing and after mixing, using one of the following methods:</p> <ul style="list-style-type: none"> - visual inspection - electronically - reference to approved authority - manual testing of material - 'use by' dates - material specification complies with procedures documentation <p>1.6 determine how the materials need to be prepared</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.7 prepare the machine(s) for use, to include all of the following aspects:</p> <ul style="list-style-type: none"> - material supply feed and discharge points are clean and operational - services and auxiliary equipment are operational - previous shift notes/reports are referred to, and actioned - safety locks/guards/screens are operational - material supply feeds are clean and operational - correct start-up procedures are initiated - emergency stop controls are tested - visual display panels are operational <p>1.8 carry out the preparations using suitable equipment</p> <p>1.9 produce the mixed materials, using any one of the following methods:</p> <ul style="list-style-type: none"> - manual mixing - batch mixing - combined methods - ribbon flow semi-automatic - continuous mixing 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 complete preparations of materials, to include all of the following:</p> <ul style="list-style-type: none"> - making adjustments for out-of-specification mixes - confirming that prepared materials are ready for use and comply with required specification - discharging mixed materials according to company procedure - completing all relevant documentation <p>1.11 report completion of preparations in line with organisational procedures</p> <p>1.12 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to prepare materials for moulding and coremaking</p>	<p>2.1 describe the hazards and specific safety precautions to be taken when preparing materials, manually and mechanically</p> <p>2.2 explain the COSHH regulations that apply when dealing with solvents, resins, catalysts and gelling agents</p> <p>2.3 explain where to obtain information on COSHH regulations</p> <p>2.4 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.5 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.6 describe the hazards associated with the use of machines and equipment used to produce materials and mixes for moulding and coremaking (such as moving mixing parts, hydraulic systems, damaged equipment and escapes of air, gas or oil), and explain how they can be minimised</p> <p>2.7 explain the procedure to be followed in the event of a machine malfunction</p> <p>2.8 explain what type of personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.9 explain how to obtain the necessary job instructions, and how to interpret their information</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.10 explain why it is necessary to check the amounts of materials prior to commencing mixing operations</p> <p>2.11 explain the actions that are needed when materials are found to be below the required amounts</p> <p>2.12 explain why checks need to be made on the materials to be used</p> <p>2.13 describe the effects on the prepared materials if the base product is passed the 'use by' date, is different in content from the company requirement/specification, is added to the mix at the wrong time or at the wrong temperature, or if too little or too much is added to the mix</p> <p>2.14 describe the different processes and machines used to prepare the materials (such as manual, semi and fully automatic)</p> <p>2.15 explain the additions and additives that are used when preparing the materials</p> <p>2.16 explain the reasons why different materials are used for different molten metal alloys</p> <p>2.17 explain why sampling of prepared materials is performed</p> <p>2.18 explain why some prepared materials, which are outside of specification after testing, have to be disposed of</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.19 describe the company quality control checks to be carried out on the prepared material (such as moisture content, strength, viscosity and freedom from foreign bodies)</p> <p>2.20 explain how to identify prepared material non-conformance (such as dry or wet sand, unmixed sand, thick/thin slurry or unmixed slurry)</p> <p>2.21 explain the importance of keeping the equipment clean and free from damage, of practicing good housekeeping of tools and equipment, of maintaining a clean working area, and of carrying out machine start-up and shut-down procedures</p> <p>2.22 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve when preparing the materials</p>			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

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

Unit 11: Assembling, core setting and closing sand/ceramic moulds

Unit reference number: D/502/9444

QCF level: 2

Credit value: 18

Guided learning hours: 84

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to assemble, locate and secure cores in sand/ceramic moulds, and to prepare the moulds for casting. Manual and mechanised methods will be used, in accordance with approved procedures.

The learner will be required to select the appropriate equipment to use, based on the type, size and number of the moulds to be assembled, and the size, shape and number of cores to be secured within the moulds. The moulds the learner will assemble, core set and close, will have been produced as one-offs, by batch or by a continuous moulding process. They will be required to check the condition of the moulds and the cores they receive, and to reject any considered to be substandard, in accordance with the company control procedures.

The learner will be expected to clean the mould drags and copes and, where appropriate, to apply a suitable mould dressing. They will need to insert the cores into the moulds and secure them, using prints and other approved methods such as studs or chaplets. Before the moulds are closed, the learner will be expected to carry out final checks to ensure that the quality of the mould and cores meets company standards. Mould closing and, where appropriate, sealing will take place using approved location devices and sealing materials. Moulds will be secured or passed to the clamping area prior to being cast.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly, core setting and closing of the sand/ceramic moulds, and to report any problems with the moulds, cores, materials or equipment in use, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the assembly, core setting and control of metal thickness, and to the closing and securing of the various types of moulds. They will have an understanding of the different types of materials used to make the moulds, and the associated

machinery that is used to handle the different size of moulds. They will understand the different methods of locating the cores in the moulds, and the mould location devices applicable to the various moulding processes (ie boxed and boxless).

The learner will understand the safety precautions required when carrying out the mould assembling and closing activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Assemble, core set and close sand/ceramic moulds</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the assembly and closing activities:</p> <ul style="list-style-type: none"> - confirm that the moulds and cores received are complete and free from defects - check that the work area is clear of obstructions and hazards - use appropriate personal protective equipment - comply with job instructions, mould assembly specifications, relevant COSHH sheets and risk assessment documentation - use the correct tools and equipment for the mould assembly, core setting and preparation activities - follow the defined assembly and preparation procedures, and apply safe working practices and procedures at all times - ensure that the completed mould assembly meets the required specification for quality and accuracy - leave the work area in a safe condition on completion of the moulding activities 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.3 follow the relevant instructions, assembly drawings and any other specifications</p> <p>1.4 ensure that the specified components are available and that they are in a usable condition</p> <p>1.5 use the appropriate methods and techniques to assemble the components in their correct positions</p> <p>1.6 assemble and prepare one of the following types of mould:</p> <ul style="list-style-type: none"> - boxed - boxless <p>1.7 apply mould coatings, as appropriate, using one of the following methods:</p> <ul style="list-style-type: none"> - brush - spray - flood <p>1.8 insert at least two cores per mould, using two of the following methods:</p> <ul style="list-style-type: none"> - horizontal locations - vertical locations - horizontal and vertical locations <p>1.9 secure the components using the specified connectors and securing devices</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 secure the cores in the moulds, using two of the following methods:</p> <ul style="list-style-type: none"> - print locations - adhesives - metallic devices <p>1.11 prepare the mould for closing, to include all of the following:</p> <ul style="list-style-type: none"> - cleaning and removing foreign bodies and surplus sand from the mould cavity - carrying out visual checks on moulds for completeness (including all cores and freedom from cracks) - checking that runner/riser/feeder systems are clean, connected and complete - applying mould sealant, where appropriate <p>1.12 complete the closing of the moulds, to include all of the following:</p> <ul style="list-style-type: none"> - locating the moulds using pins, rebates, diaboloes or cores, as appropriate - closing moulds manually or by mechanical means - securing the moulds using clamps/clips and/or weights 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to assemble, core set and close sand/ceramic moulds</p>	<p>1.13 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification</p> <p>1.14 sort the finished moulds, to include both of the following:</p> <ul style="list-style-type: none"> - placing acceptable moulds into designated areas - disposing of sub-standard moulds into designated areas <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>2.1 describe the hazards and specific safety precautions to be taken when assembling, core setting and closing sand/ceramic moulds, manually and with mechanical assistance</p> <p>2.2 describe the hazards associated with the use of mechanical equipment in the handling of sand/ceramic moulds</p> <p>2.3 explain the COSHH regulations that apply when dealing with resin bonded sands, solvents, adhesives, and mould and core dressings</p> <p>2.4 explain where to obtain information on COSHH regulations</p> <p>2.5 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.6 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.7 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.8 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.9 explain the procedure to be followed in the event of equipment or machine malfunction</p> <p>2.10 explain why it is necessary to check the moulds and cores prior to commencing core setting and mould closing operations</p> <p>2.11 describe the defects that can occur in the moulds and cores (such as cracked surfaces, exposed reinforcements, friable surfaces, broken or weak mould and core sections, incomplete mould or cores, damaged or broken core prints and core locations, mould location devices missing or distorted, uncoated moulds or cores)</p> <p>2.12 explain the actions needed when moulds or cores are found to be sub-standard</p> <p>2.13 describe the different types of sand that are used to produce the moulds and cores</p> <p>2.14 explain the differences between boxed and boxless moulds, and how this affects the preparation process</p> <p>2.15 explain the reasons why core prints are needed, and why cores must be located and secured correctly</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.16 explain the effects on casting quality and accuracy of incorrectly located and secured cores</p> <p>2.17 explain why different methods are used to secure cores in moulds produced from different sands</p> <p>2.18 explain why different techniques of mould locating are used</p> <p>2.19 explain the reasons for sealing the mould joints prior to closing the mould</p> <p>2.20 explain why it is important to keep the equipment clean and free from damage, to practise good housekeeping of tools and equipment, and to maintain a clean working area</p> <p>2.21 describe the extent of their own authority and to whom they should report if they have problems that they cannot solve when assembling, core setting and closing sand/ceramic moulds</p>			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

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

Unit 12: Assembling and preparing investment shells for casting

Unit reference number: H/502/9445

QCF level: 2

Credit value: 18

Guided learning hours: 84

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to assemble and prepare investment shells for casting, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the type, size and number of the shells to be assembled, which may have been produced as one-offs or in batches. They will be required to check the condition of the shells they receive, and to reject any considered as substandard, in accordance with the company control procedures.

The learner will need to protect the investment shell runner systems to prevent mould contamination. In preparing the shells for casting, the learner will be expected to carry out final checks to ensure that the quality of the shell meets company standards. Shell positioning, sealing and supporting will take place using approved location devices, sealing materials, support packing and equipment, as appropriate. Shells will, where appropriate, be pre-heated using approved procedures, and will be secured or passed to the clamping area prior to being cast.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly and closing of the investment shells, and to report any problems with the shells or equipment in use, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the assembly and securing of the various types of shells. They will have an understanding of the different types of materials used to make the shells, and the process of wax pattern removal. They will be familiar with the machinery that is used to handle the different types and size of mould/shell. They will also understand the different methods of locating shells, and why it is sometimes necessary to carry out pre-heating of shells before casting takes place.

