

# Unit 154: Welding Technologies

Unit code: F/615/3345

QCF level: 4

Credit value: 15

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## Aim

This unit has been designed to develop the learner's awareness of the principles and applications of a broad range of welding technology.

## Unit abstract

Many of the things we take for granted, such as motor vehicles, buildings and bridges, rely on welded joints to hold them together. Weld performance is not only dependent upon the skill of the welder and the selection of the most appropriate process, but also on an understanding of how materials and their properties are affected by weld construction.

This unit introduces learners to the range of manual and automated welding processes, equipment and applications that support the manufacture of many of the products we see within our homes, places of work and the communities we live in.

The learner will be able to demonstrate an understanding of the principles of the metallurgy of weld materials and their behaviour during and post welding operations. They will understand the structure of a weld and the metallurgical effects and stresses induced on a range of materials as a result of the weld process. They will also understand the influence of how weld design can support structures under different types of loading.

## Learning outcomes

### On successful completion of this unit a learner will:

- 1 Understand the fundamental principles of welding processes and equipment
- 2 Understand the principles of the metallurgy of materials and their behaviour during welding
- 3 Understand how weld construction and design can influence the behaviour of welded structures under different types of loading
- 4 Understand how weld stresses can affect a weld construction, their causes, avoidance and control measures.

## Unit content

### 1 **Understand the fundamental principles of welding processes and equipment**

Fundamentals of an electric arc: characteristics, limitations and applications; power sources for arc welding.

Fundamentals, including equipment, applications and procedures for welding processes: tungsten-inert gas welding; MIG/MAG and flux cored welding; manual metal arc welding; submerged-arc welding; resistance welding.

Oxy-gas welding and related processes: fundamentals of oxy-gas combustion; characteristics of the different fuel gases.

Other welding processes: plasma, electron beam, laser, electro-slag, friction, magnetic pulse welding, ultrasonic, high frequency, stud and others.

Cutting and other edge preparation processes.

Fully mechanised processes and robotics.

### 2 **Understand the principles of the metallurgy of materials and their behaviour during welding**

Testing materials and the weld joint: structure of the welded joint; formation on the different metallurgical structures within a weld.

Metallurgical effects induced by welding: carbon and carbon-manganese steels; high-alloyed (stainless) steels; cast irons and cast steels; nickel and nickel alloys; aluminium and aluminium alloys.

Fracture mechanisms in welded joints: causes and avoidance measures.

Principles of joining dissimilar materials.

### 3 **Understand how weld construction and design can influence the behaviour of welded structures under different types of loading**

Influences affecting welded joint design: material; wall thickness; accessibility; loading; welding process; welding position.

Relationship between external loads on structures, internal forces and the stresses induced by welds.

Behaviour of welded structures under dynamic and static loading: design of welded pressure equipment; design of aluminium alloys structures.

4 **Understand how weld stresses can affect a weld construction, their causes, avoidance and control measures**

Contraction and distortion due to weld-induced stress in joints and structures: procedures to minimise distortion and stress; effect on the behaviour of a structure in service.

Plant facilities, welding jigs and fixtures: workshop layout for improved productivity, safety and comfort; advantages of using fixtures, jigs and positioners; auxiliary equipment, fume extraction, heat treatment and temperature control equipment; facilities for handling and storing welding consumables.

Health and safety hazards associated with welding and fabrication processes: risk factors associated with welding from electricity, gases, fumes, fire, radiation and noise; health and safety regulations; safe working procedures to ensure the requirements are met.

## Learning outcomes and assessment criteria

<b>Learning outcomes</b> On successful completion of this unit a learner will:	<b>Assessment criteria for pass</b> The learner can:
LO1 Understand the fundamental principles of welding processes and equipment	1.1 describe the fundamental characteristics of the electric arc 1.2 describe how the selection of current (AC/DC) and polarity can affect the structure of the weld 1.3 explain how the choice of shielding gas can affect the properties of a weld 1.4 critically analyse the most appropriate welding process for a given application and material type
LO2 Understand the principles of the metallurgy of materials and their behaviour during welding	2.1 describe the areas of the Heat Affected Zone (HAZ), and their influence on the material properties of the weld 2.2 describe the process of specimen preparation for micro and macro examination 2.3 explain how multi-pass welds can significantly reduce stress in the weld microstructure 2.4 explain the fundamentals of cracking mechanisms in welded joints and the way in which welding variables affect the incidence of cracking
LO3 Understand how weld construction and design can influence the behaviour of welded structures under different types of loading	3.1 identify different types of welded joints and their applications 3.2 identify appropriate weld symbols for a range of edge preparation and welding joints 3.3 explain the effect that high pressure and temperature can have on a weld construction over time 3.4 explain the importance of welding joint design and how it can be influenced by material type, material thickness, accessibility, loading, welding process and welding position

<b>Learning outcomes</b> On successful completion of this unit a learner will:	<b>Assessment criteria for pass</b> The learner can:
LO4 Understand how weld stresses can affect a weld construction, their causes, avoidance and control measures	4.1 describe how welding sequence and techniques can help to reduce residual stresses or distortion 4.2 describe the advantages of using fixtures, jigs and positioners 4.3 explain how residual stresses may affect the behaviour of a structure in service 4.4 interpret relevant health and safety regulations with respect to the hazards associated with welding construction

## **Recommended Resources**

### **Welding Institute**

The Welding Institute is the leading international membership body for welding and joining professionals.

<http://www.theweldinginstitute.com/>

### **International Institute of Welding**

Operates as the global body for the science and application of joining technology, providing a forum for networking and knowledge exchange among scientists, researchers and industry.

<http://www.iiwelding.org/Pages/Default.aspx>

### **Textbooks**

Timings, R. (2008) Fabrication and Welding Engineering. Routledge.  
ISBN 9780750666916