

Unit 13: Application of Machine Tools

Unit code: Y/601/1499

QCF level: 4

Credit value: 15

- **Aim**

This unit will develop the skills and understanding needed for the safe and efficient production of components on manual machine tools.

- **Unit abstract**

This unit introduces learners to the types of manually operated machine tools commonly used in industry and typical applications of such equipment. It introduces the theory of cutting tools, the practice of tool and work setting for production on manual machine tools and the checking of critical features and dimensions against specifications. Safe use of equipment will be a continuing theme throughout the unit.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand the characteristics of a range of machine tools
- 2 Understand machining operations
- 3 Understand material removal and forming principles
- 4 Be able to produce components to specification using safe working practices.

Unit content

1 Understand the characteristics of a range of machine tools

Machine tools: a range of machine tools and their applications eg centre lathes, vertical and horizontal milling machines, cylindrical and surface grinders, centreless grinders, lapping, honing, planing and shaping machines, internal and external broaching machines, sawing machines, presses, sheet and tube bending machines; types of drives eg for lathes, milling machines and presses; relative motion between cutting tool and workpiece

Work holding techniques: the six degrees of freedom of a rigid body with respect to work holding and jig and fixture design eg the need for rigidity in design and build of machine tools, three and four-jaw chucks, use of centres, machine vices, worktable clamps, magnetic tables

Tool holding: toolposts; Morse taper shanks; Jacobs chucks; milling machine arbors; mounting and dressing of grinding wheels

2 Understand machining operations

Components and geometries: component features typically associated with lathe work, milling, sheet metal forming and broaching eg:

Lathe work:	rotational operations – diameters and face turning, taper turning, chamfers, radii, drilled holes and internal bores, deep holes, internal and external threads, grooving, knurling, parting off, roughing and finishing cuts, the purpose and use of cutting fluids
Milling:	prismatic operations – face milling, slab milling, profiles, pockets and slots, drilling, reaming, thread tapping, thread milling, counter-boring, counter-sinking, roughing and finishing cuts
Press work:	sheet metal forming operations – blanking, piercing, drawing, bending, notching, cropping, use of progression tooling, finishing operations
Broaching:	internal and external – square and round holes, splines, gear teeth, keyways, rifling and flat, round and irregular external surfaces

3 Understand material removal and forming principles

Tooling: choice and effects of tool geometries; choice of tool material; permissible depth of cut; types and consequences of tool wear; importance of clearance in press-working operations; calculation of expected tool life

Forces: theory of metal cutting; mechanics of chip formation; shearing mechanisms in press work; calculation of forces exerted on cutting/forming tool and workpiece during various operations; calculation of power required to perform specific operations; use of dynamometers and other condition monitoring/measuring equipment

Speeds and feeds: calculation of speeds and feeds for turning and milling operations on a variety of workpiece features, sizes and materials (eg aluminium alloys, mild steel, tool steels, cast metals and alloys); relationship between cutting speed and tool life – economics of metal removal

4 Be able to produce components to specification using safe working practices

Health and safety: issues related to machine tools, workshops and the production environment in general; responsibilities of the employer and employee under the Health and Safety at Work Act and other legislation; correct and approved use and operation of systems and equipment; potential hazards for given machine tools

Principles of production: tool and work setting techniques; interpretation of specifications and engineering/production drawings; feature measurement eg depths, diameters, screw threads

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand the characteristics of a range of machine tools	1.1 explain the typical axis conventions of given machine tools 1.2 explain the operation of types of drive and the axis control systems, such as hand-wheels and servo-motors, for given machine tools 1.3 describe the six degrees of freedom of a rigid body and how they relate to work holding techniques 1.4 describe work and tool holding devices for given machine tools
LO2 Understand machining operations	2.1 assess the suitability of machine tool types for the production of specific components and geometries 2.2 plan the sequence of operations required to produce specific components 2.3 describe the machining and forming processes involved in the production of specific features
LO3 Understand material removal and forming principles	3.1 select appropriate tooling for the production of specific features on specific materials 3.2 determine the forces acting on the tool face and work piece during ideal orthogonal cutting 3.3 calculate speeds and feeds for turning and milling operations for a variety of tool and work piece materials 3.4 describe the mechanisms and effects of different types of tool wear and catastrophic failure 3.5 estimate the life of given tools for specific applications
LO4 Be able to produce components to specification using safe working practices	4.1 demonstrate awareness of health and safety issues related to the specific machine tools used and the workshop in general 4.2 select correct tooling and machine settings 4.3 produce given components to specification in compliance with the planned sequence of operations.

Guidance

Links

This unit can be linked with *Unit 10: Manufacturing Process*.

Essential requirements

Learners will need to have access to appropriate machine tools and properly trained support staff.

Employer engagement and vocational contexts

Delivery would benefit from visits to local engineering companies that use a wide range of machine tools and from visits from guest speakers with industrial experience of machining operations.