The learner will understand the safety precautions required when carrying out the mould/shell assembling and closing activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Assemble and prepare investment shells for casting</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the assembly and closing activities:</p> <ul style="list-style-type: none"> - confirm that all the required materials and equipment are available and are in a safe and usable condition - use appropriate personal protective equipment - comply with job instructions, mould/shell assembly specifications, relevant COSHH sheets and risk assessment documentation - use the correct tools and equipment for the shell assembly and preparation activities - follow the defined assembly and preparation procedures, and apply safe working practices and procedures at all times - ensure that the completed shell assembly meets the required specification for quality and accuracy - leave the work area in a safe condition on completion of the moulding activities <p>1.3 follow the relevant instructions, assembly drawings and any other specifications</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.4 check that the specified components are available and that they are in a usable condition</p> <p>1.5 use the appropriate methods and techniques to assemble the components in their correct positions</p> <p>1.6 Assemble and prepare investment shells for one of the following casting methods:</p> <ul style="list-style-type: none"> - single - multiple <p>1.7 prepare the shells for casting, to include all of the following, as appropriate:</p> <ul style="list-style-type: none"> - checking that received shells are free from defects (such as cracks, foreign bodies/impurities) - correctly positioning the shells - covering and preventing ingress of material into downsprue/runner system - carrying out pre-heating of the shells (as appropriate) - carrying out backing/packing of shells - ensuring protection from damage during transit <p>1.8 secure the components using the specified connectors and securing devices</p> <p>1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 carry out checks of the completed work, to include all of the following:</p> <ul style="list-style-type: none"> - shells are undamaged - all necessary operations have been carried out - packing is in place - protection is intact <p>1.11 sort the finished shells, to include both of the following:</p> <ul style="list-style-type: none"> - placing acceptable shell assemblies into designated areas - disposing of sub-standard shell assemblies into designated areas <p>1.12 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to assemble and prepare investment shells for casting</p>	<p>2.1 describe the specific hazards and safety precautions to be taken when assembling and closing shells, manually and with mechanical assistance</p> <p>2.2 describe the hazards associated with the use of mechanical equipment in the handling of shell moulds</p> <p>2.3 explain the COSHH regulations that apply when dealing with refractory materials, solvents, surface coatings, release agents and adhesives</p> <p>2.4 explain where to obtain information on COSHH regulations</p> <p>2.5 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.6 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.7 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.8 explain how to obtain the necessary job instructions and interpret their information</p> <p>2.9 explain the procedure to be followed in the event of equipment or machine malfunction</p> <p>2.10 explain why it is necessary to check shells prior to their assembly</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.11 describe the defects that can occur in investment shells (such as cracks, friable surfaces, incomplete shell, damaged or broken cores, mould location devices missing or distorted, incomplete de-waxing of shells, damage to runner/feeder systems)</p> <p>2.12 explain the actions needed when shells are found to be sub-standard</p> <p>2.13 describe the different processes and machines used to make shells (manual, semi and fully automatic)</p> <p>2.14 describe the methods used to remove wax from shells</p> <p>2.15 explain how internal cavities are formed within shells</p> <p>2.16 explain why shell pre-heating is carried out, and the effects on the casting quality of using incorrect pre-heat temperature</p> <p>2.17 explain the reasons for carrying out shell backing/packing</p> <p>2.18 explain why it is necessary to protect the runner system</p> <p>2.19 explain why it is necessary to protect shells during transit</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.20 explain why it is important to keep the equipment clean and free from damage, to practise good housekeeping of tools and equipment, to maintain a clean working area, and carry out start-up and shut-down procedures</p> <p>2.21 describe the casting defects that can be directly related to the incorrect assembly and preparation of the shells</p> <p>2.22 describe the extent of their own authority and to whom they should report if they have problems that they cannot solve when assembling and preparing the investment shells</p>			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

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

Unit 13: Melting metal for casting

Unit reference number: K/502/9446

QCF level: 2

Credit value: 16

Guided learning hours: 63

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to prepare and process the materials and metal used in the production of molten metal to cast moulds and shells. Manual and mechanised methods will be used, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the type and amount of molten metal needed. Single, batch and continuous production methods for the metal are included in this unit, which also covers both ferrous and/or non-ferrous alloys.

The learner will maintain an adequate amount of the base metal and necessary materials and will notify supervision when stocks reach re-ordering levels. For single and batch production the learner will, in conjunction with others and, where appropriate, prepare the base metal for insertion into the melting furnace. The learner will light/start up the furnace and charge the base metal plus any other specified materials/additions into the melting vessel at the specified time. They will also adjust the furnace operating conditions to suit the molten metal requirements.

The learner will be expected to discharge the molten metal into receiving vessels or to other holding furnaces, as appropriate. Their activities will include the operating of any mechanical, electrical or electronic equipment used during the melting of the metal.

The learner's responsibilities will require them to comply with organisational policy and procedures for the preparation and control of the melting activities undertaken. They will report any problems with base metal, materials and equipment in use that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to verbal/written instructions, with minimal supervision, taking personal responsibility for their actions and for the quality of the molten metal produced.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the preparation and control of the molten metal they produce and any additional materials used during the melting process. They will understand the different types of metals in use, and the associated furnaces used to melt these metals. They will also understand the different methods of

melting metal (ie single, batch or continuous) and the tests that are used to confirm that the process is under control.

The learner will understand the safety precautions required when carrying out the metal melting operations, and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Melt metal for casting</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 produce molten metal, using one of the following types of furnace:</p> <ul style="list-style-type: none"> - cupola - induction (high or low frequency) - rotary - bale out - lift out crucible - tilting crucible - direct or indirect arc - other melting furnaces (specify) <p>1.3 prepare the furnace for operation, to include all of the following, as appropriate to the equipment used:</p> <ul style="list-style-type: none"> - ensure that services/power supplies are connected and operational and start-up procedures are initiated - check that guards/screens are in position and operational - check that emergency stop controls are operational 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - check that visual display panels are operational - refer to and action any notes/reports from the previous shift - ensure that supply and discharge outlets are clear and operational - use approved personal protective equipment, and safe working practices and procedures at all times - comply with job instructions, melting specifications, COSHH and risk assessment documentation - check furnace linings and equipment - shut down the furnace to a safe condition on completion of the melting activities <p>1.4 set up the operating conditions of the melting furnace making any necessary adjustments to maintain satisfactory operating conditions</p> <p>1.5 obtain the required charge materials and check they are in a suitable condition to use</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.6 prepare the materials used in the casting process, and check that they are to the required specification, to include all of the following:</p> <ul style="list-style-type: none"> - selection and preparation of metallic charge materials (such as scrap, ingots, returns, etc) - selection and preparation of any additives and additions (such as fluxes, inhibitors, deoxidisers) - selection and preparation of any fuel charge materials - taking appropriate action when stocks of raw materials are low <p>1.7 start up the furnace using approved procedures and add the materials at the appropriate time</p> <p>1.8 produce the molten material, using one of the following methods:</p> <ul style="list-style-type: none"> - single melt - batch melt - continuous melt - combined methods <p>1.9 produce molten material from one of the following:</p> <ul style="list-style-type: none"> - ferrous alloys - non-ferrous alloys 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 carry out appropriate tests of the molten metal at suitable intervals in order to achieve the material specification</p> <p>1.11 monitor the melting process, to include all of the following:</p> <ul style="list-style-type: none"> - measuring the melt temperature (such as visually, immersion pyrometer, visual display units) - adjusting the operating conditions of the melting furnace (such as melting rate by changing the power or fuel input) - making necessary additions to the melt - where applicable, informing appropriate people of non-conformance of the molten metal - confirming that the melt is ready for casting (such as verbally, visual display, email) <p>1.12 discharge the molten metal from the furnace into one of the following:</p> <ul style="list-style-type: none"> - holding furnace - prepared pouring ladles - prepared treatment ladles - other holding/casting vessels/pigs 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.13 deal promptly and effectively with problems within their control and report those that they cannot solve</p> <p>1.14 report completion of melt preparations in line with organisational procedures</p> <p>1.15 dispose of waste and excess materials in line with agreed organisational procedures</p>			
<p>2 Know how to melt metal for casting</p>	<p>2.1 explain what specific safety precautions need to be taken when working with melting furnaces and molten materials</p> <p>2.2 describe the hazards associated with working with melting furnaces and molten materials, and explain how they can be minimised</p> <p>2.3 explain the COSHH regulations that apply when dealing with charge materials, furnace additions and additives</p> <p>2.4 explain where to obtain information on COSHH regulations</p> <p>2.5 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.6 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.7 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.8 explain the emergency procedures to be followed in the event of a melting furnace/equipment malfunction</p> <p>2.9 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.10 explain why it is necessary to check the amounts of metal and other materials, prior to commencing melting operations</p> <p>2.11 explain what actions are needed when base metal and materials are found to be below the required amounts</p> <p>2.12 explain the effects on the melting operation and the molten metal if the base materials are out of date, different in content from the company requirements/specifications, added to the furnace/melt at the wrong time or temperature, or when wet or damp, or if too little or too much is added to the melt)</p> <p>2.13 describe the different types of furnace that are used to melt metals (to include cupola, induction, rotary, bale out, crucible (lift out or tilting) and direct or indirect arc)</p> <p>2.14 describe the different fuels used in melting metal</p> <p>2.15 explain the reasons why furnace start-up procedures are performed, and why these must always be adhered to</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.16 explain the additions that are made to the metals/alloys that they use on a regular basis</p> <p>2.17 explain the actions to take if the molten metal is outside of the specified temperature range</p> <p>2.18 describe the methods of checking the metal temperature, and the types of equipment used</p> <p>2.19 describe the company quality control checks required on the molten metal</p> <p>2.20 explain why it is important to keep the furnace and melting equipment clean and free from damage, to practice good housekeeping of tools and equipment, and to maintain a clean and unobstructed working area</p> <p>2.21 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve when preparing the molten materials</p>			

Learner name: _____ Date: _____

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Assessor signature: _____ Date: _____

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

Unit 14: Casting metal by manual means

Unit reference number: M/502/9447

QCF level: 2

Credit value: 28

Guided learning hours: 84

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to cast metal into prepared moulds, dies, or shells, manually, safely and in accordance with approved procedures. The moulds, dies or shells may be moving or stationary.

The learner will be required to select the appropriate equipment to use, based on the type and amount of molten metal to be cast. Both single and double pours, with ferrous or non-ferrous alloys, are included in this unit.

The learner will check that the moulds/dies/shells to be cast are positioned correctly and are bushed up and secure. The condition of the casting ladles and any supporting or carrying frames must be checked for defects that could affect the safe operation of carrying and pouring the metal. For double pours, the learner will confirm who is to assist in the casting and they will ensure, prior to the metal being collected, that they know which moulds or dies are to be cast first. They will check the temperature of the molten metal in the source vessel or furnace, in accordance with procedures, and they will confirm that the metal is suitable for purpose. They will collect the molten metal from the source vessel or furnace and skim or apply coagulant material to the metal to remove/contain impurities from the surface of the molten metal. The moulds or dies will be cast in a safe manner, at the correct speed, and in the correct order. On completion of the casting activity, any surplus metal will be disposed of safely and correctly.

The learner's responsibilities will require them to comply with organisational policy and procedures for the casting activities undertaken. They will report any problems with the molten metal or equipment in use that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to verbal or written instructions. They will also be expected to take responsibility for the temperature of the molten metal, and to use the correct techniques to cast the moulds, or shells manually.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will provide an informed approach to taking the molten metal temperature and for the collection and pouring of the metal into moulds/dies/shells. They will understand the different types of metals in use, and the different methods of disposing of surplus or non-conforming molten metal.

