
Overview

This standard identifies the competences you need to use curing and consolidation equipment to process composite materials for the production of composite mouldings (such as moulds, components, splashes, jigs), in accordance with approved procedures. You will be required to use appropriate drawings, specifications and documentation to cure and consolidate the materials to the required standard. You will be expected to setup, load, operate, monitor and unload curing and consolidation equipment. You will cure a range of composite mouldings using a range of equipment. Mouldings cured will include laminates and sandwich structures, using a range of resin, fibre and core materials. Your responsibilities will require you to comply with organisational policy, setup and operational procedures for the curing activities undertaken, and to report any problems with the production activities, equipment or materials 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 curing methods and procedures. You will understand the curing methods used, and their application, 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 carrying out the curing activities and when using 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.

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. determine what processing operations are to be performed and how the equipment will be prepared and set up to achieve this 3. set the heating equipment operating parameters required for curing and consolidation operations and prepare for use 4. check that all safety mechanisms are in place and operate correctly 5. follow the correct component drawing or any other related specifications for the component to be produced 6. obtain and prepare the appropriate tools and equipment 7. carry out the curing activities using the correct methods and techniques 8. check that the equipment operates within the operating parameters set 9. cure and consolidate mouldings to the required specification 10. check that all the required operations have been completed to specification 11. check the quality of the mouldings by visual inspection 12. complete and store all relevant documentation in accordance with organisational procedures 13. deal promptly and effectively with problems within your control and report those that cannot be solved 14. leave the work area in a safe and appropriate condition on completion of the activities

Knowledge and understanding

You need to know and understand:

1. the health and safety precautions to be taken, and procedures used, when working with composite materials, consumables, tools and equipment in the specific work area 2. the hazards associated with carrying out curing and consolidation operations, and with the composite materials, consumables, tools and equipment used, and how to minimise these and reduce any risks 3. the protective equipment (PPE) that is needed for personal protection and, where required, the protection of others 4. the specific environmental conditions that must be observed when producing composite mouldings (such as temperature, humidity, fume/dust extraction systems and equipment) 5. how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate standards) in relation to work undertaken 6. how to interpret drawings/lay-up manuals, imperial and metric systems of measurement, workpiece reference/datum points and system of tolerancing 7. the quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents 8. the conventions and terminology used for curing and consolidation (such as ramp rates, dwell times, cure times, cure temperatures, continuous and stepped temperature profiles, exotherm, glass transition temperature, vacuum back pressure, cure cycles, pressure profiles, post curing) 9. the safety mechanisms on the curing and consolidation equipment, and the procedure for checking that they function correctly 10. the operation of the curing and consolidation equipment, and emergency shut down procedures 11. the basic parts, layout and functions of the curing and consolidation equipment (to include machine controls; hydraulic, pneumatic, vacuum and electricity supplies; heating controls; pressure controls; vacuum controls) 12. the various machine operating parameters that may require setting prior to curing and consolidation activities (such as temperature cycles, pressure cycles, ramp rates, dwell times), and how these are achieved 13. the effects that changes to these settings will have on the quality of the components produced 14. the different types of resin materials used, and their effect on curing conditions 15. the various life conditions associated with the resin materials (such as storage life, defrost times, working/out life, tack life) 16. the different types of fibre materials used, and their effect on curing conditions 17. the different types of core materials used, and their effect on curing conditions 18. the visual identification of both raw and finished composite materials 19. different types of production tooling used for producing composite mouldings, and their effect on curing conditions 20. ancillary equipment, sensors, hoses and consumable materials used in the curing and consolidation activities, and their care, preparation and control procedures 21. the problems that can occur during the curing and consolidation processes (including vacuum bag bursts, vacuum back pressure, hot and cold spots, temperature deviation, pressure deviation) 22. how problems can be overcome during the curing and consolidation activities 23. the need for monitoring the temperature and pressure cycles and recording the data against specific parts (using thermocouples, probes, chart recorders and data logs) 24. the identification of defects in the composite moulding caused by curing and consolidation activities (such as de-lamination, porosity, fayed/burned areas, incomplete curing, local exotherm, voids, resin starvation, core crush, wrinkles) 25. the care and safe handling of production tooling and composite mouldings throughout the production cycle 26. the production controls used in the work area, and actions to be taken for unaccounted items 27. how the composite moulding relates to its own quality documents and cure records 28. the extent of your

own responsibility and to whom you should report if you have problems that you cannot resolve

