

SQA Advanced Unit specification

General information

Unit title: CAD: Sheet Metal (SCQF level 8)

Unit code: HV22 48

Superclass: XD

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Unit purpose

This Unit is designed to provide learners with knowledge and skills in the use of Computer Aided Design (CAD) within the design and manufacture of sheet metal components. Learners will be introduced to a variety of materials and material properties used in the manufacture of sheet metal components.

Outcomes

On successful completion of the Unit the learner will be able to:

- 1 Explain the manufacturing processes used in the design and manufacture of sheet metal components.
- 2 Design and produce sheet metal components for manufacture using a 3D CAD system.
- 3 Produce an assembly of sheet metal components using a 3D CAD system.

Credit points and level

1 SQA Credit at SCQF level 8: (8 SCQF credit points at SCQF level 8)

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Recommended entry to the Unit

Learners should possess a basic knowledge and understanding of design. This may be evidenced by the possession of SQA Advanced Units in:

HR3L 47	<i>CAD: 2D I</i>
HV1K 47	<i>CAD: 3D Surface and Solid Modelling</i>
HV1G 47	<i>CAD: Feature Based Modelling 1</i>
HV1E 47	<i>Design Methodology or any equivalent of study Unit</i>

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

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.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

SQA Advanced Unit specification: Statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Outcome 1

Explain the manufacturing processes used in the design and manufacture of sheet metal components.

Knowledge and/or Skills

- ◆ Material
- ◆ Sheet Metal Forming
- ◆ Sheet Metal Joining

Outcome 2

Design and produce sheet metal components for manufacture using a 3D CAD system.

Knowledge and/or Skills

- ◆ Design factors influencing sheet metal pattern development
- ◆ 3D sheet metal part creation
- ◆ 3D sheet metal pattern development
- ◆ Manufacturing drawings
- ◆ Annotation

Outcome 3

Produce an assembly of sheet metal components using a 3D CAD system.

Knowledge and/or Skills

- ◆ Part retrieval for assembly modelling
- ◆ 3D constraints (relevant to the software used)
- ◆ Functional testing
- ◆ Assembly drawings
- ◆ Exploded assembly drawings
- ◆ Parts list
- ◆ Annotation and assembly details

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Evidence Requirements for this Unit

Outcome 1

Learners will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can explain the manufacturing processes for a range of sheet metal materials appropriate to a sheet metal design.

In response to a design brief specification, the learner must choose and explain their choice of two sheet metal materials for the manufacturing process. The learner must provide the finish and gauge detail and explain where a minimum of two sheet metal forming processes and two joining techniques will be required.

Outcome 2

In response to a given design brief specification, learners will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ justify design choices for sheet pattern to meet design brief specification (to include: material gauge, edge design, bend allowance, bend relief, economical design and tolerances).
- ◆ produce a minimum of four 3D computerised sheet metal component parts to fulfil the given brief requirements.
- ◆ produce hardcopy folded and flat pattern drawings for manufacture of the four required 3D sheet metal components, with manufacturing details annotated.

Outcome 3

In response to a given design brief specification, learners will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ use part retrieval techniques to create a fully constrained 3D assembly of a minimum of four sheet metal components and perform required checks for functionality (to include interference and collision detection).
- ◆ produce hardcopy and exploded assembly drawing with assembly details, appropriate annotation and a parts list.

SQA Advanced Unit Support Notes

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Unit Support Notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit may form part of a group award or be completed as a free-standing Unit. It has been designed to allow learners to develop knowledge, understanding and skills in sheet metal materials and manufacturing processes, design of sheet metal components for manufacture using 3D CAD systems and production of sheet metal components using a 3D CAD system. A recommended list of topics for each of the Outcomes has been provided to assist with planning learning episodes.

In Outcome 1 the learner should be able to identify and explain the properties of materials and manufacturing processes used in the design and manufacture of sheet metal components. Range (mild steel, stainless steels, aluminium, other emerging materials), finish (chequered, brushed, dimpled and other emerging finishes) and gauge (foil, sheet [metric and imperial], plate) details of materials and the potential use of sheet metal for cladding, food industry, aircraft, automotive use and other emerging uses should be discussed. Forming (bending, laser cutting, punching) and sheet metal joining techniques (thermal types, mechanical [threads, rivets] seams, snap lock) for different materials could be experimented with to understand the interrelationship of all these manufacturing requirements.