The learner will understand the safety precautions required when carrying out the manual casting activities, especially those for transporting and pouring molten metal. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Cast metal by manual means</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the manual casting activities:</p> <ul style="list-style-type: none"> - ensure the work area is clear of obvious hazards - confirm that the required material handling equipment is available and is in a safe and usable condition - check that ancillary equipment is operational (to include, where appropriate, casting tracks, extraction equipment, inhibitor gas supply and metal treatment equipment) - use appropriate personal protective equipment, and check that it is in good order - comply with job instructions, relevant COSHH sheets and risk assessment documentation - follow the defined casting procedures, and apply safe working practices and procedures at all times - ensure that the moulds produced meet the required specification for quality and accuracy - leave the work area in a safe condition on completion of the casting activities 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.3 check that the moulds are correctly prepared, sited and positioned ready for the casting process</p> <p>1.4 check that the moulds/dies are complete and ready for casting, to include carrying out all of the following checks:</p> <ul style="list-style-type: none"> - clamps and/or weights are in position - downsprues are marked, and pouring bushes/basins are in position and free from obstructions - any necessary filters are in place - access to the moulds/dies/shells is clear - containers for surplus metal are prepared and positioned conveniently in relation to the mould/dies/shells <p>1.5 check the ladle lining/coating and associated ironwork, to include all of the following:</p> <ul style="list-style-type: none"> - the ladle is the correct size - the ladle lining is in a safe condition and is complete and dry - any necessary pre-heating has been carried out <p>1.6 check that the molten material is at the required casting temperature</p> <p>1.7 collect and transport the molten material safely and correctly from the furnace</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.8 collect molten metal and carry out all of the following melt checks/procedures, as appropriate to the melt:</p> <ul style="list-style-type: none"> - making temperature checks - skimming of the melt to remove slag and other impurities - applying coagulant material - using inhibitor materials or gas <p>1.9 discharge the molten metal, and use appropriate company procedures to deal with all of the following:</p> <ul style="list-style-type: none"> - acceptable metal into moulds, or shells - non-conforming metal - surplus molten metal <p>1.10 use the appropriate technique to pour the molten material into the moulds</p> <p>1.11 transfer and pour molten metal into moulds/dies, using one of the following:</p> <ul style="list-style-type: none"> - single operation - double pour <p>1.12 cast metals into one of the following:</p> <ul style="list-style-type: none"> - stationary moulds, dies or shells - moving moulds, dies or shells 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.13 produce castings from one of the following metals:</p> <ul style="list-style-type: none"> - ferrous alloys - non-ferrous alloys <p>1.14 produce castings to the required specification</p> <p>1.15 produce castings which comply with one or more of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - company standards and procedures - ISO 9000 quality assurance procedures - customer standards and requirements <p>1.16 dispose of surplus material safely and correctly</p> <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to cast metal by manual means</p>	<p>2.1 describe the hazards and specific safety precautions to be taken when transporting and pouring molten metal</p> <p>2.2 explain the COSHH regulations that apply when dealing with ladle coatings, additives and gases</p> <p>2.3 explain where to obtain information on COSHH regulations</p> <p>2.4 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.5 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.6 explain the emergency procedures to be followed in the event of a furnace failure</p> <p>2.7 explain the emergency procedures to be followed in the event of a malfunction in any vessel used to transport and cast molten metal</p> <p>2.8 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.9 explain the use of coagulants and inhibitors when casting molten metal</p> <p>2.10 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.11 explain why it is necessary to check the amounts of metal in ladles during the casting of a row of moulds or dies</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.12 explain why ladles are preheated and the different fuels that are used</p> <p>2.13 describe the different types of vessels used to hold ferrous and non-ferrous metal alloys</p> <p>2.14 explain why the temperature of the molten metal should be taken prior to the transfer from holding ladle to pouring vessel</p> <p>2.15 explain the actions they need to take if the molten metal is outside of the required temperature range</p> <p>2.16 describe the company quality control checks required on the molten metal</p> <p>2.17 explain why it is important to keep the ladles and metal handling equipment clean and free from damage, to practise good housekeeping of tools and equipment, to maintain a clean and unobstructed working area, and to dispose of surplus metal into prepared containers or areas</p> <p>2.18 explain the checks to be carried out on the moulds/dies/shells prior to casting (such as checking that clamps or weights are correctly positioned, downsprues are marked and pouring bushes/basins are in position, necessary filters are in place and access to moulds is clear)</p> <p>2.19 describe the methods of pouring molten metal for single operations or double pour applications</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.20 describe the defects in castings which can be directly related to using the incorrect pouring technique, incorrect metal temperature, or untreated metal</p> <p>2.21 describe the extent of their responsibilities and to whom they should report if they have problems that they cannot solve when collecting, transporting, casting or disposing of molten metal</p>			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

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

Unit 15: Casting metal using mechanical means

Unit reference number: T/502/9448

QCF level: 2

Credit value: 28

Guided learning hours: 84

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to use mechanical equipment to cast metal into prepared moulds, dies or shells, safely and in accordance with approved procedures.

The learner will be required to select the appropriate equipment to use, based upon the type and amount of molten metal to be cast. The mechanical equipment used will provide lifting and transportation facilities for the molten metal, with manual operation of the pouring rate, or it will be of the fully automatic casting type. Both ferrous and non-ferrous alloys are covered in this unit.

The learner will check that the moulds, dies or shells to be cast are positioned correctly, and are bushed-up and secure. The condition of the casting ladles and any supporting/carrying frames, hooks chains or scales must be checked for defects that could affect the safe operation of carrying and pouring the metal. They will confirm who is to operate the lifting equipment and to assist in the casting, and they will ensure, prior to the metal being collected, that they know which moulds, dies or shells are to be cast first. They will check the temperature of the molten metal in the source vessel or furnace, in accordance with procedures, and confirm that the metal is suitable for purpose. They will collect the molten metal from the source vessel or furnace, and skim the molten metal to remove impurities from the surface, or apply coagulant material to retain the impurities on the metal.

The moulds/dies/shells will be cast in a safe manner, at the correct speed and in the correct order. On completion of casting, any surplus metal will be disposed of safely and correctly. The learner will shut down any mechanical equipment used to a safe condition, on completion of their shift.

The learner's responsibilities will require them to comply with organisational policy and procedures for the casting activities undertaken. They will report any problems with the molten metal and equipment in use that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to verbal or written instructions. They will also take responsibility for the temperature of the molten metal, and for using the correct techniques to cast the moulds, shells or dies with mechanical assistance.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will provide an informed approach to the casting of moulds, dies or shells using mechanical means, taking the molten metal temperature, and the collection and pouring of the metal into the moulds, dies or shells. They will understand the different types of metals in use, and the different methods of disposing of surplus or non-conforming molten metal. They will also understand the reasons why any mechanical equipment used must be shut down at the end of a working period.

The learner will understand the safety precautions required when carrying out the casting activities using mechanical means, especially those for transporting and pouring the molten metal. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Cast metal using mechanical means</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the manual casting activities:</p> <ul style="list-style-type: none"> - ensure that the work area is clear of obvious hazards - confirm that the required mechanical equipment is available, and is in a safe and usable condition - use appropriate personal protective equipment, and check that it is in good order - comply with job instructions, relevant COSHH sheets and risk assessment documentation - follow the defined casting procedures, and apply safe working practices and procedures at all times - leave the work area in a safe condition on completion of the casting activities <p>1.3 confirm that the equipment is set up correctly and ready for the casting activities to be carried out</p> <p>1.4 complete start-up checks, to include all of the following, as appropriate to the equipment used:</p> <ul style="list-style-type: none"> - emergency stop controls are operational - visual display panels are operational 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - services/power supplies are connected and operational, and start-up procedures are initiated - referring to any previous shift notes/reports and carrying out required actions - the ladle lining is in a safe condition, and is complete and dry - any ladle pre-heating has been carried out - lifting/metal transfer and pouring equipment is available and operational - equipment required to maintain controlled environment is operational <p>1.5 check that the moulds, dies or shells are complete and ready for casting, to include carrying out all of the following checks:</p> <ul style="list-style-type: none"> - clamps and/or weights are in position - downsprues are marked, and pouring bushes/basins are in position and free from obstructions - any necessary filters are in place - access to the moulds/dies is clear - containers for surplus metal are prepared and positioned conveniently in relation to the mould/dies <p>1.6 maintain an adequate supply of base material</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.7 manipulate the machine controls safely and correctly in line with operational procedures</p> <p>1.8 collect molten metal and carry out all of the following melt checks/procedures, as appropriate to the melt:</p> <ul style="list-style-type: none"> - making temperature checks - skimming of melt to remove slag and other impurities - applying coagulant material - using inhibitor materials or gas <p>1.9 discharge molten metal, and apply appropriate company procedures to deal with all of the following:</p> <ul style="list-style-type: none"> - acceptable metal into moulds or shells - non-conforming metal - surplus molten metal <p>1.10 transfer and pour molten metal into moulds, dies or shells, using one of the following methods:</p> <ul style="list-style-type: none"> - manually controlling the flow rate - as a combined operation (pressure dies) - within a controlled furnace/casting environment - operating pre-set controls for metal flow - mechanically controlled flow rate 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.11 cast metals into one of the following:</p> <ul style="list-style-type: none"> - stationary moulds, dies or shells - moving moulds, dies or shells <p>1.12 produce castings from one of the following metals:</p> <ul style="list-style-type: none"> - ferrous alloys - non-ferrous alloys <p>1.13 produce cast components to the required specification</p> <p>1.14 produce castings which comply with one or more of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - company standards and procedures - ISO 9000 quality assurance procedures - customer standards and requirements <p>1.15 carry out quality sampling checks at suitable intervals</p> <p>1.16 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.17 shut down the equipment to a safe condition on conclusion of the casting activities</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.18 complete shutdown procedures, where appropriate, to include all of the following:</p> <ul style="list-style-type: none"> - furnace - controlled environment - mechanical metal transfer units - lifting devices <p>1.19 deal safely with excess materials in line with organisational procedures</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to cast metal using mechanical means</p>	<p>2.1 describe the hazards and specific safety precautions to be taken when transporting and pouring molten metal</p> <p>2.2 explain the COSHH regulations that apply when dealing with ladle coatings, additives and gases</p> <p>2.3 explain where to obtain information on COSHH regulations</p> <p>2.4 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.5 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.6 explain the emergency procedures to be followed in the event of a furnace failure</p> <p>2.7 explain the emergency procedures to be followed in the event of a malfunction in any vessel used to transport and cast molten metal</p> <p>2.8 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.9 explain the use of coagulants, inhibitors and controlled environments when casting molten metal</p> <p>2.10 describe the types of coagulants and inhibitors used, and which metal they would be used on</p> <p>2.11 explain how to obtain the necessary job instructions, and how to interpret their information</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.12 describe the automatic equipment used to cast moulds, dies or shells</p> <p>2.13 explain why it is necessary to check the amounts of metal in ladles during the casting of a row of moulds or dies</p> <p>2.14 explain why ladles are preheated, and the different fuels that are used</p> <p>2.15 describe the different types of vessels used to hold ferrous and non-ferrous metal alloys</p> <p>2.16 explain why the temperature of the molten metal should be taken prior to the transfer from holding ladle to pouring vessel</p> <p>2.17 explain the actions they need to take if the molten metal is outside of the required temperature range</p> <p>2.18 describe the company quality control checks required on the molten metal</p> <p>2.19 explain why it is important to keep the ladles and metal handling equipment clean and free from damage, to practise good housekeeping of tools and equipment, to maintain a clean and unobstructed working area, and to dispose of surplus metal into prepared containers or areas</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.20 explain the checks that need to be carried out on the moulds/dies prior to casting (such as checking that clamps or weights are correctly positioned, downsprues are marked and pouring bushes/basins are in position, necessary filters are in place, and access to moulds is clear)</p> <p>2.21 describe the defects in castings which can be directly related to using incorrect pouring technique, incorrect metal temperature, or untreated metal</p> <p>2.22 describe the extent of their responsibilities and to whom they should report if they have problems that they cannot resolve when collecting, transporting, casting or disposing of molten metal</p>			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

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

Unit 16: Preparing furnace and ladle linings for melting and pouring metal

Unit reference number: A/502/9449

QCF level: 2

Credit value: 23

Guided learning hours: 77

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to prepare furnace linings and, where appropriate, pouring vessels, used in the production and transportation of molten metal. Manual and fully or partially mechanised methods will be used, in accordance with approved procedures.

The learner will be required to select the appropriate materials and equipment to use, based on the type of furnace and the metal to be melted. Furnaces that produce single, batch and continuous melts of metal are included in this unit, which also covers both ferrous and non-ferrous alloys.

The learner will examine the furnace lining for damage and wear after each melt has taken place. Any substandard furnace lining material will be removed, and new lining material added. Both manual and mechanical means will be used to remove the substandard linings. The learner will, where appropriate, dry/cure the repaired lining prior to starting the melting cycle. They will light/start up the furnace to pre-heat the lining before metal charging is carried out. Where the metal is to be melted, in either fixed or movable crucibles, the learner will also inspect these vessels for wear/damage and carry out routine servicing to maintain their life. Where appropriate, they will repair/replace discharge launders. They will, where appropriate, knock out, re-line and dry/cure pouring vessels to be used for the casting operation. Their activities will include the operating of any mechanical, electrical or electronic equipment used during inspection and repair of melting furnaces and associated equipment.

The learner's responsibilities will require them to comply with organisational policy and procedures for the preparation and repair of melting furnace linings and associated equipment. They will report any problems with materials, furnaces and equipment in use that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to verbal or written instructions. They will also be expected to take responsibility for maintaining the melting furnaces, and other associated equipment, in a safe and functional condition.

