Unit 100: Fabrication and Welding Processes in Manufacturing

Unit code: J/503/0748

QCF Level: 4

Credit value: 15

Aim

The aim of this unit is to provide learners with a broad and in-depth understanding of a range of fabrication and welding manufacturing processes and techniques that can be applied to materials used for manufacturing applications.

Unit abstract

This unit enables learners to develop previous knowledge obtained in the workplace or college. Throughout the unit a high priority has been placed on allowing learners to develop appropriate technical and practical skills, thus preparing them to meet the changing requirement of modern industry. This will also ensure that they have a foundation of theory and practice upon which they can build new knowledge, understanding and skills. Learners are further able to learn and understand the core principles and technologies that underpin Fabrication and Welding. Learning these will be essential in providing learners with a platform for tackling many tasks and allowing them to develop a more in-depth knowledge of the industry.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand appropriate structural connections for different applications of attachment systems in the fabrication industry

2 Understand operational methods for achieving required product shapes in the fabrication industry

3 Understand thermal joining processes for production environments in the fabrication industry

4 Be able to design fixtures for thermal joining processes in production environments

Unit content

1 Understand appropriate structural connections for different applications of attachment systems in the fabrication industry

Terminology for Structural Connections: edge distance; pitch; crack marks; standard operating procedure (SOP); design of bolted joints; gusset plates; types of force; calculation of bolt diameters; marking out; bolting procedures; fastening sequences

Welded Joints: joint types; factors affecting weld strength; composition of weld ; dilution of weld; consumable classification; allowable stress; fillet and butt welds; calculation of weld joint strength

Jointing Methods for Sheet, Plate and Structural Sections: self secured joints; sheet material captive fasteners; riveted assemblies; chemical fixings; adhesives; calculation of strength; press joining; flow drilling; self pierce rivets; pipework and flanges

2 Understand operational methods for achieving required product shapes in the fabrication industry

Mechanical and Thermal Profiling Methods: shearing; blanking; piercing; calculation of shearing forces; punching; notching; types of equipment; computer numerical control (CNC); chip forming processes; edge preparation; oxy fuel gas; water jet; plasma; laser profiling; photo fabrication and etching; electron beam; ferrous; non ferrous; plastics and composites; comparison for material, quality, economy, cost, efficiency; arc air gouging; oxy-arc cutting

High Energy Forming (HERF) Processes: principles; techniques and applications of electro-magnetic forming; electro-hydraulic forming; high and low explosive forming; comparison of HERF processes

Traditional Sheet Metal Forming Processes: effects of forming on properties; material thickness; directional properties; planar and anisotropic properties; spinning; flow turning; stretch forming; press brakes; types; tooling; coining; air bends; swan neck soft pads; bead forming; tool sets; sequential tooling; calculations (vee die opening, bend radius, blank length, punch force, forming sequence); press die forming; calculation of blank size clearances; lubricants and fault diagnosis of press work defects; rolling equipment; pyramid; pinch; vertical section and levelling; theory of bending; equipment, box and pan folder; hydro-forming; leaf brakes and section bending equipment and principles of operation.

Calculations: blank size; punch force; material utilisation

3 Understand thermal joining processes for production environments in the fabrication industry

Structural Integrity of Welded Joints: operator skill requirements; welder approval qualification; weld procedure approval; heat impact; arc energy; cooling rate; need for pre and post heat; consumable and material type; in-service application; defects; NDE; cause and rectification

Specialised Welding Technology: power sources; transformer; rectifier; welding inverters and hybrid equipment for MIG; pulsed; traditional and specialist consumables; weld and braze; TIG; hot and cold wire feeds; orbital; surfacing; submerged arc welding; thick wall; pressure vessels and cladding; multiple wire set up; electro-slag; plasma welding; laser and electron beam; solid phase processes; resistance spot; seam and projection; stud welding; drawn arc and capacitor discharge; flash butt welding; friction processes; stir welding; surfacing diffusion bonding; cold pressure welding; comparison of processes; consideration of a variety of materials

Productivity, Mechanisation and Automation: use of jigs; fixtures; rotators and positioners; applications of use; restraint, location; safety devices; ejection of workpiece; visibility; access; synchronous operation with robotics/automation

Robotics: types; application; programming; teach trace systems; self diagnostic; ancillary equipment.

4 Be able to design fixtures for thermal joining processes in production environments

Designing a simple fixture: applications of use; design principles; relationship between cost and quantity; rigidity and durability

Learning outcomes and assessment criteria

Learning outcomes **On successful completion of this unit a learner will:**	Assessment criteria for pass **The learner can:**
1. Understand appropriate structural connections for different applications of attachment systems in the fabrication industry	1.1 explain relevant terminology for producing designed structural connections 1.2 calculate weld joint strength relevant to attachment systems 1.3 justify selection of non-thermal jointing methods for given applications
2. Understand operational methods for achieving required product shapes in the fabrication industry	2.1 justify selection of profiling method for product shape 2.2 describe High Energy Forming Processes for a given application 2.3 justify forming process required to achieve required product shape 2.4 explain principles of operation necessary to form required product shape 2.5 explain how to calculate blank size, punch force and material utilisation for a given product shape
3. Understand thermal joining processes for production environments in the fabrication industry	3.1 determine relevant requirements for assuring the structural integrity of welded joints 3.2 justify the use of welding process(es) for a production environment 3.3 evaluate the advantages of using robots for thermal joining processes over other production methods in the production environment
4. Be able to design fixtures for thermal joining processes in production environments	4.1 design a simple fixture for a given application, with consideration of appropriate production methods for the production environment

Guidance

Links

Entry requirements for this unit are at the discretion of the centre. However, it is strongly advised that students should have completed appropriate pre-requisite BTEC National or equivalent, units. Students who have not attained this standard will require bridging studies.

Essential requirements

There are no essential requirements for this unit.

Delivery

The unit may be delivered as a stand-alone package or integrated into other appropriate programmes. If it is delivered in an integrated way, care must be taken to provide tracking evidence for the outcomes and centres should be aware that study and assessment at an individual outcome level could lead to assessment overload. Wherever possible, a practical approach should be adopted. Learning and assessment can be across units, at unit level or at individual outcome level. Effort should be made to identify the relevance of the principles covered.

Text Books

A C Davies, The Science & Practice of Welding (Volumes 1 & 2) ISBN 9780521369541 / ISBN 9780521435666 Cambridge University Press, 1989 and 1993

Lincoln Electric Company, The Procedure Handbook of Arc Welding (1994) ISBN 9789994925827

Serope Kalpakjian / Manufacturing Engineering & Technology (2009) Steven R Schid, ISBN 9789810681449 Pearson Ed Asia

John A Schey, Introduction to Manufacturing Processes (1999) ISBN 9780070311367 McGraw – Hill Higher Education

J Beddoes / M J Bibby, Principles of Metal Manufacturing Processes (1999) ISBN 9780470352410 J Wiley and Sons Inc