

Unit 10: Manufacturing Process

Unit code: H/601/1487

QCF level: 4

Credit value: 15

- **Aim**

This unit will develop learners' knowledge of manufacturing processes and techniques that can be applied to a range of materials for a variety of manufacturing applications.

- **Unit abstract**

It is essential that engineering technicians involved in the planning, operation and management of manufacturing systems should have a broad underpinning knowledge of conventional production processes. Computer-aided processes are now the norm in medium- to large-scale manufacturing companies and are also to be found with small-scale specialist producers. The full potential of computer-aided systems cannot however be fully appreciated without knowledge of the conventional processes from which they are derived.

This unit provides learners with this knowledge of manufacturing processes and techniques. The first outcome gives an appreciation of conventional machining techniques together with associated tooling and work holding methods. The second outcome gives an appreciation of the basic moulding and shaping processes used with metals, plastics and ceramics. The final outcome covers non-conventional machining techniques that include electro-discharge machining, ultrasonic machining, etching of electronic printed circuit boards, laser-beam machining and plasma-jet machining.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand the use of conventional machining processes and techniques for generating geometrical forms for a given component specification
- 2 Understand the use of moulding and shaping processes for a given component specification
- 3 Understand the use of less conventional machining techniques for a given component specification.

Unit content

1 Understand the use of conventional machining processes and techniques for generating geometrical forms for a given component specification

Component manufacture: specify components for manufacture eg criteria-tolerances, types of material, machining technique, surface texture, material removal rates, speeds and feeds, cutting times, cutter offsets, table angles

Machining techniques: production of flat and cylindrical geometry eg milling, surface grinding, lapping, planing, turning, cylindrical grinding, centreless grinding, honing, super-finishing, thread milling techniques, jig boring, horizontal boring, vertical boring, transfer machines

Tooling requirements: multi-tooth cutting eg milling, grinding, hobbing, drilling, reaming, and broaching; single-point cutting eg turning, planing and slotting; appropriate cutting angles for given materials; types, advantages and disadvantages of coolants and cutting fluids used for various materials and processes eg advantages – prolonging tool life, increased material removal rate, improved surface finish; disadvantages – fumes and possible irritations to operators

Work-holding techniques: selection of appropriate work-holding devices eg three and four jaw chucks, vices, jigs, fixtures, clamping arrangements, vee blocks, angle plates and magnetic chucks; health and safety issues and limitations of devices

2 Understand the use of moulding and shaping processes for a given component specification

Component manufacture: specify components for moulding and shaping eg criteria-tolerances, type of moulding/shaping technique to be used, limitations of size, shape and production volume, properties of materials being moulded/shaped, surface texture, cost factors, post-moulding operations required (machining, clipping, welding, finishing)

Moulding processes: casting eg sand, die, investment and continuous casting; powder metallurgy; sintering

Shaping processes: extrusion eg direct, indirect and impact; forging eg drop, pressure and upset; rolling; hot and cold presswork eg forming, bending and deep drawing; metal spinning

Metallic materials: range applicable to component eg ferrous, non-ferrous, alloys

Ceramic materials: range applicable to component eg metallic carbides, nitrides and oxides

Material properties: changes to the molecular structure and hence the material properties that may arise from a moulding or shaping operation eg grain growth, work hardening, cracking, orientation of grain flow

Tooling requirements: appropriate tooling and equipment required to produce given components by moulding and shaping techniques eg re-usable moulds and non-permanent moulds, suitable casting materials for a particular casting process; press tools, punches, dies, press capacity and calculations in terms of tonnage

3 Understand the use of less conventional machining techniques for a given component specification

Component manufacture: principle of operation of the less-conventional machining techniques eg electro-discharge machining (EDM), wire erosion, ultrasonic machining, etching of electronic printed circuit boards (PCBs), laser-beam machining, plasma-jet machining; specification of components for less-conventional machining techniques eg criteria-tolerances, types of material, suitable technique, surface texture, material removal rate, cost factors

Tooling requirements: tooling and ancillary equipment needed to perform less-conventional machining techniques; work-holding techniques; health and safety issues

Learning outcomes and assessment criteria

| Learning outcomes On successful completion of this unit a learner will: | Assessment criteria for pass The learner can: |
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| LO1 Understand the use of conventional machining processes and techniques for generating geometrical forms for a given component specification | 1.1 select suitable data and processes for component manufacture using a range of conventional machining techniques 1.2 assess tooling requirements and work-holding techniques for a given component using a range of conventional machining techniques |
| LO2 Understand the use of moulding and shaping processes for a given component specification | 2.1 select suitable data and processes for component manufacture using moulding and shaping techniques for metals and ceramics 2.2 explain changes to material properties due to the moulding and shaping processes 2.3 explain the tooling requirements for producing a given component by moulding and shaping |
| LO3 Understand the use of less-conventional machining techniques for a given component specification | 3.1 select suitable data and processes for component manufacture using a less-conventional machining process 3.2 explain the tooling and ancillary equipment requirements to manufacture a given component by a less-conventional machining process. |

Guidance

Links

This unit can be linked with *Unit 15: Design for Manufacture* and *Unit 21: Materials Engineering*.

Essential requirements

There are no essential resources for this unit.

Employer engagement and vocational contexts

The learning outcomes and indicative content of this module lend themselves to be based on a real engineering environment. This approach would make the delivery more relevant through the use of detailed and realistic case study material. Equally, where learners have access to work-based traditional machining environments, including shaping and moulding, and less-traditional machining environments then they should be encouraged to use the real-life information available to them from this source wherever possible.