The learner's knowledge will be sufficient to provide a sound approach to their work, and will provide an informed approach to the preparation and maintenance of the melting furnaces and ladles they use. They will understand the different types of metal in use, and the associated furnaces and ladles used to melt and pour these metals. They will also understand the different methods of melting metal, such as single, batch or continuous processes, and the effects that each of these has on the furnace and ladle linings.

The learner will understand the safety precautions required when carrying out the furnace and ladle preparation activities. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Prepare furnace and ladle linings for melting and pouring metal</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the preparation and repair activities:</p> <ul style="list-style-type: none"> - confirm that the required equipment is available and is in a safe and usable condition - check that correct amounts of repairing/relining materials are available (refractory materials, pre-formed linings) - check the quality/specification of the materials that they use, and ensure that the materials specification complies with repair procedures documentation - use appropriate personal protective equipment, and check that it is in good order - comply with job instructions, relevant COSHH sheets and risk assessment documentation - follow the defined repair procedures, and apply safe working practices and procedures at all times - ensure that the completed furnaces and ladles meet the required specification for quality and accuracy 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - leave the work area in a safe condition on completion of the preparation activities <p>1.3 obtain all the required equipment and ensure that it is in safe and usable condition</p> <p>1.4 use a range of hand and power tools during the repair/relining of the furnaces and ladles, to include two of the following:</p> <ul style="list-style-type: none"> - hand tools - pneumatic tools - compacting tools - mixing equipment - spraying equipment - gassing equipment <p>1.5 carry out the necessary preparations to equipment in line with work requirements</p> <p>1.6 carry out a check of the equipment for completeness and freedom from defects, to include all of the following, as appropriate:</p> <ul style="list-style-type: none"> - power cables - fuel supply lines - furnaces - furnace linings 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - ladles - crucibles and associated pouring or molten metal transfer vessels <p>1.7 check, prepare and use one of the following repair/lining materials:</p> <ul style="list-style-type: none"> - water based refractory - dry powder refractory - chemically bonded - pre-formed linings <p>1.8 repair furnace and ladle linings, to include all of the following, as appropriate:</p> <ul style="list-style-type: none"> - manually chipping out damaged areas - using mechanical assistance to remove damaged areas - mixing, preparing and applying new lining/repair material - inserting new pre-formed liner - dressing repaired areas - drying or curing lining - carrying out any required pre-heating of the lining, prior to production starting - reporting any problems they cannot resolve (such as with power or fuel supply) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.9 carry out preparations and repairs that meet one or more of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - company standards and procedures - ISO 9000 quality assurance procedures - customer standards and requirements <p>1.10 make sure that required safety arrangements are in place to protect other workers from activities likely to disrupt normal working</p> <p>1.11 report completion of preparations in line with organisational procedures</p> <p>1.12 confirm the completion of the furnace/ladle preparation/repair, to include both of the following, as appropriate:</p> <ul style="list-style-type: none"> - reporting that furnace/ladles are ready for use, in accordance with company procedures - quarantining furnaces/ladles that are not suitable for use, in accordance with company procedures <p>1.13 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to prepare furnace and ladle linings for melting and pouring metal</p>	<p>2.1 describe the specific safety precautions to be taken when inspecting, preparing and repairing furnaces and ladles</p> <p>2.2 explain the COSHH regulations that apply when dealing with furnace and ladle lining materials</p> <p>2.3 explain where to obtain information on COSHH regulations</p> <p>2.4 explain the Provision and Use of Work Equipment Regulations (PUWER)</p> <p>2.5 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.6 explain the relevant parts of the Electricity at Work Regulations, as they apply work on the furnaces</p> <p>2.7 describe the hazards associated with the use of mechanical and hydraulic equipment used in the preparation of furnaces and ladles for melting and pouring metal, and explain how they can be minimised</p> <p>2.8 explain what type of personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.9 explain how to obtain necessary job instructions, and how to interpret their information</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.10 describe the different materials that are used to line/repair furnaces and ladles (such as acid/base, wet/dry, gas/heat cured, sprayed materials, pre-formed liners)</p> <p>2.11 explain why it is necessary to check amounts of materials prior to starting furnace/ladle repairs</p> <p>2.12 explain the actions needed when materials are found to be below required amounts</p> <p>2.13 explain why checks should be made on the materials to be used</p> <p>2.14 describe the effects on the repairs and the furnace operation, if the base products are past their 'use by' date, are different in content from the company requirement/specification, or are applied incorrectly</p> <p>2.15 describe the different fuels used to melt metal, and the effects they have on the furnace linings</p> <p>2.16 describe the different types of furnace used to melt metal (such as bale out, lift out crucible, tilting crucible, cupola, rotary, induction (high and low frequency), direct/indirect arc)</p> <p>2.17 describe the types of furnace used to melt ferrous and non-ferrous alloys</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.18 explain how to recognise when furnace and ladle linings need repairing and replacing (such as scoured areas, fused linings or damaged bricks, tuyere area damage, damaged lining rings, damaged or broken base block, burner box damage, thinning of refractory linings, contaminated crucibles, broken/cracked or damaged furnace surround, insulation breakdown, damage to pouring vessels, damage to power input cables or fuel supply lines, and damage to burner nozzle)</p> <p>2.19 explain how to safely remove linings from the furnaces and ladles, and the tools and equipment that are used (such as hand and power tools)</p> <p>2.20 explain how to mix, prepare and apply the various linings (such as refractory materials and pre-formed linings)</p> <p>2.21 explain the reasons why the repaired furnace lining and, where appropriate, pouring vessels linings, should be dried or cured prior to the furnace/vessel being used to melt/carry metal</p> <p>2.22 describe the company quality control checks for the furnaces/ladles</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.23 explain why it is important to keep the furnace and repair equipment clean and free from damage, to practise good housekeeping of tools and equipment, to maintain a clean and unobstructed working area, and to carry out start-up and shut-down procedures</p> <p>2.24 describe the extent of their responsibilities, and to whom they should report if they have problems that they cannot solve when preparing melting furnace or pouring vessel/ladle linings</p>			

Learner name: _____ Date: _____

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Assessor signature: _____ Date: _____

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

Unit 17: Controlling and treating molten metal in readiness for casting

Unit reference number: M/502/9450

QCF level: 2

Credit value: 20

Guided learning hours: 70

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to control the temperature of, and treat, molten metal used to make castings. The learner will be required to use approved techniques, methods and equipment, in accordance with approved procedures.

They will be required to select the appropriate equipment to use, based on the type and amount of molten metal being controlled and treated. Single, batch and continuous production methods for the metal are included in this unit, which also covers both ferrous and non-ferrous alloys.

The learner will maintain an adequate amount of the materials needed to treat the molten metal, and will notify supervision when stocks reach re-ordering levels. They will provide information and materials, where appropriate, to others who will add the specified materials/additions into the melting furnace at the specified time.

The learner will be required to monitor and record the temperature of the molten metal on a regular basis. They will perform simple tests on samples taken from the molten metal, in accordance with the company control procedures. The tests could be performed manually, or by using inbuilt continuous monitoring equipment that provides information visually or by printouts. For the manually performed tests, the learner will be expected to record the results obtained on control charts. From information obtained from the test results, or from other sources, the learner will, if necessary, be expected to add materials/metal to correct any deficiencies. The learner will treat the molten metal to remove/contain impurities and to modify the cast metal to meet the casting specification.

The learner's responsibilities will require them to comply with organisational policy and procedures for the control and treatment of the molten metal. They will report any problems with the materials and equipment in use that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to verbal or written instructions, and to take responsibility for the quality and accuracy of the treated molten metal.

The learner's knowledge will be sufficient to provide a sound approach to their work, and will provide an informed approach to the control and treatment of the molten metal. They will understand the different types of metals in use, and the associated furnaces used to melt these metals. They will also understand the different methods of melting metal, such as single melt, batch or continuous processes, and the tests and treatments that are used to confirm that the process is under control.

The learner will understand the safety precautions required when carrying out the testing and treatment of the molten metal. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Control and treat molten metal in readiness for casting</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following during the molten metal treatment activities:</p> <ul style="list-style-type: none"> - obtain the correct amounts of consumables to treat the molten material (such as fluxes, deoxidizers, oxidising agents, inhibitors, grain refiners, inoculating materials) - check the quality/specification of the materials that they use, and ensure that the materials specification complies with melt documentation - use appropriate personal protective equipment, and check that it is in good order - comply with job instructions, relevant COSHH sheets and risk assessment documentation - follow the defined testing and sampling procedures, and apply safe working practices and procedures at all times - ensure that the completed melt meets the required specification <p>1.3 check and monitor the operating conditions of the melting furnace making any necessary adjustments to maintain satisfactory operating conditions</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.4 check and prepare the molten metal, to include carrying out both of the following:</p> <ul style="list-style-type: none"> - determining the temperature of the molten metal (immersion pyrometer, visual display units, visually, or by electronic mail) - adjusting the operating conditions of the melting furnace <p>1.5 carry out temperature tests of the molten metal at the appropriate intervals</p> <p>1.6 apply appropriate treatments to the melt in order to achieve material specification</p> <p>1.7 carry out treatment of the melting/molten metal, to include two of the following:</p> <ul style="list-style-type: none"> - adding deoxidising agents to charge material - adding oxidising agents to charge material - deoxidising molten metal - modification of molten metal - adding cover fluxes to charge material - degassing molten metal - grain refining of molten metal - removal of slag/oxide skins <p>1.8 take samples of the molten metal and carry out appropriate tests to determine quality</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.9 take samples of the molten metal, for one of the following types of test:</p> <ul style="list-style-type: none"> - carbon equivalent measurement - chemical analysis - X-Ray Fluorescence Spectrometry (XRF) - spark emission spectrometry - wedge tests <p>1.10 make any necessary adjustments/additions to the melt to ensure it achieves the required characteristics and meets the final material specification</p> <p>1.11 take action to adjust the molten metal, as required, by one of the following methods:</p> <ul style="list-style-type: none"> - manual/mechanical addition of further metal/materials - informing a technician/supervisor of non-conformance of molten metal - adjusting the power or fuel input to furnace 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.12 complete preparations of the molten materials, to include carrying out all of the following:</p> <ul style="list-style-type: none"> - recording of test results according to company specifications - confirming that the prepared melt is ready for use and complies with required specification - discharging molten metal according to company procedures <p>1.13 deal promptly and effectively with problems within their control and report those that they cannot solve</p> <p>1.14 dispose of waste and excess materials in line with agreed organisational procedures</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to control and treat molten metal in readiness for casting</p>	<p>2.1 describe the hazards and specific safety precautions to be taken when controlling and treating molten metal</p> <p>2.2 explain the COSHH regulations that apply when dealing with furnace and ladle additions</p> <p>2.3 explain where to obtain information on COSHH regulations</p> <p>2.4 explain the Provision and Use of Work Equipment regulations (PUWER)</p> <p>2.5 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.6 explain the electricity at Work regulations, in relation to the work that they carry out</p> <p>2.7 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.8 explain the emergency procedures to be followed in the event of a malfunction of any melting furnace, holding ladle or pouring vessels in use</p> <p>2.9 explain how to obtain the necessary job instructions and specifications, and how to interpret their information</p> <p>2.10 explain why it is necessary to check the amounts of materials prior to starting the treatment operations</p> <p>2.11 explain what actions are needed when materials are found to be below the required amounts</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.12 explain why quality checks should be made on the materials to be used</p> <p>2.13 describe the effects on the molten metal if the treatment materials are past the 'use by' date, are different in content from the company requirement/specification, are added to the furnace/metal at the wrong time or at the wrong temperature, or if too little or too much is added to the furnace/molten metal</p> <p>2.14 describe the different types of furnace and fuels used in melting metal</p> <p>2.15 describe the types of furnace used to melt ferrous and non-ferrous alloys</p> <p>2.16 describe the materials/gases they use on a regular basis when treating metal, during melting or when molten</p> <p>2.17 explain why it is important to keep records of test results</p> <p>2.18 explain why sampling of molten metal should be performed</p> <p>2.19 describe the types of test which they perform on the molten metal</p> <p>2.20 explain why molten metal, which is outside of specification after testing, has to be disposed of</p> <p>2.21 explain the actions they need to take if the molten metal is outside of specification</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.22 describe the company quality control checks required for the molten metal</p> <p>2.23 explain why it is important to keep the furnace and treatment equipment clean and free from damage, to practise good housekeeping of tools and testing equipment, and to maintain a clean and unobstructed working area</p> <p>2.24 describe the defects in castings which can be directly related to the use of molten metal which is outside of the specified temperature range, is untreated, is treated but the casting of the moulds, etc, is delayed, or to the use of un-skimmed metal</p> <p>2.25 describe the extent of their own responsibilities and to whom they should report if they have problems that they cannot resolve when preparing the molten metal</p>			

Learner name: _____ Date: _____

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Assessor signature: _____ Date: _____

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

Unit 18: Producing metallic castings using the gravity die process

Unit reference number: T/502/9451

QCF level: 2

Credit value: 28

Guided learning hours: 84

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to produce castings using the gravity die-casting process, in accordance with approved procedures. The learner will be expected obtain the correct dies, and to inspect them for any damage or non-conformance that could impair the quality of the castings produced. Dies will be assembled, and any cores required will be inserted, using recognised techniques. The dies will be secured and positioned ready for casting. The learner will ensure that the molten metal is available for use, to enable production to begin. It is expected that the learner will collect their own metal from specified points, and that they will check its temperature. They will then produce the castings, in a safe manner and in accordance with specified company procedures. Any surplus metal not required will be returned to the collection point or disposed of safely.

