

Overview

This standard covers a broad range of basic computer numerical control (CNC) fabrication machine tool programming 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 programmed will include machines such as shearing, punching, forming and bending; plasma, laser and gas cutting. You will be required to produce the component program, using manual data input or by use of a remote computer, saving the prepared program or by downloading it into the machine controller from the computer.

You will be expected to prepare part programs, using operational sequences and machining techniques that avoid unnecessary tool movements or tool changes, and to use repetitive programs and canned cycles, to reduce program size and input time. You will prepare component programs that combine a number of different operations, such as cutting, punching, profiling, bending and forming.

You will need to check the program using single block run and program edit facilities. You will also be required to adjust the machine tool equipment and program, following proving/editing procedures, to achieve component specification. You must ensure that any edited programs are saved safely and correctly.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the programming activities undertaken. You will need to take account of any potential difficulties or problems that may arise with the programming 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.

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

SEMPEO2-25 - SQA Unit Code FP32 04

Preparing and proving CNC fabrication machine tool programs

You will understand the safety precautions required when working with the CNC fabrication machines, and with the 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.

SEMPEO2-25 - SQA Unit Code FP32 04

Preparing and proving CNC fabrication machine tool programs

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 programming activities before you start them
 - P3 determine an operational sequence that avoids wasted tool/cutter movements and tool changes
 - P4 develop component programs, using appropriate programming codes and techniques
 - P5 specify positional information and machine axes that are consistent with the requirements of each stage/operation
 - P6 load/input the program to the machine controller, and check the program for errors using the approved procedures
 - P7 save and store the program in line with organisational procedures
 - P8 deal promptly and effectively with problems within your control, and seek help and guidance from the relevant people when you have problems you cannot resolve
 - P9 shut down the equipment to a safe condition on completion of the programming activities

SEMPEO2-25 - SQA Unit Code FP32 04

Preparing and proving CNC fabrication machine tool programs

Knowledge and understanding

You need to know and understand:

- K1 the safe working practices and procedures to be followed when developing and proving CNC fabrication machine tool programs
- K2 the hazards associated with using CNC fabrication machine tools (such as automatic machine operations, power operated workholding devices, moving parts of machinery, sharp cutting tools and burrs and sharp edges on components), and how they can be minimised
- K3 the importance of wearing the appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy
- K4 the safety mechanisms on the machine, and the procedure for checking that they function correctly (such as emergency stop buttons, emergency brakes)
- K5 the correct operation of the various hand and automatic modes of machine control (such as program operating and control buttons)
- K6 how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency
- 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, absolute and incremental systems, workpiece zero/reference points and system of tolerancing
- K9 the computer coding language used in CNC fabrication machine programs (with regard to machine axes, positional information, machine management and auxiliary functions)
- K10 how to prepare part programs, using operational sequences and machining techniques that avoid unnecessary tool/cutter head movements or tool changes
- K11 the use of repetitive programs and canned cycles to reduce program size and input time
- K12 the function keys and operating system of the machine computer control system being operated
- K13 how to set machine datums for each of the machine axes being used
- K14 how to set the machine controller in the program and editing mode, and how to enter or download the prepared program
- K15 how to deal with error messages and faults on the program or equipment
- K16 how to access the program edit facility in order to enter tooling data (such as tool datums, positions, lengths, offsets and radius compensation)
- K17 the use of tool posts, magazines and carousels, and how to identify the tools in relationship to the operating program
- K18 how to conduct trial runs, using single block run, dry run and feed and

SEMPEO2-25 - SQA Unit Code FP32 04

Preparing and proving CNC fabrication machine tool programs

- speed override controls
- K19 factors affecting the feeds and speeds that can be used, and why they may need to be adjusted from the program setting (such as condition of material, workholding method, tooling used, tolerance and finish to be achieved)
- K20 the items that you need to check before allowing the machine to operate in full program run mode
- K21 how to save the completed programs in the appropriate format, and the importance of storing program safely and correctly, away from contaminants and possible corruption
- K22 the methods and procedures used to minimise the chances of infecting a computer with a virus
- K23 the implications if the computer you are using does become infected with a virus and who to contact if it does occur
- K24 typical problems that can occur with the programming, loading and editing activities, and what to do if they occur
- K25 when to act on your own initiative and when to seek help and advice from others
- K26 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, and removing and disposing of waste)

