

# Unit 41: Service and Repair of Land-based Air Conditioning, Climate Control and Refrigeration Plant and Equipment

**Unit code:** F/601/5305  
**QCF Level 3:** BTEC National  
**Credit value:** 3  
**Guided learning hours:** 20

## ● Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required in the service and repair land based air conditioning, climate control and refrigeration plant and equipment.

## ● Unit introduction

Increasing numbers of modern mobile land based machinery, have air conditioning systems fitted as standard, from simple refrigeration to complex climate control systems. Along with increased use of land based static refrigeration units the demand for engineers who can diagnose, repair and maintain climate control and refrigeration equipment has grown.

Learners will develop skills in the service, repair and maintenance of refrigeration units using correct equipment and consumables, along with their understanding of relevant handling requirements. They will investigate diagnosis and rectification of faults, the documentation used and appropriate disposal of waste.

## ● Learning outcomes

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

- 1 Be able to perform air conditioning, climate control and refrigeration service and maintenance operations
- 2 Understand the construction function and operation of air conditioning, climate control and refrigeration systems and their components.

## Unit content

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### 1 Be able to perform air conditioning, climate control and refrigeration service and maintenance operations

*Systems and components:* safe removal, dismantling, inspection, repair and reinstatement of systems and components to legislative and manufacturer's specifications and standards; identification and location of system types and their components as appropriate

*Testing and checks:* selection and use of tools and equipment; testing and maintenance activities eg leak testing, pressure testing, vacuum testing, gas recovery, system flushing, recharging, performance testing; operational checks and tests to establish system functionality

*Fault diagnosis and rectification:* faults eg compressor and/or drive failure, refrigerant loss, restricted refrigerant flow, restricted air flow, faulty switch and/or sensors, faulty temperature controls, under/over charge of refrigerant/lubricant, system contamination/corrosion; appropriate recording of faults; legal and appropriate collection, transfer and disposal of waste

### 2 Understand the construction function and operation of air conditioning, climate control and refrigeration systems and their components

*Air conditioning, climate control and refrigeration systems:* types; construction; function; operating principles; components eg compressors and their drives, couplings, pipes and hoses, condenser, evaporator, receiver drier, thermostats, control and thermal expansion valves (TXV), fixed orifice tube (FOT)

*Testing and checks:* diagnostic tests to establish system functionality eg compressor drive, switches and controls, cooling rate/effectiveness, condensation and or icing, insulation, air flow, filter inspection; test results evaluation; appropriate diagnostic conclusions

*Fault recognition and rectification:* eg compressor and or/drive failure, refrigerant loss, restricted refrigerant/air flow, faulty switch and/or sensors, temperature controls, under/over charge of refrigerant or lubricant, system contamination/corrosion; appropriate collection, transfer and disposal of waste

## 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> remove, dismantle, inspect, repair and reinstate systems and components	<b>M1</b> compare manual and automated equipment available to carry out testing and maintenance of air conditioning systems and refrigeration plant	<b>D1</b> discuss the ramifications in terms of cost and performance of poorly maintained air conditioning and refrigeration systems.
<b>P2</b> select and use the appropriate tools and equipment to carry out testing and maintenance activities		
<b>P3</b> diagnose and rectify different faults [TW, SM, EP]		
<b>P4</b> collect, transfer and dispose of any waste material following current legal and environmental requirements [SM]		
<b>P5</b> maintain appropriate records		
<b>P6</b> describe the types, construction, function and operating principles of air conditioning, climate control and refrigeration systems and their components	<b>M2</b> assess service and repair risks in detail.	
<b>P7</b> explain how to carry out operational checks and diagnostic tests to establish system functionality [IE]		
<b>P8</b> describe how to recognise and rectify faults		
<b>P9</b> describe how to collect, transfer, dispose of any waste material following current legal and environmental requirements		

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:
<p><b>P10</b> summarise the procedures, tools and equipment to remove dismantle, inspect and reinstate air conditioning and refrigeration components</p>		
<p><b>P11</b> explain what relevant documentation should be used when handling refrigerants. [RL]</p>		

**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 CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators
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# Essential guidance for tutors

## Delivery

This unit is likely to be delivered in combination with *Unit 40: Refrigerant Handling*.

Delivery of this unit will involve practical and written assessments, visits to suitable collections and possible links to work related experience placements.

Whichever delivery methods are used, it is essential that tutors stress the importance of sound environment management and the need to manage equipment using legal methods.

Health and safety issues relating to workshop situations must be stressed and regularly reinforced, and risk assessments must be undertaken prior to practical activities. Adequate PPE must be provided and used following the production of suitable risk assessments, particularly in relation to the presence of pressurised gasses in refrigeration units. The equipment used for assignments can be mobile or static, depending on the learners' requirements.