After allowing a suitable time for the molten metal to solidify, the learner will remove the casting from the die and visually inspect the product for compliance with the specification. Acceptable castings will be placed in the required locations, ready for their next operation. Any substandard castings will be held for investigation, or returned to the furnace area for re-melting.

The learner's responsibilities will require them to comply with organisational policy and procedures for the die-casting activities undertaken. They will report any problems with the die-casting operations which have been identified during their production run that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work to verbal or written instructions, and to take responsibility for the quality and accuracy of the castings that they produce.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the production of gravity die-castings. Their knowledge will enable them to identify when there are faults in the castings produced, and why these faults have occurred. They will know which defects are caused by their own actions, and which ones are outside of their control.

The learner will understand the safety precautions required when carrying out the die casting activities, and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Produce metallic castings using the gravity die process</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 prepare the dies in readiness for the casting operations, to include carrying out all of the following:</p> <ul style="list-style-type: none"> - obtain all necessary documents and job instructions for the casting operations being performed - ensure that the work area is clear of obvious hazards - obtain any necessary personal protective equipment, and check it is in good order - ensure that all guards and screens are in place and are in good order - check that all molten metal handling/transfer equipment that they use is available and in good order (such as spoons and ladles) - check that all services are connected and that all connections are in good order (such as power supply, hydraulics, water cooling) - ensure that die coolant and die spray systems are operational, as appropriate <p>1.3 ensure that the moulds are correctly prepared, sited and positioned ready for the casting process</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.4 assemble the dies and site them in two of the following locations, ready for casting:</p> <ul style="list-style-type: none"> - floor - fixed bases - movable bases - carousel - conveyor/roller track <p>1.5 prepare for the die casting operations, to include carrying out all of the following:</p> <ul style="list-style-type: none"> - checking that the correct die is located in the machine, and that it is complete, clean and free from damage - ensuring that die location points are clean - checking that secondary die and core locations are clean, free from damage and free to move - heating the die to the correct operating temperature - applying appropriate die release agents - ensuring that the furnace contains sufficient molten metal of the correct specification, and at the correct temperature - pre-heating metal transfer tools (to include single bale-out or double shanks/crucibles) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.6 produce castings, to include carrying out all of the following, as appropriate:</p> <ul style="list-style-type: none"> - insertion of cores into the die cavity - collection of molten metal - removal of the casting from the die - disposal of surplus metal according to company procedures (such as return to holding furnace, return to ladle, pour into prepared ingot moulds) <p>1.7 ensure that the molten material is at the required casting temperature</p> <p>1.8 complete quality checks on the molten metal, to include carrying out two of the following:</p> <ul style="list-style-type: none"> - molten metal temperature (such as immersion pyrometer, furnace readout, visually or technician approved) - cast sample test bars - cast samples for chemical analysis <p>1.9 collect and transport the molten material safely and correctly from the furnace</p> <p>1.10 use the appropriate technique to pour the molten material into the moulds</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.11 produce castings using three of the following types of gravity die:</p> <ul style="list-style-type: none"> - split die with no secondary die movement - split die with one secondary die movement - split die with two or more secondary die movements - split die with no cores - split dies with one core - split dies with two or more cores <p>1.12 produce diecast components made from one or more of the following materials:</p> <ul style="list-style-type: none"> - zinc - aluminium - iron - copper based - lead - precious metal <p>1.13 produce castings to the required specification</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.14 complete the visual inspection and segregation of castings, according to company procedures, to include all of the following:</p> <ul style="list-style-type: none"> - acceptable castings - scrap castings - castings requiring further inspection by supervision <p>1.15 dispose of surplus material safely and correctly</p> <p>1.16 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.17 complete all of the following operations at shut-down:</p> <ul style="list-style-type: none"> - check that all systems are failsafe - complete the operational log, where appropriate - hand over to supervision 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to produce metallic castings using the gravity die process</p>	<p>2.1 describe the hazards and specific safety precautions to be taken when producing castings by gravity die methods</p> <p>2.2 explain the COSHH regulations that apply when dealing with release agents and die coatings</p> <p>2.3 explain where to obtain information on COSHH regulations</p> <p>2.4 explain the Provision and Use of Work Equipment regulations (PUWER)</p> <p>2.5 explain the electricity at Work regulations with regard to the activities that they are carrying out</p> <p>2.6 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.7 explain the emergency procedures to be followed in the event of a malfunction of a melting furnace</p> <p>2.8 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.9 describe the basic parts and functions of a gravity die (to include die location points, secondary die locations, core locations, die heating arrangements, die coolant supply, connection and operation of the die spray system, furnace type, guards and other safety devices)</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.10 explain why it is necessary to carry out pre-production checks on the dies</p> <p>2.11 describe the different types of gravity die casting</p> <p>2.12 describe the different methods used to locate dies and associated parts</p> <p>2.13 describe the different types of core used in the gravity die casting process</p> <p>2.14 explain the benefits and limitations of the gravity die casting process</p> <p>2.15 describe the different metals used in gravity die castings</p> <p>2.16 explain the pouring temperature range of the metal alloy being cast</p> <p>2.17 explain why castings need time to solidify before removing them from the die</p> <p>2.18 explain why dies need to have release agent applied prior to casting</p> <p>2.19 explain why some dies need to have coolant circulating through the die</p> <p>2.20 explain how to identify casting defects (such as mis-runs, broken sections, blows, distorted sections, sinks, die-dressing runs, short runs, shrinkage, cracks, inclusions and flash)</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.21 describe the company quality control checks required to the prepared gravity die (to include cleanliness, completion and freedom from foreign bodies and defects)</p> <p>2.22 explain why it is important to keep the gravity dies and equipment clean and free from damage, to practice good housekeeping of metal handling tools and equipment, and to maintain a clean and unobstructed working area</p> <p>2.23 describe the extent of their own responsibilities and to whom they should report if they have problems that they cannot resolve when making gravity die castings</p>			

Learner name: _____ Date: _____

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Assessor signature: _____ Date: _____

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

Unit 19: Producing metallic castings using pressure die processes

Unit reference number: A/502/9452

QCF level: 2

Credit value: 28

Guided learning hours: 84

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to produce castings using high (hot or cold chamber), squeeze and low pressure die casting processes, in accordance with approved procedures. The molten metal will either be drawn into the die automatically (hot chamber) or collected from a furnace close to, or integrated into, the die casting machine (cold chamber or squeeze). In all cases, the learner will be expected to check the temperature of the metal prior to production of the castings. The learner will then cast the dies in a safe manner, as appropriate, and to specified company procedures. Any surplus metal not required will be returned to the collection point or disposed of safely.

After allowing a suitable time for the molten metal to solidify, the learner will remove the casting from the die and visually inspect the product for compliance with the specification. Acceptable castings will be placed in the required locations ready for their next operation. Any substandard castings will be held for investigation or returned to the furnace area for re-melting.

The learner's responsibilities will require them to comply with organisational policy and procedures for the die casting activities undertaken. They will report any problems with the operations which have been identified during their production run, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work to verbal or written instructions, and to take responsibility for the quality and accuracy of the castings that they produce.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the production of pressure die castings. Their knowledge will enable them to identify when there are faults in the castings produced, and why these faults have occurred. They will know which defects are caused by their own actions, and which are outside of their control.

The learner will understand the safety precautions required when carrying out the pressure die casting activities, and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Produce metallic castings using pressure die processes</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 prepare the machine in readiness for the casting operations, to include carrying out all of the following:</p> <ul style="list-style-type: none"> - obtain all necessary documents and job instructions for the casting operations being performed - ensure that the work area is clear of obvious hazards - obtain any necessary personal protective equipment, and check it is in good order - ensure that all guards and screens are in place and in good order - check that all molten metal handling/transfer equipment that they use is available and in good order (such as spoons and ladles) - check that all services are connected, and that all connections are in good order (such as power supply, hydraulics, water cooling) - check that all machine controls are operational - check that die coolant and die spray systems are operational, as appropriate 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.3 prepare for the pressure die casting operations, to include carrying out all of the following:</p> <ul style="list-style-type: none"> - checking that the correct die is located in the machine, and is complete, clean and free from damage - ensuring that die location points are clean - checking that secondary die and core locations are clean, free from damage and free to move - heating the die to the correct operating temperature - applying appropriate die release agents - ensuring that the furnace contains sufficient molten metal of the correct specification and at the correct temperature - preheating the metal transfer tools where appropriate (to include single bale-out or double shanks/crucibles) <p>1.4 confirm that the equipment is set up correctly and ready for the casting activities to be carried out</p> <p>1.5 maintain an adequate supply of base material</p> <p>1.6 manipulate the machine controls safely and correctly in line with operational procedures</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.7 produce pressure die castings, using one of the following methods:</p> <ul style="list-style-type: none"> - high pressure hot chamber - high pressure cold chamber - squeeze process - other specific process <p>1.8 produce castings using two of the following types of pressure die/mould:</p> <ul style="list-style-type: none"> - split die with no secondary die movement - split die with one secondary die movement - split die with two or more secondary die movements - split die with no cores - split dies with one core - split dies with two or more cores - core assembly with external cores - core assembly with internal core 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.9 produce castings by mechanical or manual means, to include all of the following, as appropriate:</p> <ul style="list-style-type: none"> - insertion of cores into die cavity - collection of molten metal from the specified location - disposal of surplus metal according to company procedures - removal of the casting from the die <p>1.10 produce pressure die cast components made from one or more of the following materials:</p> <ul style="list-style-type: none"> - zinc - aluminium - iron - copper based - lead - precious metal <p>1.11 produce cast components to the required specification</p> <p>1.12 carry out quality sampling checks at suitable intervals</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.13 complete quality checks on the molten metal, to include carrying out two of the following:</p> <ul style="list-style-type: none"> - molten metal temperature (such as immersion pyrometer, furnace readout, visually or technician approved) - cast sample test bars - cast samples for chemical analysis <p>1.14 complete the visual inspection and segregation of castings, according to company procedures, to include all of the following:</p> <ul style="list-style-type: none"> - acceptable castings - scrap castings - castings requiring further inspection by supervision <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.16 shut down the equipment to a safe condition on conclusion of the casting activities</p> <p>1.17 complete all of the following operations at shut down:</p> <ul style="list-style-type: none"> - close down the machine after use - check that all systems are failsafe - complete the operational log, where appropriate - hand over to supervision 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to produce metallic castings using pressure die processes</p>	<p>1.18 deal safely with excess materials in line with organisational procedures</p> <p>2.1 describe the hazards and specific safety precautions to be taken when producing castings by pressure die methods</p> <p>2.2 explain the COSHH regulations that apply when dealing with release agents and die coatings</p> <p>2.3 explain where to obtain information on COSHH regulations</p> <p>2.4 explain the Provision and Use of Work Equipment regulations (PUWER)</p> <p>2.5 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.6 explain the emergency procedures to be followed in the event of a malfunction of a pressure die casting machine or melting furnace</p> <p>2.7 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.8 describe the basic parts and functions of a pressure die casting machine (to include dies, die location points, secondary die locations, core locations, die heating arrangements, die coolant supply, connection and operation of the die spray system, furnace type, machine controls, hydraulic, pneumatic and electricity supplies, metal transfer systems, guards and other safety devices)</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.9 explain why it is necessary to carry out pre-production checks on the dies</p> <p>2.10 describe the different types of pressure die casting</p> <p>2.11 describe the different methods used to locate dies and associated parts</p> <p>2.12 describe the different types of core used in the pressure die casting process</p> <p>2.13 explain the benefits and limitations of the various processes (high pressure hot chamber process, high pressure cold chamber process and squeeze process)</p> <p>2.14 describe the different metals used in producing pressure die castings</p> <p>2.15 explain the pouring temperature range of the metal alloy being cast</p> <p>2.16 explain why castings need time to solidify before removing them from the die</p> <p>2.17 explain why dies need to have release agent applied prior to casting</p> <p>2.18 explain why some dies need to have coolant circulating through the die</p> <p>2.19 explain how to identify casting defects (such as mis-runs, broken sections, blows, distorted sections, sinks, die-dressing runs, short runs, shrinkage, cracks, inclusions and flash)</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.20 describe the company quality control checks to be carried out on the prepared pressure die (to include cleanliness, completion, and freedom from foreign bodies and defects)</p> <p>2.21 explain why it is important to keep the pressure dies and equipment clean and free from damage, to practice good housekeeping of metal handling tools and equipment, and to maintain a clean and unobstructed working area</p> <p>2.22 describe the extent of their own responsibilities and to whom they should report if they have problems that they cannot resolve when making pressure die castings</p>			