SEMPEO2-25 - SQA Unit Code FP32 04

Preparing and proving CNC fabrication machine tool programs

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 programming 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 obtain the correct component drawings, and check them for currency and validity
 - 1.3 use the appropriate reference manuals and programming codes to suit the machine controller
 - 1.4 prepare the machine controller to accept the operating program
 - 1.5 input/load the prepared program into the controller safely and correctly
 - 1.6 store the programs safely and correctly in the appropriate format
 - 1.7 store program media safely and correctly, away from contaminants or corruption

2. Prepare and prove programs for **one** of the following types of CNC machine tool:
 - 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. Produce CNC programs using **one** of the following methods:
 - 3.1 entered directly into the machine controller
 - 3.2 using computer software

4. Develop part programs that contain **all** of the following, as applicable to the machine type:
 - 4.1 all necessary positional information
 - 4.2 appropriate codes
 - 4.3 machine management commands (preparatory/auxiliary functions)

SEMPEO2-25 - SQA Unit Code FP32 04

Preparing and proving CNC fabrication machine tool programs

- 4.4 repetitions within programs (using features such as sub-routines, canned cycles, labels)
- 4.5 absolute or incremental co-ordinates
- 4.6 tool/cutter change positions
- 4.7 tool information (such as lengths, offsets, radius compensation)
5. Develop programs to produce components combining several different operations, covering **four** of the following:
 - 5.1 straight cuts
 - 5.2 holes radially pitched
 - 5.3 multi-bend platework
 - 5.4 square/rectangular profiles
 - 5.5 louvres
 - 5.6 curved plates
 - 5.7 curved profiles
 - 5.8 swages
 - 5.9 bends of various angles
 - 5.10 internal profiles
 - 5.11 bends at 90°
 - 5.12 holes linearly pitched
 - 5.13 other specific operations
6. Develop part programs to produce components made from **two** of the following types of material:
 - 6.1 ferrous
 - 6.2 non-ferrous
 - 6.3 stainless
 - 6.4 special alloys
 - 6.5 other specific materials
7. Prove the part program using **six** of the following:
 - 7.1 single block run
 - 7.2 full dry run
 - 7.3 program override controls (speed, feed, tool data)
 - 7.4 graphic displays/modelling
 - 7.5 search facilities
 - 7.6 program save/store facilities
 - 7.7 data input facilities
 - 7.8 edit facilities
8. Confirm that the program operates safely and correctly, by checking **all** of the following:
 - 8.1 all operations are carried out to the program co-ordinates
 - 8.2 tool change/park positions are safe and clear of the workpiece and machine equipment
 - 8.3 the correct tools are selected at the appropriate points in the

SEMPEO2-25 - SQA Unit Code FP32 04

Preparing and proving CNC fabrication machine tool programs

- program (where applicable)
- 8.4 tool offsets are correctly entered into the machine controller
- 8.5 tool cutter head paths are executed safely and correctly
- 8.6 auxiliary functions operate at the correct point in the program
- 8.7 programs have been saved in the appropriate format

SEMPEO2-25 - SQA Unit Code FP32 04

Preparing and proving CNC fabrication machine tool programs

Developed by	SEMTA
Version number	2
Date approved	December 2011
Indicative review date	December 2016
Validity	Current
Status	Original
Originating organisation	SEMTA
Original URN	25
Relevant occupations	Engineering and manufacturing technologies; Engineering;
Suite	Performing Engineering Operations Suite 2
Key words	engineering, engineering operations, CNC fabrication machine tool programs, manufacturing, fabrication machinery, shearing, punching, forming, bending, plasma cutting