

# Unit 23: Understand and Work with Land-based Repair Processes and Materials Technology

<b>Unit code:</b>	<b>Y/601/4256</b>
<b>QCF Level 3:</b>	<b>BTEC National</b>
<b>Credit value:</b>	<b>10</b>
<b>Guided learning hours:</b>	<b>60</b>

## ● Aim and purpose

This unit aims to introduce learners to the skills and understanding required for the successful repair of machinery by thermal and non thermal processes, and how these processes can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

## ● Unit introduction

Modern land-based practices dictate that machinery must be well prepared and have the technical support to keep 'down time' to a minimum during breakdown and unplanned maintenance periods. Those employed in the maintenance, fault diagnosis, operation and repair of harvesting machinery must have the knowledge and skills to undertake a wide range of emergency repairs to machinery. A land-based technician needs the ability to carry out thermal and non-thermal joining of materials used in land-based machinery.

This unit focuses on this area and gives learners the skills and understanding needed to select the most appropriate repair process, carry out the repair and check its quality.

Health, safety and sustainability issues encountered when carrying out these repair processes will be stressed during delivery of this unit.

## ● Learning outcomes

**On completion of this unit a learner should:**

- 1 Know the structure and properties of materials
- 2 Understand mechanical, non-thermal and thermal joining processes
- 3 Be able to prepare materials for mechanical, non-thermal and thermal joining processes
- 4 Be able to use mechanical, non-thermal and thermal joining processes.

# Unit content

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## 1 Know the structure and properties of materials

*Structure and properties of materials:* ferrous; non-ferrous and alloy metals; thermo set and thermosetting plastics; hardness; eg softness; strength (tensile, compressive, shear, torsional); brittleness; toughness; elasticity; yield point; plasticity; malleability; ductility; conductivity (electrical, thermal); expansion; chemical stability (corrosion, oxidation)

*Methods and effects of heat treatment on ferrous metals:* annealing; normalising; hardening; case hardening; tempering

*Identification methods for ferrous, non-ferrous, thermo set and thermosetting plastic materials:* eg filing; sawing; spark test; nick break; 'scrape'; heat

## 2 Understand mechanical, non-thermal and thermal joining processes

*Mechanical:* nuts; bolts; studs; set screws; thread forms 'eg' Unified National Fine, Unified National Course, Metric Fine, Metric Course, British Association; locking devices; eg rivets; keys; pins; circlips; captive fasteners. materials; costs; health and safety; risk assessment; personal protective equipment (PPE)

*Non-thermal:* adhesives; eg fibreglass; crimping; soldering; brazing; methods; uses; equipment; materials; costs; health and safety; risk assessment; PPE

*Thermal:* welding standards; oxy-acetylene; manual metal arc; metal inert gas; safe working practices; PPE

## 3 Be able to prepare materials for mechanical, non-thermal and thermal joining processes

*Health and safety:* health and safety; risk assessment; safe working practices; PPE; effects of fumes, dust, heat, light radiation, swarf, sparks and spatter on worker and third parties; relevant current legislation and codes of practice

*Processes:* thermal cutting (oxy-acetylene, oxy-propane, plasma); non-thermal cutting (sawing, shearing); material removal (abrasives, filing, grinding, drilling, thread cutting); joint preparation (marking out, preparation, positioning of materials to be joined by thermal, non-thermal or mechanical processes); methods; equipment; materials

## 4 Be able to use mechanical, non-thermal and thermal joining processes

*Mechanical, non-thermal and thermal processes:* common types and durability of joint; advantages; disadvantages; availability of resources; mechanical processes eg nuts, bolts, studs, set screws, thread forms, locking devices, rivets, keys, pins, circlips, captive fasteners; non-thermal eg adhesives, fibreglass, crimping, soldering, brazing; thermal eg oxy-acetylene, manual metal arc, metal inert gas; weld test procedures

*Health and safety:* health and safety; risk assessment; safe working practices; PPE; environmental risk assessment; fumes; dusts; heat; light and heat radiation; sparks and spatter; relevant current legislation and codes of practice

## Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
<b>P1</b> describe the structure and properties of metals used in land-based technology [IE, SM, RL, EP]	<b>M1</b> justify the choice of metals and non-metals used in the construction of land-based vehicles and machinery	<b>D1</b> carry out appropriate testing procedures on material joining processes and report findings.
<b>P2</b> describe the structure and properties of non-metal materials used in land-based technology [IE, SM, RL, EP]		
<b>P3</b> explain selected mechanical, non-thermal and thermal joining processes for metals [IE, SM, RL, EP]	<b>M2</b> justify the choice of joining processes for repairs to land-based vehicles and machinery	
<b>P4</b> explain selected mechanical, non-thermal and thermal joining processes for non-metal materials used in land-based technology [IE, SM, RL, EP]		
<b>P5</b> safely prepare selected metal engineering materials for joining	<b>M3</b> assess most risks in given repair processes.	
<b>P6</b> safely prepare selected non-metal engineering materials for joining		
<b>P7</b> safely join metal engineering materials to meet given objectives		
<b>P8</b> safely join non-metal engineering materials to meet given objectives.		