Learner name: _____ Date: _____

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Assessor signature: _____ Date: _____

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

Unit 20: Inspecting metallic castings visually

Unit reference number: L/502/9455

QCF level: 2

Credit value: 15

Guided learning hours: 91

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to visually inspect castings produced from sand or ceramic moulds, dies or investment shells. The learner will be required to select the appropriate aids and equipment to use, based on the type, size, alloy and inspection requirements of the castings. Both ferrous and non-ferrous castings are covered by this unit. The learner will carry out checks to the aids and equipment to ensure that it is safe to use and is suitable for purpose.

The castings may be circular, square or irregular in shape, with projections and internal cavities, and curved or tapered profiles. The learner will carry out visual inspections of external and internal areas of the castings, during any or all of the processes used to finish a casting to meet a company or customer specification.

The learner will use any provided aids to inspect the castings and, where appropriate, they will mark the castings to indicate defects, either obvious or suspected, in accordance with procedures. Where appropriate, they will use workholding devices, benches and lifting equipment to manipulate the castings during the inspection operation. There could be occasions when larger castings are sited on the floor and the learner will be expected to manoeuvre these to complete the work. Castings that meet specification will be passed to the next operation. Substandard castings will be scrapped or segregated for further inspection or testing. They will record, on the appropriate sheets, all their findings on inspected castings and pass these records to named persons.

The learner's responsibilities will require them to comply with organisational policy and procedures for the inspection activities undertaken. They will report any problems with the inspection activities, tools and equipment used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to verbal or written instructions, and to take responsibility for the safe and correct inspection of the castings.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the inspection of the various types and sizes of casting. They will understand the different methods used and the various aids, machines and materials that are used during the inspection operations. They will also be familiar with the lifting and moving equipment that is used to handle the different types and sizes of casting.

The learner will understand the safety precautions required when carrying out the inspection activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Inspect metallic castings visually</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following in preparation for the inspection activities:</p> <ul style="list-style-type: none"> - obtain all necessary documents and job instructions for the inspection operations being performed - ensure that the work area is clear of obvious hazards - obtain any necessary personal protective equipment, and check that it is in good order - check that all tools and equipment to be used in the inspection activity are in a safe and usable condition - check that any lifting and handling equipment required is available and in good order <p>1.3 follow the correct specification for the product or equipment being inspected</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.4 use the correct equipment to carry out the inspection</p> <p>1.5 perform the visual inspection of castings, using two of the following:</p> <ul style="list-style-type: none"> - normal visual scan - electronic scanning units - shadowgraph units - magnifying glasses - dye-penetrant process equipment <p>1.6 identify and confirm the inspection checks to be made and acceptance criteria to be used</p> <p>1.7 carry out all required inspections as specified</p> <p>1.8 inspect castings produced from one of the following materials:</p> <ul style="list-style-type: none"> - ferrous alloys - non-ferrous alloys <p>1.9 visually inspect castings at two of the following finishing process stages:</p> <ul style="list-style-type: none"> - mould knock-out and de-core - prior to mechanical cleaning - after mechanical cleaning - before, during and after repair/reclamation 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - prior to manual cleaning - after manual cleaning - during and after fettling <p>1.10 identify any defects or variations from the specification</p> <p>1.11 identify, by visual inspection, four of the following casting defects:</p> <ul style="list-style-type: none"> - sinks - inclusions - swells - cross joints - scabs - sub-surface porosity - undercuts on runners/risers/feeders - poor ingate or feeder cut off - broken ingates/runners/risers - mis-runs/cold shuts - surface porosity - shrinkage - cracks - mis-placed cores 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - variable metal section thickness - excessive flash - others (specify) <p>1.12 complete the visual inspection, identification marking and segregation of castings, to include all of the following according to company procedures:</p> <ul style="list-style-type: none"> - meets required specification - requiring dimensional checking - requiring repair/reclamation work - requiring further investigation - total scrap <p>1.13 record the results of the inspection in the appropriate format</p> <p>1.14 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to inspect metallic castings visually</p>	<p>2.1 explain the health and safety requirements of the work area in which they are carrying out the inspection activities, and the responsibility they place upon the learner</p> <p>2.2 explain the specific safety precautions to be taken when inspecting castings</p> <p>2.3 describe the hazards associated with inspecting castings, and explain how they can be minimised</p> <p>2.4 explain what personal protective equipment (PPE) should be used during the cleaning operations; how to obtain it and check that it is in a safe and usable condition</p> <p>2.5 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.6 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.7 explain the emergency procedures to be followed in the event of a malfunction of any of the equipment that they use</p> <p>2.8 explain why different methods of inspecting castings are used for different types of defect</p> <p>2.9 explain why different methods of inspection are used on castings that have to meet critical criteria (eg turbine blades)</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.10 describe the different equipment that can be used to assist with the visual inspection activities (such as electronic scanning units, shadowgraph units, magnifying glasses or dye-penetrant equipment)</p> <p>2.11 explain why it is important to inspect castings at all stages of the finishing process</p> <p>2.12 explain why inspection equipment must be calibrated</p> <p>2.13 describe the different types of defects which can be detected through visual inspection (including sinks, inclusions, mis-runs/cold shuts, shrinkage, surface/sub-surface porosity, cracks, undercuts on runners/risers/feeders, poor ingate or feeder cut-off, swells, cross joints, scabs, mis-placed cores, variable metal section thickness and excessive flash)</p> <p>2.14 explain why it is important to keep the equipment clean and free from damage, to practice good housekeeping of tools and equipment, and to maintain a clean working area</p> <p>2.15 explain why costs of repair/reclamation need to be considered carefully before any casting is submitted for this operation</p> <p>2.16 describe the types of casting/fettling defect that can be effectively repaired without loss to the serviceability of the casting</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.17 explain why it is important that records of casting inspections are comprehensive and maintained on a regular basis</p> <p>2.18 explain to whom they pass the inspection records</p> <p>2.19 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve when visually inspecting castings</p>			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

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

Unit 21: Knocking out and de-coring metallic castings

Unit reference number: F/502/9453

QCF level: 2

Credit value: 8

Guided learning hours: 39

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to knock out and de-core castings produced from sand moulds, ceramic moulds or investment shells, and includes the use of manual, mechanised and chemical methods, in accordance with approved procedures.

The learner will be required to select the appropriate equipment and chemicals to use, based on the type, size and number of the moulds/shells to be knocked out and de-cored. The moulds/shells the learner deal with will have been produced as one-offs, batches or by a continuous casting process. Ferrous and non-ferrous castings are covered in this unit.

Sand moulds will be knocked out in specified areas, and the castings containing cores will be moved for de-coring, to ensure that the used core sand can be segregated from the moulding sand. Investment moulds and shells will be knocked out and the waste material collected for specialised removal. Cores from ceramic moulds or shells will, where appropriate, be removed by vibratory methods or chemical leaching. Moulding equipment, such as boxes, clamps, etc, will be returned to the mould production area. Any coremaking ancillaries will be collected, and recycled or scrapped. The learner will operate any machinery that is used to transport, knock out and de-core the castings, and also any machinery used to remove the castings to other areas for further processing. Where chemicals are used to remove cores from castings, the learner will ensure that the solutions used are to the required specification. They will place obvious and suspect scrap castings in specified areas to await confirmation.

The learner's responsibilities will require them to comply with organisational policy and procedures for the knocking out and de-coring of sand or ceramic moulds and investment shells. They will report any problems with the equipment and material in use that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to verbal or written instructions, and to take responsibility for the safe and correct handling of the rough castings.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the knocking out and de-coring of the various types of moulds/shells. They will understand the different types of materials used to make the moulds/shells, and the process of casting removal from the various types. They will have knowledge of the associated machinery that is used to handle the different types and size of cast mould/shells, and they will understand why different methods and chemicals are used in the knocking out and de-coring process.