Scope/range related to performance criteria

1. Carry out all of the following during the curing and consolidation activities:

1. obtain and use the appropriate documentation (such as job instructions, drawings, material data sheets, specifications, equipment setting-up documentation, planning and quality control 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. provide and maintain a safe working environment for the curing activities
4. obtain and check that all tools and equipment to be used are correct for the operation to be carried out and are in a safe and usable condition
5. follow safe working practices at all times during the curing activities
6. ensure that there are appropriate facilities for storing the cured mouldings (where applicable)
7. return all tools and equipment to the correct location on completion of the setting and moulding activities
8. segregate and dispose of waste materials using the correct procedure

2. Prepare and use the heating equipment, to include carrying out all of the following where applicable:

1. ensure all heating services are connected and operational (such as electrical, fluids, steam)
2. set up the process heating conditions to suit the moulding being produced (such as zones, target temperature, ramp rates, dwell times), including alarm conditions
3. check that all the heating controls are operational and function correctly
4. check the correct mouldings are available and suitably prepared for the curing activity
5. load the composite mouldings or fit the heating equipment to the mouldings as required
6. ensure correct positioning of the composite mouldings relative to the heating equipment
7. fit insulation blankets/baffle plates as required to achieve the correct heating pattern
8. connect temperature sensors (such as thermocouples) to the heating controls/recording equipment
9. start the temperature cycle
10. monitor the temperature cycle and temperature sensors to ensure the temperature cycle is within the required curing tolerances
11. on completion of the cure cycle, unload the composite mouldings or remove the heating equipment from the mouldings as required
12. complete cure records/documentation for the cured mouldings

3. Prepare and use the consolidation equipment, to include carrying out all of the following where applicable:

1. ensure all services are connected and operational (such as electrical, hydraulic, pneumatic, vacuum)
2. set up the process consolidation conditions to suit the moulding being produced (such as target pressure, vacuum level, ramp rates, dwell times), including alarm conditions
3. check that all the equipment controls are operational and function correctly
4. ensuring that all guards and safety mechanisms are in place and in good working order
5. check the correct mouldings are available and suitably prepared for the consolidation activity
6. check the integrity of tooling seals or vacuum integrity of the mouldings
7. load the composite mouldings as required
8. connect all service and monitoring hoses/sensors to the consolidation controls/recording equipment
9. start the consolidation cycle
10. monitor the consolidation cycle and pressure/vacuum sensors to ensure the consolidation cycle is within the required tolerances
11. on completion of the consolidation cycle, unload the composite mouldings as required
12. complete consolidation records/documentation for the mouldings

4. Use three of the following for applying temperature during the cure cycle:

1. oven
2. autoclave
3. heated tools/moulds
4. heat mats
5. heated press
6. curing lamps
7. infrared heating
8. electro-magnetic inductance
9. micro-wave
10. hot bonder
11. electric heating
12. water heating
13. steam heating
14. oil heating
15. other specific method

5. Use two of the following for applying pressure to consolidate the moulding:

1. vacuum bags
2. hot de-bulk
3. pressure de-bulk
4. pressure bags
5. thermal mould expansion
6. press
7. autoclave
8. other specific method

6. Setup and use curing equipment for five of the following types of temperature profiles:

1. temperature survey
2. thin

laminates, up to 10mm 3. thick laminates, over 10mm 4. sandwich panels 5. low temperature cures, up to 30-80°C 6. medium temperature cures, 80-150°C 7. high temperature cures, over 150°C 8. post curing 9. multi stage curing 10. other specific type 7. Cure a range of mouldings, using four of the following types of production tool: 1. metal 2. tooling block 3. glass pre-preg 4. carbon pre-preg 5. female tooling 6. male tooling 7. multi-part tools 8. matched tooling 9. closed tooling 8. Cure a range of mouldings incorporating two types of resin from: 1. polyester 2. vinyl ester 3. epoxy 4. phenolic 5. bismaleimide 6. cyanate ester 7. other specific type 9. Cure a range of mouldings incorporating two types of fibre from: 1. polyethylene 2. glass 3. aramid 4. carbon 5. other specific type 10. Cure a range of mouldings incorporating two types of core material: 1. wood 2. foam 3. syntactic core 4. expanding core 5. nomex honeycomb 6. aluminium honeycomb 7. other specific type 11. Using both cure records and visually inspection of the cured mouldings, identify two of the following: 1. mouldings which meet the required cure specification 2. mouldings which have curing defects 3. mouldings that require further investigation 12. Produce composite mouldings in compliance with all of the following quality and accuracy standards: 1. company standards and procedures 2. dimensionally accurate within specification tolerances 3. has an appropriate surface finish and is free from defects or surface blemishes

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