

Overview

This standard covers a broad range of basic competences that you need, to carry out hand forging activities on engineering materials/components. It will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or it will provide a basis for the development of additional skills and occupational competences in the working environment.

You will be expected to prepare for the hand forging activities by obtaining all necessary information, documentation, materials, tools and equipment, and to plan how you intend to carry out the required hand forging activities.

You will be required to prepare the appropriate equipment to use, based on the hand forging operations required and the materials to be used. You will be expected to use the specified or appropriate techniques to prepare the materials and equipment in readiness for the hand forging activities. The forging activities will include operations such as bending, twisting, drawing down, upsetting, swaging, punching, cutting off and flame welding, as applicable to the task.

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

Your underpinning knowledge will provide an understanding of your work, in order to safely apply appropriate hand forging techniques and procedures. You will understand the hand forging techniques used, and their application, and will know about the equipment, materials and consumables, 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 carrying out the hand forging operations, and when using the associated tools and equipment. You will be required to demonstrate safe working practices throughout, and will understand your responsibility for taking the necessary safeguards to protect yourself and others in the workplace.

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Carrying out hand forging of engineering materials

Specific Standard Requirements

In order to prove your ability to combine different forging operations, at least one of the components produced must be of a significant nature, and must involve a minimum of **four** of the operations listed in scope 3.

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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 hand forging activities before you start them
- P3 prepare the materials in readiness for the forging operations
- P4 prepare the forging equipment in readiness for the forging operations
- P5 carry out the hand forging operations, using appropriate techniques and procedures
- P6 check that the finished components conform to specification
- P7 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
- P8 shut down the forging equipment to a safe condition on completion of the activities
- P9 leave the work area in a safe condition on completion of the hand forging activities

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Knowledge and understanding

You need to know and understand:

- K1 the specific health and safety precautions which must be taken when carrying out hand forging processes (such as wearing protective clothing and protective equipment, using fume extraction equipment)
- K2 the hazards associated with carrying out hand forging processes (such as handling hot materials, fume inhalation, fire), and how they can be minimised
- K3 the personal protective equipment (PPE) to be used (such as leather aprons, eye/ear protection, overalls, face masks, breathing equipment); how to obtain it and check that it is in a safe and usable condition
- K4 the importance of ensuring that fume extraction equipment is operating effectively, and that good housekeeping and fire prevention procedures are observed
- K5 the importance of following job instructions and defined hand forging techniques and procedures
- K6 how to obtain the required information on forging colours/temperatures to be used
- K7 the various types of material that can be hand forged
- K8 the characteristics of the materials, and how they effect and are affected by the forging process
- K9 the meaning of forging terminology (such as drawing down, upsetting, swaging, twisting, punching and flame welding)
- K10 how to prepare the equipment for the hand forging activities (such as setting furnace controls to give correct temperature; the procedure for lighting and extinguishing the blacksmith's forge; setting up gas torches; ensuring that suitable tongs/handling devices are available)
- K11 the material preparation methods and techniques to be undertaken prior to carrying out the hand forging operations (such as removing scale, oil and dirt; heating the material to the correct forging temperature)
- K12 how to determine when the material is ready for the forging operations (by checking the colour of the hot material)
- K13 the various hand forging methods used, and the range of tools required (including types of hammers, formers, swages, stakes, punches and drifts)
- K14 the use of the various parts of the blacksmith's anvil for the forging operations
- K15 the use of various cooling or quenching mediums (such as water, oil, air or sand)
- K16 the effect on the materials of plunging them into cooling mediums whilst they are still hot
- K17 how to check that the forged components meet the specification requirements (such as visual checks for cracks, scale inclusions or distortion; use of measuring equipment, gauges or templates to check dimensional and geometric features)

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- K18 the problems that can occur with the hand forging operations, and how these can be overcome
- K19 when to act on your own initiative and when to seek help and advice from others
- K20 the importance of leaving the work area and equipment in a safe and clean condition on completion of the forging activities (such as returning tools and equipment to the designated location, cleaning the work area, and removing and disposing of waste)

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Additional Information

Scope/range related to performance criteria

- You must be able to:*
1. Carry out **all** of the following during the hand forging 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 follow job instructions and hand forging specifications and procedures
 - 1.3 ensure that the material handling equipment and hand tools are in a safe and usable condition
 - 1.4 return all tools and equipment to their correct designation on completion of the hand forging activities
 - 1.5 dispose of waste and excess materials, in line with organisational procedures
 2. Use **one** of the following methods of heating the components:
 - 2.1 Furnace/oven
 - 2.2 blacksmith's forge
 - 2.3 gas torch
 - 2.4 induction heating
 3. Carry out **six** of the following hand forging operations:
 - 3.1 bending
 - 3.2 upsetting
 - 3.3 cutting off
 - 3.4 twisting
 - 3.5 swaging
 - 3.6 flame welding
 - 3.7 drawing down
 - 3.8 punching
 4. Carry out hand forging operations on **two** different materials from the following:
 - 4.1 wrought iron
 - 4.2 alloy steel
 - 4.3 copper
 - 4.4 low carbon steel
 - 4.5 brass
 - 4.6 high carbon steel
 - 4.7 other materials (specify)

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5. Use **five** of the following during the forging process:
 - 5.1 hand hammers
 - 5.2 formers
 - 5.3 punches
 - 5.4 pneumatic hammers
 - 5.5 swages
 - 5.6 drifts
 - 5.7 blacksmith's anvil
 - 5.8 stakes
 - 5.9 other tools (specify)

6. Carry out the hand forging activities, to include **all** of the following:
 - 6.1 lighting up the furnace/forging or torch, using approved procedures
 - 6.2 setting the equipment to maintain the correct conditions (such as temperature), where applicable
 - 6.3 checking that the components are correctly prepared for the required hand forging activities (such as free from scale or excessive rust, heated to the correct colour/temperature)
 - 6.4 using appropriate tools and techniques to forge the required shapes/profiles
 - 6.5 re-heating the forged components at suitable periods during the forging process
 - 6.6 using appropriate tools/gauges to determine when the required shape is achieved

7. Produce hand forged components which comply with **all** of the following:
 - 7.1 all dimensions are within $\pm 3.0\text{mm}$ or $\pm 0.125''$
 - 7.2 finished components meet the required shape/geometry (such as flat, straight, angles, twists)
 - 7.3 completed components are free from excessive tooling/hammer marks, deformation or cracks

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