The learner will understand the safety precautions required when carrying out the knocking out and de-coring activities, and when using the associated tools, equipment and/or chemicals. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Knock out and de-core metallic castings</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following, in preparation for the knocking out and de-coring activities:</p> <ul style="list-style-type: none"> - obtain all necessary documents and job instructions for the operations being performed - ensure that the work area is clear of obvious hazards - obtain any necessary personal protective equipment, and check that it is in good order - ensure that all guards and screens are in place and in good order - check that lifting and handling equipment required is available and in good order - check that the necessary tools and equipment are available and in a safe and usable condition (such as blasting equipment, or vibratory tables) - where appropriate, check that chemical leaching tanks are in good order, and that chemicals are to the required specification - ensure that dust extraction equipment is functioning correctly 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.3 check that the knocking-out and de-coring tools and equipment are available and in a safe and usable condition</p> <p>1.4 ensure that any chemical solutions used to remove cores from castings are to the required specification</p> <p>1.5 carry out the knocking-out and de-coring activities in accordance with operating procedures and the casting specification requirements</p> <p>1.6 knock out and de-core castings produced from one of the following:</p> <ul style="list-style-type: none"> - ferrous alloys - non-ferrous alloys <p>1.7 knock out moulds produced by one of the following casting processes:</p> <ul style="list-style-type: none"> - green sand (naturally or synthetically bonded) - chemically bonded resin activated sand - ceramic materials - chemically bonded gas activated sand - resin bonded heat activated sand - investment casting shells 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.8 remove castings from moulds, and carry out all of the following, as appropriate to the castings produced:</p> <ul style="list-style-type: none"> - knocking castings out of the moulds - removing castings from the moulding material - de-coring - removing runner/riser/feeder systems <p>1.9 remove and de-core castings, using one of the following methods:</p> <ul style="list-style-type: none"> - manually - using vibratory tables/grids - using punch-out mechanism - by blasting (such as air, water, sand) - by chemical leaching <p>1.10 complete the knocking-out and de-coring activities, to include all of the following:</p> <ul style="list-style-type: none"> - segregate and dispose of core sands and moulding sands - return mould and core-making equipment and ancillaries to the production area (where appropriate) - segregate and identify, where appropriate, runners/risers/feeders 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.11 check that removed castings are complete and free from obvious defects</p> <p>1.12 complete the visual inspection and segregation of castings, according to company procedures, to include all of the following:</p> <ul style="list-style-type: none"> - acceptable castings - scrap castings - castings requiring further inspection by supervision <p>1.13 carry out segregation of castings according to company procedures</p> <p>1.14 dispose of core sands, moulding sands and other waste materials according to company procedures</p> <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.16 shut down the knocking-out and de-coring equipment to a safe condition on completion of the activities</p> <p>1.17 complete all of the following operations at shut-down, as appropriate to the equipment used:</p> <ul style="list-style-type: none"> - close down any machinery or equipment used during knock out and de-coring operations - check that all systems are failsafe - complete the operational log - hand over to supervision 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to knock out and de-core metallic castings</p>	<p>2.1 explain the health and safety requirements of the work area in which they are working, and the responsibility they place upon the learner</p> <p>2.2 explain the specific safety precautions to be taken when knocking out castings manually</p> <p>2.3 describe the hazards associated with knocking out and de-coring of castings, and explain how they can be minimised</p> <p>2.4 explain what personal protective equipment (PPE) should be used; how to obtain it and check that it is in a safe and usable condition</p> <p>2.5 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.6 explain the emergency procedures to be followed in the event of a malfunction of any of the equipment that they use</p> <p>2.7 explain why it is advisable to remove sub-standard castings from the production line during knock out and de-coring activities</p> <p>2.8 describe the different types of materials used to produce moulds</p> <p>2.9 explain the difference between sand moulds and ceramic moulds/shells</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.10 describe the different methods and machines used to transport moulds and/or shells to the knock out and de-coring areas</p> <p>2.11 describe the different methods and machines that can be used to knock out and de-core moulds and shells</p> <p>2.12 explain the reasons why some cores are removed from castings using chemicals</p> <p>2.13 explain the reasons why mould and core equipment and ancillaries are returned to the production areas</p> <p>2.14 explain the effect on casting quality of incorrectly knocking out and de-coring castings</p> <p>2.15 describe the casting defects which can be directly related to the use of incorrect methods for the removal of runners/risers/feeders from castings during the knocking out</p> <p>2.16 explain the reasons why runners/risers/feeders need to be identified</p> <p>2.17 explain why some moulding materials can be returned for recycling and others must be disposed of</p> <p>2.18 explain why some core materials need to be disposed of using specialist methods</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.19 explain why it is important to keep the equipment clean and free from damage, to practice good housekeeping of tools and equipment, to maintain a clean working area, and to carry out shut-down procedures</p> <p>2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve</p>			

Learner name: _____ Date: _____

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Assessor signature: _____ Date: _____

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

Unit 22: Fettleling metallic castings

Unit reference number: J/502/9454

QCF level: 2

Credit value: 8

Guided learning hours: 39

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to use hand and power tools to fettle castings produced from sand moulds, ceramic moulds or investment shells. This will involve removing flash and other irregularities, and polishing the surfaces of the castings. The unit includes ferrous and/or non-ferrous castings.

The learner will be required to select the appropriate equipment to use, based on the type, size, number and alloy of the castings to be fettled. The castings will have been produced as one-offs, in batches or by the continuous casting process. The learner will be expected to carry out checks on the tools and equipment, to ensure that they are safe to use, and to ensure that the abrasive wheels/discs to be used during the fettling operation are available and suitable for the material and intended purpose.

The castings could be circular, square or irregular in shape, and may have projections and internal cavities. The profiles could be curved or tapered. The learner will receive them singly, in batches, or in skips. The learner will remove the runners and risers/feeders, using manual or mechanical means. Other surplus metal present, on both external and internal surfaces (eg joint line and core print flash) must also be removed. The learner will operate fixed and portable machines to remove other surface protrusions and, where appropriate, they will polish the castings in accordance with procedures. They will use workholding devices, benches and lifting equipment to manipulate the castings during the fettling operation. There could be occasions when larger castings are sited on the floor, and they will be expected to manoeuvre these to complete the fettling. Fettled castings will be placed in skips, on pallets, in racks or in other specified containers or jigs. Metal waste removed from the castings will need to be segregated, marked up and removed to designated areas.

The learner's responsibilities will require them to comply with organisational policy and procedures for the fettling of the castings. They will report any problems with the fettling activities, tools, machines and abrasive substances in use that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to verbal or written instructions, and to take responsibility for the safe and correct fettling of the rough castings.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to the fettling of various types and sizes of casting. They will understand the different tools, machines and abrasives used during the fettling operations, and their applications. They will be familiar with the lifting and moving equipment which is used to handle the different types and sizes of casting.

The learner will understand the safety precautions required when carrying out the fettling activities, and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Sema Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Fettle metallic castings	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following, in preparation for the fettling activities:</p> <ul style="list-style-type: none"> - obtain all necessary documents and job instructions for the fettling operations being performed - ensure that the work area is clear of obvious hazards - obtain any necessary personal protective equipment, and check that it is in good order - ensure that all guards and screens are in place and in good order - check that all necessary services are connected and operational - check that lifting and handling equipment required is available and in good order - check that the tools and equipment that they need are available and in a safe and usable condition (such as extension leads, hoses, pneumatic equipment, hand tools) 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - ensure that dust extraction and air filtering equipment is functioning correctly - ensure that any tracks or carousels are operational <p>1.3 obtain the required materials and check them for quantity and quality</p> <p>1.4 fettle castings which have been produced from one of the following materials:</p> <ul style="list-style-type: none"> - ferrous alloys - non-ferrous alloys <p>1.5 determine how the materials need to be prepared</p> <p>1.6 carry out the preparations using suitable equipment</p> <p>1.7 carry out the removal of joint line flash and runners/risers/feeders of castings, to include three of the following:</p> <ul style="list-style-type: none"> - manual removal using hand tools - thermal cutters (manually or mechanically operated) - pneumatic chipping hammers - slitting saw - linishers - laser cutters - disc/angle grinder 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - pedestal grinders - band saw - other methods (specify) <p>1.8 dress castings with all of the following shapes:</p> <ul style="list-style-type: none"> - circular - square - irregular - projections or internal cavities - curved or tapered profiles <p>1.9 monitor the equipment performance during the fettling operation, checking all of the following, as appropriate:</p> <ul style="list-style-type: none"> - abrasive wheel wear - security of the abrasive wheels - escape of air - tool tip wear - supply pressure of services - extraction equipment functioning - filtration systems functioning - abrasive condition 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.10 complete the visual inspection and segregation of castings, according to company procedures, to include identifying all of the following:</p> <ul style="list-style-type: none"> - acceptable castings - scrap castings - castings requiring further fettling operations - castings requiring further inspection by supervision <p>1.11 complete all of the following operations at shut-down, where appropriate:</p> <ul style="list-style-type: none"> - close down any machinery or equipment used during the fettling operations (such as extraction units, power supplies, air supplies, filtering equipment) - check that all systems are failsafe - complete the operational log <p>1.12 report completion of preparations in line with organisational procedures</p> <p>1.13 deal promptly and effectively with problems within their control and report those that cannot be solved</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to fettle metallic castings</p>	<p>2.1 explain the health and safety requirements of the work area in which they are working, and the responsibility they place upon the learner</p> <p>2.2 explain the specific safety precautions to be taken when fettling castings</p> <p>2.3 describe the hazards associated with fettling castings, and explain how they can be minimised</p> <p>2.4 explain what personal protective equipment (PPE) should be used during the fettling operations; how to obtain it and check that it is in a safe and usable condition</p> <p>2.5 explain the manual lifting techniques and EU requirements on acceptable weights to be handled</p> <p>2.6 explain how to obtain the necessary job instructions, and how to interpret their information</p> <p>2.7 explain how to set up and use dust extraction equipment, and the importance of ensuring that the equipment is operating correctly</p> <p>2.8 explain the emergency procedures to be followed in the event of a malfunction of any of the equipment that they use</p> <p>2.9 explain why different methods of fettling castings are used for different moulding materials</p> <p>2.10 explain the various hand and power tools that are used to carry out the fettling activities</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.11 describe the checks to be made on the tools and equipment to ensure that they are in a safe and usable condition</p> <p>2.12 explain the difference between sand moulds and ceramic moulds/shells</p> <p>2.13 describe the effect on casting quality of incorrectly fettling of castings (eg under or over-dressing)</p> <p>2.14 explain the reasons why different types of machine are used to fettle ferrous and non-ferrous castings</p> <p>2.15 explain the reasons why different grades of abrasives are used to clean ferrous and non-ferrous castings</p> <p>2.16 describe the defects which can be directly related to using incorrect methods to remove runners/risers/feeders from castings during fettling (eg undercutting, proud finish)</p> <p>2.17 explain the reasons why runners/risers/feeders need to be identified</p> <p>2.18 explain why it is important to keep the equipment clean and free from damage, to practise good housekeeping of tools and equipment, to maintain a clean working area, and to carry out shut-down procedures</p> <p>2.19 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve</p>			

Learner name: _____
Learner signature: _____
Assessor signature: _____
Internal verifier signature: _____
(if sampled)

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Date: _____

Unit 23: Operating plastic injection moulding machines

Unit reference number: R/502/9456

QCF level: 2

Credit value: 28

Guided learning hours: 130

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to produce components by plastic injection moulding, in accordance with approved procedures. The learner will be expected to confirm with the authorised person, such as their immediate supervisor, that the equipment is ready for the injection moulding operations to be performed, and that all the required materials and consumables are available. They will be expected to check that the mould tools are free from any damage that could impair the quality of the mouldings produced, and that all services required to operate the machine are fully operational.

The learner will be required to operate the injection moulding machine, in line with safe working practices and approved procedures, continuously monitoring the moulding operations and, where necessary, making minor adjustments or seeking help from the authorised person to make the required adjustments, in order to ensure that the work output is to the required quality. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.

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

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying injection moulding procedures. They will understand the plastic injection moulding process and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound background for carrying out the activities, recognising and reporting moulding defects and ensuring that completed components are to the required specification.

