

Overview

This standard covers a broad range of basic computer numerical control CNC fabrication machining competences that will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or that will provide a basis for the development of additional skills and occupational competences in the working environment.

The fabrication machinery to be prepared and used will include machines such as shearing, punching, forming and bending; plasma, laser and gas cutting. You will be expected to select the appropriate workholding devices, and to mount and secure them to the machine. You will also be required to select the appropriate cutting heads or forming tools, to mount and secure them to the appropriate tool holding devices, and to place the cutting/forming tools in the relevant positions within the tool-posts, slides or tool change magazine/carousel, where this is applicable.

You will need to ensure that all the tools have been allocated a relevant tool number, and that the relevant data on their co-ordinates and datum positions is entered into the operating program and machine. This will involve loading and checking component programs, checking for errors/faults, and editing and saving program changes. You will also be required to adjust the machine tool equipment and program, following editing procedures, to achieve component specification. You will be expected to produce components that combine a number of different features, such as straight cuts, square and rectangular profiles, curved profiles, internal profiles, louvers, swages, holes radially and linearly pitched, bends of various angles and curved plates.

During, and on completion of, the machining operations, you will be expected to check the quality of the workpiece, using measuring equipment appropriate to the aspects being checked and the tolerances to be achieved. On completion of the machining activities, you will be expected to remove all tools and workholding devices, and to leave the machine and work area in a safe and tidy condition.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the CNC fabrication machining activities undertaken. You will need to take account of any potential difficulties or problems that may arise with the turning activities, and to seek appropriate help and advice in determining and implementing a suitable solution. You will work under a high level of supervision, whilst taking responsibility for your own actions and for the quality and accuracy of the work that you produce.

SEMPEO2-26 - SQA Unit Code FP33 04

Preparing and using CNC fabrication machinery

Your underpinning knowledge will provide an understanding of your work, and will enable you to apply appropriate CNC fabrication machine setting and operating techniques safely. You will understand the CNC machining process, and its application, and will know about the equipment, workholding devices, tooling, machine operating programs and setting-up procedures, to the required depth to provide a sound basis for carrying out the activities to the required specification.

You will understand the safety precautions required when working with the CNC fabrication machinery, and with its associated tools and equipment. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

SEMPEO2-26 - SQA Unit Code FP33 04

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Performance criteria

- You must be able to:*
- P1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
 - P2 plan the CNC machining activities before you start them
 - P3 load/input the program to the machine controller, and check the program for errors using the approved procedures
 - P4 mount and set the required workholding devices, workpiece and tooling
 - P5 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
 - P6 run the operating program, and check and adjust the machine tool speeds/feeds and operating parameters to achieve the component specification
 - P7 measure and check that all dimensional and geometrical aspects of the component are to the specification
 - P8 deal promptly and effectively with problems within your control, and seek help and guidance from the relevant people if you have problems that you cannot resolve
 - P9 shut down the equipment to a safe condition on completion of the machining activities

SEMPEO2-26 - SQA Unit Code FP33 04

Preparing and using CNC fabrication machinery

Knowledge and understanding

You need to know and understand:

- K1 the specific safety precautions to be taken when setting up workholding devices and tooling on CNC fabrication machines
- K2 how to start and stop the machine, in normal and emergency situations
- K3 the importance of ensuring that the machine is isolated from the power supply before mounting the cutting and forming tools and workholding devices
- K4 the importance of wearing the appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy
- K5 the hazards associated with working on CNC fabrication machines (such as moving machinery, automatic machine operation, handling of cutting and forming tools, lifting and handling workholding devices, handling sheet materials), and how they can be minimised
- K6 how to handle and store cutting and forming tools, and programs, safely and correctly
- K7 how to use and extract information from engineering drawings or data and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken
- K8 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- K9 how to carry out currency/issue checks of the specifications you are working with
- K10 the range of workholding methods and devices that are used on CNC fabrication machines
- K11 why it is important to set the workholding device/workpiece in relationship to the machine datums and reference points
- K12 the methods of setting the workholding devices/workpieces, and the tools and equipment that can be used
- K13 the range of cutting and forming tools that are used on the CNC fabrication machine
- K14 how to check that the cutting and forming tools are in a safe and serviceable condition
- K15 the various tool holding devices that are used, and the methods of correctly mounting and securing the cutting and forming tools to the tool holders
- K16 the advantages of using pre-set tooling, and how to set the tooling by using setting jigs/fixtures
- K17 the use of tool-posts, magazines and carousels, and how to position and identify the tools in relationship to the operating program
- K18 how to set and secure the workpiece to the machine/workholding device; the effects of clamping the workpiece; and how material removal can