**PLTS:** This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

<b>Key</b>	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

# Essential guidance for tutors

## Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors delivering this unit have opportunities to use as wide a range of teaching and learning techniques, for example lectures, discussions, seminar presentations, site visits and supervised repair practicals. Research using the internet and/or library resources and participation in work experience would enhance the learning experience.

Delivery should stimulate, motivate, educate and enthuse learners. Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time.

Health and safety issues relating to working in the field and in repair workshops must be stressed and reinforced regularly, and risk assessments must be undertaken before practical activities.

Tutors should consider integrating the delivery, private study and assessment of this unit with other relevant units.

Learning outcomes 1 and 2 are directly linked and are likely to be delivered through formal lectures, discussion, supervised repair practicals, site visits, and independent learner research. Learners will be aware of the broad range of repair processes and techniques. Visiting speakers could add to the relevance of the subject.

Learning outcomes 3 and 4 develop the skills needed to carry out repairs. Delivery techniques should be varied and can be linked to delivery of learning outcomes 1 and 2. It is expected that practical activities will form a major part of the delivery of these learning outcomes. Visiting speakers could add to the relevance of the subject for learners. For example, land-based machinery technicians or workshop managers could talk about their work and the techniques they use.

## Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of unit.
<b>Assignment 1: Structures and Properties of Materials</b> (P1, P2, M1)
Practical activities to determine material properties.
Group investigations to determine material structures.
<b>Assignment 2: Repair Processes Report</b> (P3, P4, M2)
Lectures, group activities to determine procedures and techniques for joining processes.
Group investigations to justify the choice of joining processes for given situations.

## Topic and suggested assignments/activities and/assessment

### Assignment 3: Repair Skills Assessment (P5, P6, P7, P8, M3, D1)

Lectures, group activities to determine preparation techniques for repairs.

Practical activities to develop material preparation skills for repairs.

Lectures, group activities to determine techniques for repairs.

Practical activities to develop skills for repairs.

Unit review.

## Assessment

P1 requires learners to describe the structure and properties of selected metals used in land-based technology. Learners are expected to give evidence for ferrous, non-ferrous and alloy metals.

Evidence could take the form of a pictorial presentation with notes, or a written assignment. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

P2 requires learners to describe the structure and properties of selected non-metal materials used in land-based technology. Learners are expected to give evidence for thermo set plastics; and thermosetting plastics

Evidence could take the form of a pictorial presentation with notes, or a written assignment. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

P3 and P4 requires learners to explain selected mechanical, non-thermal and thermal joining processes of metal and non-metal materials. Tutors should identify the joining processes or agree them through discussion with learners. Learners are expected to provide evidence for at least one process in each category. The joining processes may be the same as those used to provide evidence for other grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

P5 and P6 require learners to prepare selected metal and non-metal materials for given mechanical, non-thermal and thermal joining processes to meet given objectives. Learners are expected to give evidence for at least one material from each of the following groups ferrous; non-ferrous and alloy metals, thermo set plastics; and thermosetting plastics. Tutors should ensure that learners use various preparation methods, for example cutting and metal removal for joint preparation.

P7 and P8 require learners to use mechanical, non-thermal and thermal joining processes for metal and non-metal repair to meet given objectives. Tutors should identify the joining processes or agree them through discussion with learners. The joining processes may be the same as those used to provide evidence for other grading criteria. Learners are expected to give evidence for at least one process in each category.

Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

M1 requires learners to be able to justify why particular metal and non-metal materials are used in specific land-based machine applications.

M2 requires learners to select the most appropriate repair process for given repairs. Tutors should identify metal and non-metal repairs or agree them through discussion with learners.

Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

M3 requires learners to develop risk assessments for the practical activities in P5,P6, P7 and P8. These should be developed using guidance from the HSE. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

DI requires learners to independently carry out tests on metal and non-metal repairs and report on their findings. The report should determine the repair's fitness for purpose and recommendations if it is not.

### Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1,P2 M1	Structures and Properties of Materials	A report describing the structures and properties of materials and how these influence the choice of repair methods.	Written Report. Verbal presentation.
P3,P4 M2	Repair Processes Report	A report determining the procedures followed and techniques used to carry out our given repairs.	Written Report. Verbal presentation.
P5,P6,P7,P8 M3 DI	Repair Skills Assessment	Carry out selected repairs, displaying preparation and joining skills, repair evaluation skills and appropriate health and safety consideration.	Individual practical skills assessment including verbal questioning.

### Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Land-based Engineering Operations – Material Preparation, Shaping and Assembling	Undertake and Review Work Related Experience in the Land-based Industries
LEO4 Core Land-based Engineering Principles – Mechanical Principles	
LEO5 Core Land-based Engineering Principles – Tools and Equipment	
LEO6 Core land-based engineering principles – Material Preparation, Shaping and Assembling	
LEO8 Core Land-based Engineering Principles – Servicing and Maintenance	

### Essential resources

Learners will need access to a range of repair process tools and equipment to carry out repairs or simulated repairs. Equipment to support practical investigation and sufficient test and repair equipment and materials to enable accurate evaluation of materials and repairs will also need to be available.

Manufacturers' service manuals and test data will make a significant contribution to learners achievement.

Tutors delivering this unit should be familiar with current repair processes and techniques.

## Employer engagement and vocational contexts

This unit focuses on the development of skills and understanding service engineers need to maintain machinery and will give learners the background to carry out these activities safely and with consideration for the environment. Centres are encouraged to create and further develop links with practising land-based service engineers and managers to help learners develop their confidence when applying new skills and knowledge. This could be via site visits, works experience, guest speakers, seminars and coaching sessions.

### Indicative reading for learners

#### Textbooks

Gibson S and Smith A – *Basic Welding* (Thomson Learning, 1993) ISBN 0333578538

Gourd L – *Principles of Welding Technology, 3rd Edition* (Butterworth-Heinemann, 1995) ISBN 0340613998

Griffin I, Roden E and Briggs C – *Basic Oxyacetylene Welding, 4th Edition* (Delmar, 1984) ISBN 0827321376

Griffin I, Roden E and Briggs C – *Basic Arc Welding, 4th Edition* (Delmar, 1984) ISBN 0827321317

Health and Safety Executive – *Health and Safety in Arc Welding* (HSE Books, 2000) ISBN 0717618137

Kenyon W – *Basic Welding and Fabrication, 2nd Edition* (Longman, 1987) ISBN 0582005361

Pritchard D – *Soldering, Brazing & Welding: A Manual of Techniques* (The Crowood Press, 2001) ISBN 1861263910

#### Websites

[www.baba.org.uk](http://www.baba.org.uk)

British Artist Blacksmiths Association

[www.bagma.com](http://www.bagma.com)

British Agricultural and Garden Machinery Association

[www.defra.gov.uk](http://www.defra.gov.uk)

Department for Environment, Food and Rural Affairs

[www.gowelding.com](http://www.gowelding.com)

Go Welding

[www.howstuffworks.com](http://www.howstuffworks.com)

HowStuffWorks

[www.hse.gov.uk](http://www.hse.gov.uk)

Health and Safety Executive

[www.iagre.org](http://www.iagre.org)

Institution of Agricultural Engineers

[www.lantra.co.uk](http://www.lantra.co.uk)

Lantra Sector Skills Council

[www.roymech.co.uk](http://www.roymech.co.uk)

Welding Processes

[www.twi.co.uk](http://www.twi.co.uk)

The Welding Institute

## Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
<b>Independent enquirers</b>	researching metals used in land-based technology
<b>Reflective learners</b>	considering materials used in land-based technology
<b>Self-managers</b>	researching metals used in land-based technology
<b>Effective participators</b>	considering materials used in land-based technology.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
<b>Independent enquirers</b>	justifying and selecting appropriate repair processes for given repairs
<b>Creative thinkers</b>	justifying and selecting appropriate repair processes for given repairs
<b>Reflective learners</b>	discussing achievement, performance and further development with tutors
<b>Team workers</b>	developing their practical repair skills
<b>Self-managers</b>	completing assessment activities
<b>Effective participators</b>	giving feedback on the skills and knowledge they have gained during the unit and making suggestions for further improvement of the unit's delivery and assessment.

## ● Functional Skills – Level 2

Skill	When learners are ...
<b>ICT – Use ICT systems</b>	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	presenting reports, risk assessments and repair testing data
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	
<b>Mathematics</b>	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	selecting welding preparation profiling angles, using data to represent material structure and properties
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
<b>English</b>	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	discussing the quality of repairs discussing own performance and areas for further development.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	