Overview

This standard identifies the competences you need to heat treat ferrous and non-ferrous materials, in order to assist with the manufacturing activities in accordance with approved procedures. You will be required to access the appropriate heat treatment specifications, check that these are of the latest issue and extract all necessary information in order to carry out the heat treatment operations. You will be required to check that all necessary preparations to the base materials have been carried out (such as cleaning, degreasing, masking, jigging techniques and other appropriate preparations). You will be expected to prepare and adjust the heat treatment equipment to give the required results. You will be expected to identify any heat treatment defects and carry out the necessary actions and adjustments to the heat treatment process in order to correct them. You will need to ensure appropriate tests are carried out on the materials to ensure the heat treatment meets the specification requirements.

The heat treatment processes will include hardening, carburising, tempering, annealing and normalising/stress relieving and can be applied to raw materials used in manufacturing, manufactured components or structures.

Your responsibilities will require you to comply with organisational policy and procedures for the heat treatment activities undertaken and to report any problems with the heat treatment activities, equipment or materials used 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 a sound approach to applying the heat treatment procedures required for manufacturing activities. You will understand the principles of heat treatment, and their application and will know about the effects on the structure of the materials and their characteristics, in sufficient depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the process is carried out to the required specification.

You will understand the safety precautions required when carrying out
the heat treatment operations. You will need to take particular account of the hazards associated with hot working and the use of heat treatment solutions/salt baths, and to take actions that minimise the risks of using these processes. You will be required to demonstrate safe working practices throughout and will understand the responsibility you owe to yourself and others in the workplace and towards the environment.
Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety legislation, regulations, directives and other relevant guidelines
2. ensure the materials to be processed are suitably prepared for the processing operations to be carried out
3. check and monitor that the processing equipment is set up and maintained at satisfactory operating conditions throughout the processing operations
4. carry out the heat treating process in accordance with operating procedures and the workpiece specification requirements
5. check that the processed workpiece achieves the required characteristics and meets the processing specification
6. deal promptly and effectively with problems within your control and report those that you cannot solve
7. dispose of waste and excess materials in line with agreed organisational procedures
8. ensure that work records are completed, stored securely and available to others, as per organisational requirements
9. leave the work area in a safe condition on completion of the activities, as per organisational and legal requirements
Knowledge and understanding

You need to know and understand:

1. the specific safety precautions to be taken whilst carrying out the activities (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
2. the health and safety requirements of the work area and the activities, and the responsibility these requirements place on you
3. the hazards associated with the activities, and how to minimise them and reduce risks
4. the personal protective equipment and clothing (PPE) to be worn during the activities
5. the reasons for heat treating materials
6. materials and their characteristics, and how their structure can be modified
7. the type of materials that can be heat treated and the processes that may be applied
8. how the materials need to be prepared in readiness for the heat treatment operations
9. the various heat treatment processes, methods and procedures that may be applied (such as hardening, tempering, annealing, normalizing, carburising)
10. the type of equipment that can be used to carry out the various heat treatment processes (such as furnaces, blacksmith's hearth, gas torches, salt bath, vacuum furnace, gas carbonising furnace)
11. the various cooling and quenching techniques that are applied to the processes and why it is important to use the correct process (including water, oil, sand, air, gas fan cooling)
12. the use of quenching oils and the need to maintain the oil temperature below the oil flashpoint
13. information sources on heat treatment temperatures, tempering colours, soak times required and quenching/cooling mediums to be used
14. the various testing techniques that can be used to check that the correct condition has been achieved (simple file or spark tests to check that hardening or annealing has been achieved, the use of hardness test machines)
15. ways of limiting distortion during the heat treatment process
16. quality control procedures and recognition of defects
limitations of the various heat treatment processes
17. organisational procedures for disposing of and recycling of waste
18. the extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
19. how to access, use and maintain information to comply with organisational requirements and legislation
1. Carry out heat treatment, complying with all of the following requirements:
   1. use the correct heat treatment specifications, procedures and quality control documentation
   2. adhere to health and safety regulations, systems and procedures to realise a safe system of work
   3. leave the work area in a safe and tidy condition on completion of the activities

2. Carry out two of the following heat treatment processes/techniques:
   1. flame hardening
   2. tempering
   3. carburising
   4. case hardening
   5. annealing
   6. normalising/stress relieving
   7. induction hardening
   8. pre/post heating

3. Use one of the following in the heat treatment process:
   1. gas or electric furnace
   2. salt bath
   3. induction heating
   4. blacksmith's hearth
   5. vacuum furnace
   6. gas torch
   7. gas carbonising furnace
   8. other heat source

4. Apply the appropriate heat treatment process to two of the following:
   1. ferrous low carbon materials/components
   2. non-ferrous materials/components
   3. ferrous high carbon materials/components specialised steels

5. Use two of the following methods of cooling/quenching the
materials/components applicable to the heat treatment process required
1. oil
2. air
3. gas fan cooled
4. water
5. sand
6. other appropriate method

6. Carry out heat treatment processes to include all of the following operations:
   1. checking that you have the correct materials/components for the required heat treatment activity
   2. setting and checking that the heat treatment furnace/treatment solutions are at the correct temperature
   3. placing the materials/components safely in the heat source
   4. bringing the materials/components up to the correct temperature and maintaining this for the required time
   5. cooling/quenching the materials using the appropriate methods depending on the heat treatment required
   6. checking the materials/components for defects and correct specification

7. Check that heat treated components comply with two of the following quality and accuracy standards:
   1. materials/components are of the correct hardness for the application and where appropriate, suitably tempered
   2. hardened materials are free from cracks
   3. materials/components are suitably treated to permit working (such as annealed, normalised)
   4. stresses are relieved and distortion is limited and controlled
Heat treating materials for manufacturing activities

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