In Outcome 2 the learner is required to design and produce sheet metal components for manufacture using a 3D CAD system in response to a given brief. The learner should be able to produce 3D CAD details and detailed manufacturing drawings (folded and flat pattern). Each learner should have an understanding of how design factors such as material gauge, edge design — hems, open, closed/safety, tear drop, rolled, bend allowance, bend relief, economical design (nesting, weld versus bend) and tolerances influence sheet metal pattern development for the manufacturing process. 3D sheet metal part creation and manufacturing drawings and related annotation, are also covered by this Outcome.

In Outcome 3 learners will produce an assembly of sheet metal components using a 3D CAD system. They should be able to retrieve and use the parts created for Outcome 2 and fully develop an assembly of 3D sheet metal components and apply appropriate 3D constraints. Learners should use CAD system tools to check the fit of the assembled components, ensuring there is no interference between adjacent parts. Collision detection should also be utilised where the CAD system supports this function and moving parts are within the assembly.

Learners should also demonstrate their ability to produce assembly/exploded assembly drawings with appropriate annotation and parts list.

Guidance on approaches to delivery of this Unit

It is intended that this Unit be presented using the specialist application CAD software available at the centre, with appropriate technical and support material available to the learner. This Unit is at SCQF level 8 and has been devised as an Optional Unit within the SQA Advanced Diploma in Computer Aided Draughting and Design.

In delivery of this Unit, learners should be provided with the opportunity to gain as much practical experience as possible. Each learner will need access to a PC with CAD software installed.

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

All assessments for this Unit are undertaken as open-book in a supervised environment. All assessment could be by standalone tasks if required, however a design brief specification (brief) would be an ideal assessment task to provide the necessary opportunities for learners to develop the required evidence and would allow integration of assessment for all Outcomes.

As an open-book assessment, sufficient time should be allocated for the learner to prepare and present all the required evidence and submit this by an agreed deadline.

It is recommended that centres develop assessment checklists to support the recording of Evidence Requirements for each of the Knowledge and/or Skills items.

Suggested assessment timings are given below:

Outcome 1	Written or oral recorded	2 hours
Outcome 2	Practical	4 hours
Outcome 3	Practical	3 hours

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

There are opportunities to develop the Core Skills of *Communication*, *Problem Solving* and *Information and Communication Technology (ICT)*, all to SCQF level 6, and the Core Skill of *Numeracy* to SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Communication may be developed principally during the first two Outcomes in which learners will produce designs and further develop these in relation to the given brief. Learners will be required to explain their designs and must justify each choice in relation to technical criteria such as material gauge, edge design, bend allowance, bend relief, economical design and tolerances.

Learners will use IT systems and specific applications throughout the whole of the Unit, from the planning/design stages, through the development stages and during the manufacturing process itself.

There are opportunities to develop the Core Skill of *Numeracy* provided by the design aspects of the Unit, which will require a number of calculations and extensive use of graphical information, including use and production of annotated technical drawings.

There is wide scope for learners to utilise and develop the Core Skill of *Problem Solving* throughout the Unit, as there are critical thinking, planning and evaluation aspects inherent in the design, production and testing of sheet metal components.

History of changes to Unit

Version	Description of change	Date

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our [Centre Feedback Form](#).

General information for learners

Unit title: CAD: Sheet Metal (SCQF level 8)

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

This Unit is designed to provide you with knowledge and skills in the use of Computer Aided Design (CAD) for the design and manufacture of sheet metal components. You will also gain knowledge of a variety of materials and material properties used in the manufacture of sheet metal components. On completion of the Unit you will be able to explain the manufacturing processes for a range of sheet metal materials, design and produce sheet metal components for manufacture using a 3D CAD system in response to a given brief and produce an assembly of sheet metal components using a 3D CAD system.

This Unit will help you to develop practical skills that will enable you to create part and assembly drawings and produce 3D CAD details and detailed manufacturing drawings (folded and flat pattern). By the end of the Unit, as well as having gained practical skills, you will have an understanding of the design factors influencing sheet metal component for manufacture.

In Outcome 1 you will identify the properties of sheet metal materials and the most appropriate manufacturing processes for the production of sheet metal components and assemblies. In Outcome 2 you will move on to designing sheet metal components using a 3D CAD system and in Outcome 3 you will produce an assembly of sheet metal components using a 3D CAD system.

All assessments for this Unit are undertaken as open-book in a supervised environment. Your assessment may be by standalone tasks or by an integrated assessment for all Outcomes.

During the course of the Unit there may be opportunities for you to develop the Core Skills of *Communication*, *Problem Solving* and *Information and Communication Technology (ICT)* all to SCQF level 6, and the Core Skill of *Numeracy* to SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.