

Practical Metalworking: Machine Processes

SCQF: level 5 (6 SCQF credit points)

Unit code: J2CS 75

Unit outline

The general aim of this Unit is to help learners build measuring and marking out skills and to develop skills in using common metalwork machine tools, equipment and related processes. Learners will also develop their knowledge and understanding of metalworking materials, recycling and sustainability issues, as well as an appreciation of safe working practices in a workshop environment.

Learners who complete this Unit will be able to:

- 1 Prepare for metalwork machine process tasks
- 2 Use a range of marking out tools, machine tools and equipment
- 3 Manufacture a metalwork product from working drawings using machine tools and processes

This Unit is available as a free-standing Unit. The Unit Specification should be read in conjunction with the *Unit Support Notes*, which provide advice and guidance on delivery, assessment approaches and development of skills for learning, skills for life and skills for work. Exemplification of the standards in this Unit is given in the *Unit Assessment Support*.

Recommended entry

Entry to this Unit is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- ◆ National 4 Practical Metalworking Course or relevant Units

Equality and inclusion

This Unit Specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence. For further information, please refer to the *Unit Support Notes*.

Standards

Outcomes and assessment standards

Outcome 1

The learner will:

1 Prepare for metalwork machine process tasks by:

- 1.1 Selecting metalworking tools, equipment and materials appropriate for tasks
- 1.2 Confirming that metalworking tools and equipment are in good condition and safe working order before, during and after use
- 1.3 Adjusting tools where necessary, following safe working practices
- 1.4 Using correct names and terminology when referring to common metalworking tools, equipment, materials and processes

Outcome 2

The learner will:

1 Use a range of marking out tools, machine tools and equipment by:

- 2.1 Correctly creating and using datum marks
- 2.2 Marking out components or workpieces in accordance with working drawings with three functional and two linear sizes to within specified tolerances
- 2.3 Performing drilling and countersinking operations on a pedestal drill to within specified tolerance
- 2.4 Performing facing, parallel turning, centre drilling chamfering knurling and parting operations with guidance on a centre lathe and consistency of finish 2.5 Using tools and equipment safely and correctly

Outcome 3

The learner will:

3 Manufacture a metalwork product from working drawings using machine tools and processes by:

- 3.1 Checking materials supplied against working drawings
- 3.2 Manufacturing a metalwork product with three functional sizes within specified tolerances
- 3.3 Working in accordance with recognised procedures and safe working practices
- 3.4 Carrying out good practice in terms of sustainability and recycling

Evidence Requirements for the Unit

Assessors should use their professional judgement, subject knowledge and experience, and understanding of their learners, to determine the most appropriate ways to generate evidence and the conditions and contexts in which they are used.

Evidence may be presented for individual Outcomes, or gathered for the Unit. If the latter approach is used, it must be clear how the evidence covers each Outcome.

For this Unit, learners will be required to provide evidence of:

- ◆ knowledge and understanding of a range of practical metalworking machine tools, equipment, processes and materials
- ◆ practical skills in using machine tools, equipment, materials and related processes
- ◆ knowledge and understanding of sustainability issues and good practice in recycling in practical metalworking activities and environments
- ◆ the ability to work in accordance with given procedures and safe working practices

It is assumed that the component/workpieces and products in this Unit are readily portable. The specified tolerances referred to in the Assessment Standards are:

Operation	Tolerance
Marking out	±0.5mm
Drilling and countersinking	±0.5mm
Turning, facing and chamfering	±0.2mm
Metalwork product: functional sizes	±0.2mm on diameter ±0.5mm on linear

The tolerances are also given assuming that available machinery and equipment can reasonably meet these expectations.

Exemplification of assessment for this Unit is provided in the *Unit Assessment Support*. Advice and guidance on possible approaches to assessment is provided in the *Unit Support Notes*.

Functional dimension

Any size on a component part that **must** be within tolerance or the product will not function or assemble properly. This is particularly important for moving parts.

Assessment standard thresholds

If a candidate successfully meets the requirements of the specified number of Assessment Standards they will be judged to have passed the Unit overall and no further re-assessment will be required.

The specific requirements for this Unit is as follows:

- ◆ 9 out of 13 Assessment Standards must be achieved.

It should be noted that there will still be the requirement for candidates to be given the opportunity to meet all Assessment Standards. The above threshold has been put in place to reduce the volume of re-assessment where that is required.

Development of skills for learning, skills for life and skills for work

It is expected that learners will develop broad, generic skills through this Unit. The skills that learners will be expected to improve on and develop through the Unit are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and drawn from the main skills areas listed below. These must be built into the Unit where there are appropriate opportunities.