The learner will understand the safety precautions required when operating the plastic injection moulding machines and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout. They will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

This unit is assessed in the workplace or in conditions resembling the workplace. Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>1 Operate plastic injection moulding machines</p>	<p>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</p> <p>1.2 carry out all of the following when operating plastic injection moulding machines:</p> <ul style="list-style-type: none"> - use the correct issue of production documentation (such as job instructions, drawings, specifications) - use relevant health and safety documentation (such as material data sheets, COSHH sheets, risk assessments) - confirm with the authorised person that the machine tool is ready for carrying out the moulding operations - where appropriate, seek any necessary instructions or training on the operation of the moulding machine - follow the defined operating procedures, and apply safe working practices and procedures at all times - wear appropriate protective clothing and equipment at all times during the moulding activities 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - ensure that the equipment settings are adjusted (either by themselves or the authorised person) to maintain the correct customer specification - leave the work area in a safe and clean condition <p>1.3 follow the correct component drawing or any other related specifications for the component to be produced</p> <p>1.4 determine what has to be done and how this will be achieved</p> <p>1.5 obtain and prepare the appropriate tools, equipment and materials</p> <p>1.6 produce plastic injection mouldings, using one of the following types of mould tools:</p> <ul style="list-style-type: none"> - two-plate tools - three-plate tools - combination/composite tools - split tools - unscrewing tools <p>1.7 produce plastic injection mouldings from one of the following types of material:</p> <ul style="list-style-type: none"> - acrylonitrile-butadiene-styrene (ABS) - nylon - polycarbonate - polypropylene 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - polystyrene - polyethylene - acetal - other specific material <p>1.8 carry out the moulding or laying-up activities using the correct methods and techniques</p> <p>1.9 carry out all of the following activities before moulding commences:</p> <ul style="list-style-type: none"> - check that the correct mould tool is located in the machine, and is complete, clean and free from damage - ensure that mould surfaces are clean and free from damage - check that secondary mould tool components are clean and free from damage - confirm all moulding settings (such as temperature, pressure, speed/time, distance) - check that component delivery/collection mechanisms are working correctly (such as robots, conveyors, separators and collection chutes) - ensure that all guards, screens and safety mechanisms are in place and in good working order 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<ul style="list-style-type: none"> - check that all services are connected, and that all connections are in good order (such as water, electrical, pneumatic, hydraulic) - check that all machine controls are operational <p>1.10 monitor the moulding operations, and make adjustments to the machine settings to deal with two of the following:</p> <ul style="list-style-type: none"> - flashing - short shot - distortion - burning - colour deviation <p>1.11 produce components to the required specification</p> <p>1.12 produce plastic injection mouldings which comply with one of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> - BS and/or ISO standards - company standards and requirements - customer standards and requirements <p>1.13 check that all the required operations have been completed to specification</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>1.14 complete visual inspection and segregation of mouldings according to company procedures, to include all of the following:</p> <ul style="list-style-type: none"> - mouldings which meet the required specification - mouldings which have defects - mouldings that require further investigation <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.16 complete all relevant documentation, to include one of the following:</p> <ul style="list-style-type: none"> - production documentation - quality control documentation - records of machine settings 			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
<p>2 Know how to operate plastic injection moulding machines</p>	<p>2.1 explain the health and safety requirements of the area in which the plastic injection activity is to take place, and the responsibility these requirements place on the learner</p> <p>2.2 explain what specific health and safety precautions need to be followed during the plastic injection moulding activity, and the potential effects on themselves and others</p> <p>2.3 describe the hazards associated with carrying out plastic injection moulding activities, and explain how they can be minimised</p> <p>2.4 explain the safety mechanisms on the machine, and the procedures for checking that they function correctly</p> <p>2.5 explain what personal protective equipment and clothing must be worn during the plastic injection moulding activity</p> <p>2.6 explain the importance of keeping the work area clean and tidy</p> <p>2.7 explain how to obtain and interpret the production documentation required during the plastic injection moulding activity</p> <p>2.8 explain how raw materials are loaded or fed to the injection moulding machine</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.9 describe the basic principles of the operation of plastic injection moulding machines</p> <p>2.10 explain how to ensure that there are sufficient raw materials available to carryout the moulding operation</p> <p>2.11 explain what checks need to be made on the machine and mould tooling, before moulding commences</p> <p>2.12 explain the importance of monitoring the equipment settings during the plastic injection moulding process</p> <p>2.13 describe the types of adjustment that can be made to equipment settings to maintain component quality</p> <p>2.14 explain how to identify plastic injection moulding faults (including flashing, short shot, distortion, burning and colour deviation)</p> <p>2.15 explain the basic quality checks to be carried out on plastic injection moulded components</p> <p>2.16 explain the importance of keeping moulding surfaces clean</p> <p>2.17 explain the importance of completing the production documentation throughout the injection moulding process</p>			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	<p>2.18 describe the problems that can occur during the plastic injection moulding activities, and explain how they can be minimised</p> <p>2.19 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve</p>			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

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

Further information

Our customer service numbers are:

BTEC and NVQ	0844 576 0026
GCSE	0844 576 0027
GCE	0844 576 0025
The Diploma	0844 576 0028
DiDA and other qualifications	0844 576 0031

Calls may be recorded for training purposes.

Useful publications

Related information and publications include:

- *Centre Handbook for Edexcel QCF NVQs and Competence-based Qualifications* published annually
- functional skills publications – specifications, tutor support materials and question papers
- *Regulatory Arrangements for the Qualification and Credit Framework* (published by Ofqual, August 2008)
- the current Edexcel publications catalogue and update catalogue.

Edexcel publications concerning the Quality Assurance System and the internal and standards verification of vocationally related programmes can be found on the Edexcel website.

NB: Some of our publications are priced. There is also a charge for postage and packing. Please check the cost when you order.

How to obtain National Occupational Standards

To obtain the National Occupational Standards go to www.ukstandards.org.uk.

Professional development and training

Edexcel supports UK and international customers with training related to NVQ and BTEC qualifications. This support is available through a choice of training options offered in our published training directory or through customised training at your centre.

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

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

The national programme of training we offer can be viewed on our website (www.edexcel.com/training). You can request customised training through the website or by contacting one of our advisers in the Training from Edexcel team via Customer Services to discuss your training needs.

The training we provide:

- is active
- is designed to be supportive and thought provoking
- builds on best practice
- may be suitable for those seeking evidence for their continuing professional development.

Annexe A: Progression pathways

The Edexcel qualification framework for the engineering sector

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/professional	NVQ/competence
8					
7					
6					We have too many qualifications to list in this space. Please go to www.edexcel.com for further information.

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/professional	NVQ/competence
5			<p>Edexcel BTEC Level 5 HND Diploma in Manufacturing Engineering</p> <p>Edexcel BTEC Level 5 HND Diploma in Mechanical Engineering</p> <p>Edexcel BTEC Level 5 HND Diploma in Operations Engineering</p> <p>Edexcel BTEC Level 5 HND Diploma in Electrical/Electronic Engineering</p> <p>Edexcel BTEC Level 5 HND Diploma in General Engineering</p> <p>Edexcel BTEC Level 5 HND Diploma in Automotive Engineering</p> <p>Edexcel BTEC Level 5 HND Diploma in Aeronautical Engineering</p>		<p>We have too many qualifications to list in this space. Please go to www.edexcel.com for further information.</p>

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/professional	NVQ/competence
4			<p>Edexcel BTEC Level 4 HNC Diploma in Manufacturing Engineering</p> <p>Edexcel BTEC Level 4 HNC Diploma in Mechanical Engineering</p> <p>Edexcel BTEC Level 4 HNC Diploma in Operations Engineering</p> <p>Edexcel BTEC Level 4 HNC Diploma in Electrical/Electronic Engineering</p> <p>Edexcel BTEC Level 4 HNC Diploma in General Engineering</p> <p>Edexcel BTEC Level 4 HNC Diploma in Automotive Engineering</p> <p>Edexcel BTEC Level 4 HNC Diploma in Aeronautical Engineering</p>		<p>We have too many qualifications to list in this space. Please go to www.edexcel.com for further information.</p>

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/professional	NVQ/competence
3		Edexcel Level 3 Diploma in Engineering	<p>Edexcel BTEC Level 3 Certificate, Subsidiary Diploma, Diploma and Extended Diploma in Engineering</p> <p>Edexcel BTEC Level 3 Diploma and Extended Diploma in Mechanical Engineering</p> <p>Edexcel BTEC Level 3 Diploma and Extended Diploma in Manufacturing Engineering</p> <p>Edexcel BTEC Level 3 Diploma and Extended Diploma in Operations and Maintenance Engineering</p> <p>Edexcel BTEC Level 3 Diploma and Extended Diploma in Electrical/Electronic Engineering</p> <p>Edexcel BTEC Level 3 Diploma and Extended Diploma in Aeronautical Engineering</p>		We have too many qualifications to list in this space. Please refer to www.edexcel.com for further information.

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/ professional	NVQ/ competence
2	GCSE Engineering GCSE Manufacturing	Edexcel Level 2 Diploma in Engineering	Edexcel BTEC Level 2 Certificate, Extended Certificate and Diploma in Engineering		We have too many qualifications to list in this space. Please refer to www.edexcel.com for further information.
1		Edexcel Level 1 Diploma in Engineering	Edexcel BTEC Level 1 Award, Certificate and Diploma in Engineering		We have too many qualifications to list in this space. Please refer to www.edexcel.com for further information.
Entry					

Annexe B: Quality assurance

Key principles of quality assurance

- A centre delivering Edexcel qualifications must be an Edexcel recognised centre and must have approval for qualifications that it is offering.
- The centre agrees, as part of gaining recognition, to abide by specific terms and conditions relating to the effective delivery and quality assurance of assessment. The centre must abide by these conditions throughout the period of delivery.
- Edexcel makes available to approved centres a range of materials and opportunities to exemplify the processes required for effective assessment and provide examples of effective standards. Approved centres must use the guidance on assessment to ensure that staff who are delivering Edexcel qualifications are applying consistent standards.
- An approved centre must follow agreed protocols for: standardisation of assessors; planning, monitoring and recording of assessment processes; internal verification and recording of internal verification processes and dealing with special circumstances, appeals and malpractice.

Quality assurance processes

The approach to quality assured assessment is made through a partnership between a recognised centre and Edexcel. Edexcel is committed to ensuring that it follows best practice and employs appropriate technology to support quality assurance processes where practicable. The specific arrangements for working with centres will vary. Edexcel seeks to ensure that the quality assurance processes it uses do not inflict undue bureaucratic processes on centres, and works to support them in providing robust quality assurance processes.

The learning outcomes and assessment criteria in each unit within this specification set out the standard to be achieved by each learner in order to gain each qualification. Edexcel operates a quality assurance process, designed to ensure that these standards are maintained by all assessors and verifiers.

For the purposes of quality assurance, all individual qualifications and units are considered as a whole. Centres offering these qualifications must be committed to ensuring the quality of the units and qualifications they offer, through effective standardisation of assessors and internal verification of assessor decisions. Centre quality assurance and assessment processes are monitored by Edexcel.

The Edexcel quality assurance processes will involve:

- gaining centre recognition and qualification approval if a centre is not currently approved to offer Edexcel qualifications
- annual visits to centres by Edexcel for quality review and development of overarching processes and quality standards. Quality review and development visits will be conducted by an Edexcel quality development reviewer
- annual visits by occupationally competent and qualified Edexcel Standards Verifiers for sampling of internal verification and assessor decisions for the occupational sector
- the provision of support, advice and guidance towards the achievement of National Occupational Standards.

Centres are required to declare their commitment to ensuring quality and appropriate opportunities for learners that lead to valid and accurate assessment outcomes. In addition, centres will commit to undertaking defined training and online standardisation activities.

Annexe C: Centre certification and registration

Edexcel Standards Verifiers will provide support, advice and guidance to centres to achieve Direct Claims Status (DCS). Edexcel will maintain the integrity of Edexcel QCF NVQs through ensuring that the awarding of these qualifications is secure. Where there are quality issues identified in the delivery of programmes, Edexcel will exercise the right to:

- direct centres to take action
- limit or suspend certification
- suspend registration.

The approach of Edexcel in such circumstances is to work with the centre to overcome the problems identified. If additional training is required, Edexcel will aim to secure the appropriate expertise to provide this.

What are the access arrangements and special considerations for the qualification in this specification?

Centres are required to recruit learners to Edexcel qualifications with integrity.

Appropriate steps should be taken to assess each applicant's potential and a professional judgement should be made about their ability to successfully complete the programme of study and achieve the qualification. This assessment will need to take account of the support available to the learner within the centre during their programme of study and any specific support that might be necessary to allow the learner to access the assessment for the qualification. Centres should consult Edexcel's policy on learners with particular requirements.

Edexcel's policy on access arrangements and special considerations for Edexcel qualifications aims to enhance access to the qualifications for learners with disabilities and other difficulties (as defined by the 1995 Disability Discrimination Act and the amendments to the Act) without compromising the assessment of skills, knowledge, understanding or competence. Please refer to *Access Arrangements and Special Considerations for BTEC and Edexcel NVQ Qualifications* for further details (www.edexcel.com).

Annexe D: Assessment Strategy

The Semta Assessment Strategy will be available on the Edexcel website, alongside the full specification on the Engineering NVQ/Competence-based qualifications (QCF) page.

Annexe E: Additional requirement for qualifications that use the term 'NVQ' in a QCF qualification title

Please go to www.ofqual.gov.uk to access the document '*Operating rules for using the term 'NVQ' in a QCF qualification title*'.

Ofqual
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Llywodraeth Cynulliad Cymru
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For more information on Edexcel and BTEC qualifications please
visit our website: www.edexcel.com

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