Unit 15: Design for Manufacture

Unit code: R/601/1503
QCF level: 5
Credit value: 15

• Aim
This unit will develop learners’ understanding of the processes involved in analysing a product design and preparing for its manufacture.

• Unit abstract
The learner will identify the key factors that need to be considered in the design of a product for manufacture. This will include the selection of the most economic methods for manufacture and assembly, and the importance of specified tolerances and dimensions for products and components. The unit also looks at the applications of computer-based technologies used in design for manufacture.

The unit can be delivered effectively through case studies and industrial visits that reinforce the relevance and provide context and scale. However, it would also be very effective with work-based learners where the focus of assessment could be directed towards products and components from the learner’s industry/workplace. The unit has also been designed to be non-sector specific and therefore could be used in a range of industry settings.

• Learning outcomes
On successful completion of this unit a learner will:
1. Understand how to analyse a product design for its economic manufacture
2. Understand the product design features and techniques that facilitate economic assembly
3. Be able to apply the principles of geometrical tolerancing
4. Be able to select and use appropriate computer-aided manufacturing software.
Unit content

1 Understand how to analyse a product design for its economic manufacture

*Manufacturing methods*: key design factors eg design form, material type and properties, quality requirements, manufacturing equipment, processing capability, costs, skills of labour force, impact on environment; analytical review of manufacturing methods eg alternatives, most suitable, least waste, use of design criteria; decision-making eg which, why, alternatives, suitability

*Total cost*: breakdown of the three major costs eg material, labour and overheads; fixed and variable costs; relationship between manufacturing method and complexity of design eg form, finish and relative costs; break-even analysis

*Standardisation*: standards relevant to design form and materials eg BS, ISO, industry-specific; use of standard components, parts and fittings; application of preferred number methods for detection and standardisation; advantages of using standard parts eg design, development, tooling, planning, choice, labour, ease of replacement; inter-changeability, cost; conformity with relevant health and safety standards

*Process requirements*: factors affecting material requirements eg form, size, weight, quality, processing method, quantity, availability, service life, and mechanical, electrical and chemical characteristics

*Implementation*: timescale, ease of implementation, lifespan/upgradeability

2 Understand the product design features and techniques that facilitate economic assembly

*Methods of assembly*: application of analytical and questioning techniques to select the most appropriate method of assembly eg a value engineering approach that evaluates the specification and validity of the product; cost saving techniques eg variations between similar components, sequencing of assembly stages, symmetrical and asymmetrical parts, number of components

*Economic manufacture*: automated methods eg ability to feed and assemble components automatically, unidirectional component location, ease of handling, positioning, stacking and accessibility within assemblies; significant features of good design eg location of spigots, flanges, tenons, locating faces, accessibility, alignment, families of parts or groupings

3 Be able to apply the principles of geometrical tolerancing

*Principles of geometric tolerancing*: applications of dimensional tolerance and the dimensioning of components, sub-assemblies and assemblies, using relevant BS and ISO standards; effects of tolerance build-up and assess its application on an assembled product; dimensional data for the manufacture and inspection of a component
4 Be able to select and use appropriate computer-aided manufacturing software

Manufacturing software: selection and use of computer numerical control (CNC) software for component manufacturing; selection and use of computer-aided manufacturing software (CAM) for product assembly and material selection/handling.
## Learning outcomes and assessment criteria

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<th>Learning outcomes</th>
<th>Assessment criteria for pass</th>
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| **LO1 Understand how to analyse a product design for its economic manufacture** | 1. Learner can:  
1.1-examine the most appropriate manufacturing methods for a product  
1.2-discuss the elements involved in the total cost of a product  
1.3-explain the advantages and disadvantages of standardisation  
1.4-analyse the manufacturing process and material requirements for a component |
| **LO2 Understand the product design features and techniques that facilitate economic assembly** | 2. Learner can:  
2.1-explain the most appropriate method of assembly for a product  
2.2-explain the flexible manufacturing systems and robots used in the economic manufacture of a product  
2.3-evaluate the features of a component that assist and/or prevent economic manufacture using automatic assembly methods |
| **LO3 Be able to apply the principles of geometrical tolerancing** | 3. Learner can:  
3.1-apply the principles of geometric tolerancing to the manufacture of a product  
3.2-report on the effects of tolerance build-up and assess its application on an assembled product  
3.3-select and use dimensional data for the manufacture and inspection of a component |
| **LO4 Be able to select and use appropriate computer-aided manufacturing software** | 4. Learner can:  
4.1-demonstrate how CNC software can be used for component manufacture  
4.2-demonstrate how CAM software programs can be used for the assembly of a product  
4.3-demonstrate how CAM software can be used for material selection and handling processes. |
Guidance

Links

This unit can be delivered on a stand-alone basis but does require the learner to have an understanding of the processes of engineering design and manufacture. For example Unit 2: Engineering Science, Unit 8: Engineering Design and Unit 10: Manufacturing Process would provide a suitable foundation of study.

The unit can also be linked with the SEMTA Level 4 National Occupational Standards in Engineering Management, particularly Unit 4.12: Create Engineering Designs.

Essential requirements

Centres will need to provide access to suitable manufacturing facilities, CAD/CAM and appropriate software packages.

Employer engagement and vocational contexts

The unit would benefit from input by guest speakers from industry and visits to a facility using flexible manufacturing systems including the use of CNC and CAM software applications.