

## Setting CNC gear cutting machines for production

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### Overview

This standard identifies the competences you need to prepare and set up Computer Numerical Control (CNC) gear cutting machines, in accordance with approved procedures. You will be expected to select the appropriate workholding devices to be used, and to mount and position them to the machine in the correct location for the type of operation being carried out. You will also be required to select the appropriate tools and cutters, check them for defects, and mount and secure them to the relevant tool holding devices and machine spindle.

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 are entered into the operating program and machine. This will involve loading and proving component programmes, checking for errors/faults, editing and saving program changes. You must produce trial components and prove the machine is working satisfactorily before declaring the machine ready for production. Making adjustments to settings to achieve specification, and solving machine- related problems during production, will also form part of your role.

Your responsibilities will require you to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any problems with the equipment, tooling, programs or setting up activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with a minimum of supervision, taking personal responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide a good understanding of your work, and will provide an informed approach to the setting-up procedures used. You will understand the CNC gear cutting machine used, and its application, and will know about the workholding devices, tooling, machine operating programmes and setting- up procedures, in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring the work output is produced to the required specification.

You will understand the safety precautions required when working with the machine and 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

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### Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
2. follow the correct specifications for the component to be produced
3. determine what has to be done and how the machine will be set to achieve this
4. mount and set the required workholding devices, workpiece and cutting tools
5. set the machine tool operating parameters to achieve the component specification
6. check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
7. complete the required production documentation
8. deal promptly and effectively with problems within your control and report those that cannot be solved

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## Knowledge and understanding

## You need to know and understand:

1. how to work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
2. how to start and stop the machine in normal and emergency situations
3. the importance of ensuring that the machine is isolated from the power supply before mounting cutting tools and workholding devices
4. the importance of wearing the appropriate protective clothing (PPE) and equipment, and of keeping the work area clean and tidy
5. the hazards associated with working on CNC gear cutting machines and how to minimise them and reduce any risks
6. how to handle and store cutting tools and programs, safely and correctly
7. how to save the programs in the appropriate format, and the importance of storing programs and storage devices safely and correctly, away from contaminants and possible corruption
8. the methods and procedures used to minimise the chances of infecting a computer with a virus
9. the implications if the computer you are using does become infected with a virus and who to contact if it does occur
10. how to extract and use information from engineering drawings or data and related specifications (to include symbols and conventions to appropriate standards) in relation to work undertaken
11. how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
12. the range of workholding methods and devices that are used on CNC gear cutting machines
13. why it is important to set the workholding device in relationship to the machine datums and reference points
14. the methods of setting the workholding devices, and the tools and equipment that can be used
15. the range of cutting tools used on CNC gear cutting machines, and typical applications
16. the different types of gears and their application
17. how to check that the cutting tools are in a safe and serviceable condition
18. the use of tungsten carbide, ceramic and diamond indexable tips, and the factors which will determine their selection and use
19. the various tool holding devices that are used, and the methods of correctly mounting and securing the cutting tools to the tool holders
20. the advantages of using pre-set tooling, and how to set the tooling using setting jigs/fixtures

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21. the use of magazines and carousels, and how to position and identify the tools in relation to the operating program
22. 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)
23. how to conduct trial runs, using single block run, dry run and feed/speed override controls
24. why you would conduct a full dry run and single block run
25. the items that you need to check before allowing the machine to operate in full program run mode
26. how the various types of materials will affect the feeds and speeds that can be used
27. the application of cutting fluids with regard to a range of different materials, and why some materials do not require the use of cutting fluids
28. typical problems that can occur with the setting-up of the tooling and workholding devices, and what to do if they occur.
29. The gear nomenclature for pitch circle diameter, addendum, involute profile etc, to understand the meaning of their function
30. the extent of your own responsibility and to whom you should report if you have problems that you cannot resolve

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## Scope/range related to performance criteria

1. Carry out all of the following during the setting-up activities:
  1. obtain and use the appropriate documentation
  2. adhere to procedures or systems in place for risk assessment, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  3. follow safe practice/approved setting up procedures at all times
  4. confirm that the correct operating program has been loaded
  5. check that the tooling is in a usable condition
  6. ensure that the workpiece is correctly positioned and secured without distortion
  7. update the program tool data as applicable
  8. ensure that correctly adjusted machine guards are in place
  9. leave the work area and machine in a safe and appropriate condition on completion of the activities
2. Prepare one of the following CNC gear cutting machines in readiness for production:
  1. CNC gear cutting machine
  2. CNC gear hobbing machine
  3. CNC gear shaving machine
3. Position and secure workpieces using four of the following workholding methods and devices:
  1. arbors
  2. chucks
  3. collets
  4. centres
  5. face plates
  6. mandrels
  7. pots
  8. fixtures
  9. clamps
4. Select and mount, in the appropriate tool holding device, three of the following types of cutting tool:
  1. hobs
  2. bevel gear cutting tools
  3. spline/serration cutting tools
  4. shaving tools
  5. rack cutting tools
  6. fly tools
  7. other specific cutting tools
5. Prepare the tooling by carrying out all of the following activities, as applicable to the machine type:
  1. positioning tools in the correct position in the turrets, magazine or carousel

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2. checking tools have a specific tool number in relation to the operating program
3. entering all relevant tool data to the operating program (such as tool lengths, tool offsets)
4. setting tool datums
5. pre-setting tooling using setting jigs/fixtures
6. saving changes to program
6. Set up the machine to produce components, and cover four from:
  1. external spur gears
  2. internal helical gears
  3. serrations
  4. internal spur gears
  5. straight splines
  6. bevel gears
  7. external helical gears
  8. involute splines
  9. racks
  10. worm gears
7. Machine one of the following types of material:
  1. ferrous
  2. non-ferrous
  3. non-metallic
8. Set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
  1. components to be free from false tool cuts, burrs and sharp edges
  2. straight splines and serrations to relevant standard
  3. spur and helical gears to relevant standard
  4. involute splines to relevant standard
  5. tolerance to relevant standard
  6. surface texture 32µin or 0.8µm
  7. contact pattern
  8. backlash
  9. company / customer requirements

## Setting CNC gear cutting machines for production

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