2 Numeracy

2.2 Money, time and measurement

4 Employability, enterprise and citizenship

4.3 Working with others

5 Thinking skills

5.3 Applying

5.5 Creating

Amplification of these is given in SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work*. The level of these skills should be at the same SCQF level of the Unit and be consistent with the SCQF level descriptor. Further information on building in skills for learning, skills for life and skills for work is given in the *Unit Support Notes*.

Appendix: Unit support notes

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing this Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- ◆ the *Unit Specification*
- ◆ the *Unit Assessment Support packs*

Developing skills, knowledge and understanding

Teachers and lecturers are free to select the skills, knowledge, understanding and contexts which are most appropriate for delivery in their centres.

Approaches to learning, teaching and assessment

Learners should be encouraged to make use of both micrometers and Vernier callipers to measure completed components in order to ensure the greatest possible accuracy in manufacture. It is not essential for digital instruments to be used; however, where manual instruments are used, learners will need to be taught how to read the appropriate device.

The learner should use as many machines and items of equipment as possible (a minimum of two), and items that are produced to given working drawings should embody as wide a range of operations as possible to give learners the experience of what can be undertaken.

If a milling machine is not available to the learners for actual use, then at least one drilling-machine operation should include an activity where the machine vice is clamped to the table. This will ensure that the learners have practical experience of work holding of this type.

Turning operations should include: plain parallel turning, facing, taper turning using a compound slide, parting off, centre drilling and drilling, and knurling, although this range might well be extended, according to needs, to include boring and other relevant operations. The use of a four-jaw chuck to hold square or irregularly shaped components should also be demonstrated. Machined finishes should be without significant defects, and probably best gauged against exemplar pieces, visually and by thumbnail check.

Application of the knowledge, processes and skills related to the following, as appropriate:	
Measuring and marking out	<p>Tools and equipment:</p> <ul style="list-style-type: none"> ◆ scribe and scribing block ◆ steel rule ◆ combination set ◆ engineer's square ◆ centre finder ◆ spring dividers ◆ calipers (oddleg, inside, outside, and Vernier or digital) ◆ micrometer (analogue or digital) ◆ centre punch ◆ witness marks ◆ surface table ◆ angle block ◆ v-block <p>Knowledge and understanding of:</p> <ul style="list-style-type: none"> ◆ units of measurement: datum, functional dimensions ◆ engineer's blue ◆ allowances for expansion, bending, stretching, forming, trimming, welding, brazing and soldering

Reading and interpreting drawings and documents	Working drawings, pictorial drawings, diagrams, cutting lists. Knowledge and understanding of orthographic projection, scale, dimensioning (linear, radial angular dimensions and diameter) and basic drawing conventions including: line types, centre lines and hidden detail.
Materials	Knowledge of a variety of common metalworking materials: <ul style="list-style-type: none"> ◆ ferrous metals (steel, high carbon steel, iron) ◆ non-ferrous metals (aluminium, copper, nickel) ◆ alloys (bronze, brass, stainless steel) ◆ common sections (square bar, round bar, hexagonal bar, angle iron, tube) ◆ sheet materials (tin plate, copper, brass, steel, aluminium) Common metals associated with different fabrication and joining techniques.
Machine processes	Centre lathe: parallel turning, taper turning (using a compound slide), facing, chamfering, centre drilling and drilling generally, knurling, parting off, use of a 4-jaw chuck (if appropriate). Pedestal drill for drilling and countersinking. Knowledge of: <ul style="list-style-type: none"> ◆ bench grinders ◆ centring of cutting tools ◆ milling machines (vertical, horizontal and CNC) ◆ industrial cutting processes (including laser and plasma cutters)
Machine tools	<ul style="list-style-type: none"> ◆ lathe cutting tools (left-hand cut, right-hand cut, finishing) ◆ knurling tool ◆ parting tool ◆ 3-jaw chuck, 4-jaw chuck, Jacob's chuck ◆ chuck keys ◆ revolving centres ◆ machine vices Appropriate holding devices Safety equipment
Care and maintenance of tools and equipment	Knowledge and understanding of: <ul style="list-style-type: none"> ◆ reporting faults and fault reporting systems ◆ general condition before, during and after use ◆ position and condition of guards ◆ position and security of cutting tools on machine tools ◆ secure holding techniques

Safe working practices	Good practices and safe systems for general workshop and individual activities as appropriate. Personal Protective Equipment
Sustainability and recycling	Best practice in selecting materials appropriate for use. Understanding and following workshop recycling practices and processes.

Combining assessment within Units

Assessment could be combined in this Unit by holistically assessing all the Outcomes of the Unit in a single assessment. When assessment within the Unit is holistic, teachers and lecturers should take particular care to track the evidence for each individual Outcome.

Administrative information

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Superclass: XD

History of changes to National Unit Specification

Version	Description of change	Authorised by	Date
1.1	Unit Support Notes added. Assessment standard threshold added.	Qualifications Manager	September 2018
2.0	Unit code updated	Qualifications Manager	July 2019

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