Learning outcome 1 will be based around workshop and site visits looking at the inspection and diagnosis of faults, the repair of these and recording.

Learning outcome 2 looks at the theory of refrigeration, including the construction, function and operation of refrigeration equipment, waste disposal and relevant documentation.

## 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
<b>Assignment 1: Practical Diagnosis and Repair of Refrigeration Systems</b> (P1, P2, P3, P4, P5, P7, P8, P9, M2)
Health and safety requirements including PPE needed, and risk assessments.
Practical removal, dismantling, inspection, repair and reinstatement of components.
Diagnoses of faults (practical).
<b>Assignment 2: Working with Air Conditioning, Climate Control and Refrigeration Systems</b> (P6, P10, P11, M1, D1)
Refrigeration theory.
Explanation of refrigeration systems, operating principals and equipment used in the servicing/repair as well as required recording of procedures.
Discussion on need for good maintenance.

## Assessment

For P1, P2, P3, P4 and P5 learners need to diagnose faults within refrigeration systems, follow the correct removal and storage of gasses, remove, dismantle, inspection and reinstate these systems. Appropriate risk assessment must be undertaken prior to any practical activities. Evidence for these assessment criteria could be in the form of recorded practical observations during workshop sessions, along with the use of correct recording of work carried out.

For P6, P7, P8, P9, P10 and P11 learners need to provide information on the theory, components, legalities, and documentation required to service and repair refrigeration units. Evidence for these could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or written assignment.

For M1, learners must compare differing equipment available to service refrigeration equipment (from manual gauges to fully automated equipment). This must be in the context of cost, performance and ease of use, along with any other relevant considerations.

M2 requires learners to carry out risk assessments for selected maintenance, service or adjustment activities on refrigeration equipment. Learners are expected to provide detailed evidence covering stages of the service procedure.

For D1 learner must discuss consequences of poor maintenance and servicing of refrigeration systems. Evidence for these assessments could be written, it could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or written assignment.

### 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, P3, P4, P5, P7, P8, P9, M2	Practical Diagnosis and Repair of Refrigeration Systems	You work as a land-based vehicle engineer with specialised air conditioning and refrigeration skills. One of your key roles is to service and repair air conditioning plant and equipment. You have been asked to produce an overview of the key safe removal, inspection, diagnosis and repair tasks you carry out, records kept and appropriate waste disposal methods.	Practical. Report.
P6, P10, P11, M1, D1	Working with Air Conditioning, Climate Control and Refrigeration Systems	You have been asked to develop a new refrigerant user guide, you need to provide information on the types, construction, function and efficient maintenance and use of air conditioning, climate control and refrigeration systems and the procedures, documentation, tools and equipment used.	Report/pictorial presentation.

## 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
Service and Repair Electrical Systems on Land-based Equipment	Refrigerant Handling
	LEO 28 Service and Repair Land-based Air-conditioning/refrigeration Equipment

### Essential resources

Equipment available to learners must include diagnostic gauges, Vacuum Pump, refrigerant, storage container, lubricant, PPE, thermometer and multimeter.

### Indicative reading for learners

#### Textbooks

Bell B – *Farm Machinery* (Old Pond Publishing, 2005) ISBN 1 903366682

Culpin C – *Farm Machinery, 12th Edition* (Blackwell Scientific, 1992) ISBN 063203159X

Hawker M and Keenlyside J – *Horticultural Machinery, 3rd Edition* (Longman Higher Education, 1985) ISBN 0582408075

#### Journals

*Farmers' weekly*

*Profi*

#### Other Publications

Mobile air conditioning training manual – Autoclimate Limited

#### Websites

[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.environment-agency.gov.uk](http://www.environment-agency.gov.uk)

Environment Agency

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

Profi

## 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>	exploring operational checks and diagnostic tests to establish system functionality
<b>Reflective learners</b>	considering relevant documentation should be used when handling refrigerants
<b>Team workers</b>	working with others to diagnose and rectify faults
<b>Self-managers</b>	organising own time and resources when disposing of waste material
<b>Effective participators</b>	identifying improvements to systems that would benefit others as well as themselves.

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>Creative thinkers</b>	developing risk assessments for new refrigerant and/or air conditioning scenarios.

## ● 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	
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	using computer-based manufacturer's data and handbooks
Follow and understand the need for safety and security practices	
Troubleshoot	
<b>ICT – Develop, present and communicate information</b>	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> <li>• text and tables</li> <li>• images</li> <li>• numbers</li> <li>• records</li> </ul>	recording system test results
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	giving presentation to peers on the handling of refrigerant and air conditioning systems and components
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	
<b>English</b>	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	explaining the use and function of refrigerant systems and their components
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	using manufacturer's data sheets, manuals and specifications
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing an evaluation of the use of air conditioning systems.