SEMPEO2-26 - SQA Unit Code FP33 04

Preparing and using CNC fabrication machinery

- cause warping/distortion of the finished workpiece
- K19 how to place the machine into the correct operating mode, and how to access the program edit facility in order to enter tooling data (such as tool datums, positions, lengths, offsets and radius compensation)
- K20 how to interpret the visual display and the various messages displayed
- K21 the function of error messages, and what to do when an error message is displayed
- K22 how to find the correct restart point in the program, when the machine has been stopped before completion of the program
- K23 the operation of the various hand and automatic modes of machine control (such as hand wheels, joysticks, program operating and control buttons)
- K24 how to operate the machine using single-block run, full program run and feed/speed override controls
- K25 how to make adjustments to the program operating parameters
- K26 how to conduct trial runs using single block run, dry run, and feed and speed override controls
- K27 the items that you need to check before allowing the machine to operate in full program run mode
- K28 how the various types of materials used will affect the feeds/speeds that can be used
- K29 typical problems that can occur with the setting up and operating of the machine and workholding devices, and what to do if they occur
- K30 how to save the completed or edited programs in the appropriate format, and the need to store programs and storage devices safely and correctly, away from contaminants and possible corruption
- K31 when to act on your own initiative and when to seek help and advice from others
- K32 the importance of leaving the work area and machine in a safe condition on completion of the activities (such as correctly isolated, operating programs closed or removed, cleaning the machine, ensuring that any spilt cutting fluids are correctly dealt with, and removing and disposing of waste)

SEMPEO2-26 - SQA Unit Code FP33 04

Preparing and using CNC fabrication machinery

Additional Information

Scope/range related to performance criteria

You must be able to:

1. Ensure that you apply **all** of the following checks and practices at all times during the CNC fabrication machining activities:
 - 1.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
 - 1.2 ensure that machine guards are in place and are correctly adjusted
 - 1.3 ensure that components are held securely (without damage or distortion)
 - 1.4 ensure that tooling is maintained in a suitable/safe condition
 - 1.5 make sure that the work area is maintained and left in a safe and tidy condition

2. Prepare **one** of the following CNC fabrication machines in readiness for production:
 - 2.1 shearing machine
 - 2.2 bending machine
 - 2.3 laser cutting
 - 2.4 punching machine
 - 2.5 plasma cutting
 - 2.6 gas cutting
 - 2.7 water cutting
 - 2.8 forming machine

3. Position and secure workpieces, using **two** of the following workholding methods and devices:
 - 3.1 jigs and fixtures
 - 3.2 pneumatic/magnetic devices
 - 3.3 clamps and stops
 - 3.4 other workholding devices

4. Select and mount, in the appropriate holding device, **one** of the following types of cutting/forming tool:
 - 4.1 shearing blades
 - 4.2 forming tools
 - 4.3 bending tools
 - 4.4 hole punching tools

SEMPEO2-26 - SQA Unit Code FP33 04

Preparing and using CNC fabrication machinery

- 4.5 nibbling tools
- 4.6 cutting heads/nozzles

- 5. Prepare the tooling by carrying out **all** of the following activities, as applicable to the machine type:
 - 5.1 pre-setting tooling, using setting jigs/fixtures
 - 5.2 setting tool datums
 - 5.3 mounting tools in the correct position in the tool-posts, turrets, magazine or carousel
 - 5.4 checking that tools have a specific tool number in relationship to the operating program
 - 5.5 entering all relevant tool data into the operating program (such as tool lengths, tool offsets, radius compensation)
 - 5.6 saving changes to the program

- 6. Set up the machine to produce components, combining several different operations and covering **four** of the following:
 - 6.1 straight cuts
 - 6.2 holes radially pitched
 - 6.3 multi-bend platework
 - 6.4 square/rectangular profiles
 - 6.5 louvres
 - 6.6 curved plates
 - 6.7 curved profiles
 - 6.8 swages
 - 6.9 bends of various angles
 - 6.10 internal profiles
 - 6.11 bends at 90°
 - 6.12 holes linearly pitched
 - 6.13 other specific operations

- 7. Confirm that the machine and program operate safely and correctly, by checking **all** of the following:
 - 7.1 all operations are carried out to the program co-ordinates
 - 7.2 tool change positions are safe and clear of the workpiece and machine equipment
 - 7.3 the correct tools are selected at the appropriate points in the program
 - 7.4 tool offsets are correctly entered into the machine controller
 - 7.5 tool cutter paths are executed safely and correctly
 - 7.6 auxiliary functions operate at the correct point in the program (cutter start/stop, coolant flow)
 - 7.7 programs have been saved in the appropriate format

- 8. Produce components using **one** of the following types of material:
 - 8.1 ferrous

SEMPEO2-26 - SQA Unit Code FP33 04

Preparing and using CNC fabrication machinery

- 8.2 non-ferrous
 - 8.3 stainless
 - 8.4 special alloys
 - 8.5 other specific materials
9. Carry out the necessary checks for accuracy of **three** of the following:
- 9.1 linear dimensions
 - 9.2 flatness/freedom from excessive distortion
 - 9.3 position of features
 - 9.4 accuracy of louvres and swages
 - 9.5 accuracy of profiles
10. Produce components that meet **all** of the following:
- 10.1 dimensional accuracy is within specification tolerance
 - 10.2 components are free from deformity, burrs and sharp edges
 - 10.3 profiles conform to specification/template requirements

SEMPEO2-26 - SQA Unit Code FP33 04

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