

## Setting gear cutting machines for production

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### Overview

This standard identifies the competences you need to prepare and set up gear cutting machines, such as gear hobbing, gear shaping, gear shaving, gear planning and bevel gear cutting machines, in accordance with approved procedures. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out. You will also be expected to select the appropriate cutters to use, and to mount and secure them to the appropriate tool holding devices.

You will be expected to check that the components and cutting tools are running true and concentric before starting the cutting operations. You will be expected to set up hob slides to the required angle, select and fit appropriate index change gears and differential gears, feed cams, determine and set parameters for axial or conventional shaving, tangential or underpass methods, diagonal or plunge methods, push or pull methods, and the appropriate feeds and speeds for the particular gears and gear cutting methods being used.

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 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 machine used, and its application, and will know about the workholding devices, gear cutting tools, relevant materials, consumables and setting-up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is to the required specification.

You will understand the safety precautions required when working with the machines and their 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.

This standard does not cover CNC gear cutting, for which other standards apply.

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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, set and secure 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. the hazards associated with setting gear cutting machines (such as moving parts of machinery, handling gear cutters, handling cutting fluids, airborne particles, tool breakage, insecure components) and how to minimise them and reduce any risks
3. how to start and stop the machine in normal and emergency situations
4. the importance of ensuring that the machine is isolated from the power supply before mounting cutters and workholding devices
5. the importance of wearing the appropriate protective clothing (PPE) and equipment, and of keeping the work area clean and tidy
6. how to handle and store gear cutting tools safely and correctly
7. how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
8. how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
9. terminology used in gear cutting in relation to the activities undertaken
10. the range of workholding methods and devices that are used on gear cutting machines
11. the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used
12. the various gear cutting operations that are used to produce the required gear forms, and the types of tooling used (such as straight hobs having single and multi-start, tapered hobs, shank type hobs, protuberance hobs, inserted blade hobs, skiving hobs, disc and shank type gear shaping and shaving cutters, gear planing cutters and bevel gear cutters)
13. how to check that the gear cutting tools are in a safe and serviceable condition
14. the various tool holding devices that are used, and the methods of mounting and securing the gear cutting tools to the tool holders and machine spindles
15. how to set up the various machines for the particular gears being machined
16. how the various types of material will affect the feeds and speeds that can be used
17. the application of cutting fluids with regard to a range of different

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- materials, and why some materials do not require the use of cutting fluids
- 18. the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
- 19. problems that can occur with setting up of the tooling, workholding devices and machine operating parameters, and what to do if problems occur
- 20. 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 activities during setting up:
  1. obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)
  2. adhere to procedures or systems in place for risk assessment, COSHH, 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. ensure that correctly adjusted machine guards are in place
  5. check that cutting tools are in a suitable condition
  6. hold components securely without distortion
  7. leave the work area and machine in a safe and appropriate condition on completion of the activities
2. Set up two of the following types of machine:
  1. gear hobbing
  2. gear shaping
  3. bevel gear cutting
  4. gear planing
  5. gear shaving
3. Select, mount and secure the workpiece using two of the following workholding devices:
  1. arbors
  2. chucks
  3. collets
  4. centres
  5. face plates
  6. mandrels
  7. pots
  8. fixtures
  9. clamps
4. Select and mount to the appropriate tool holding device, four of the following types of gear cutting tools:
  1. shank type hobs
  2. inserted blade hobs
  3. bevel gear roughing cutters
  4. protuberance hobs
  5. tapered hobs
  6. bevel gear finishing cutters
  7. skiving hobs
  8. single or multi-start straight hobs
  9. disc type shaping/shaving cutters
  10. shank type shaping/shaving cutters
  11. rack type gear planing roughing cutters

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12. extended hub type shaving cutters
13. single tooth gear planing roughing cutters
14. screwed hub type shaping/shaving cutters
15. rack type full fillet planing finishing cutters
16. special cutters
17. single tooth full fillet planing finishing cutters
5. Prepare the machine by carrying out all the following activities applicable to the machine type:
  1. set the slide angles
  2. set the speed and feed rates
  3. fitting differential/index change gears
  4. select and set climb or conventional hobbing
  5. set other machine operating parameters
  6. select and fit appropriate index change gears and differential gears
  7. select/set shaving method (axial or conventional, tangential or underpass, diagonal or plunge)
6. Set up the machine to produce machined components that include two of the following:
  1. external spur gear
  2. single helical gear
  3. chain sprockets
  4. splines
  5. internal spur gear
  6. double helical gear
  7. serrations
  8. straight bevel gears
7. Machine components made from one of the following types of material:
  1. ferrous
  2. non-metallic
  3. non-ferrous
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 63  $\mu\text{in}$  or 1.6  $\mu\text{m}$

## Setting gear cutting machines for production

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