

SEMPEO2-44 - SQA Unit Code FP43 04

Producing Composite Mouldings using Pre-Preg Techniques



Overview

This standard covers a broad range of basic competences that you need to produce composite mouldings using pre-preg laminating techniques. 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 pre-preg laminating activities by obtaining all necessary information, documentation, materials, tools and equipment, and to plan how you intend to carry out the required activities and the sequence of operations you intend to use.

You will be expected to prepare the tooling, apply release agents and prepare the composite materials. You will produce composite mouldings, which will incorporate a range of features, using a range of application methods. Mouldings produced will include laminates and sandwich structures, using suitable resin, fibre and core materials. The activities will also include making all necessary visual and dimensional checks, to ensure that the mouldings meet the required specification and have an appropriate cosmetic appearance.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the pre-preg laminating activities undertaken. You will need to take account of any potential difficulties or problems that may arise with the activities, 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, and will enable you to apply appropriate composite moulding pre-preg laminating techniques and procedures safely. You will understand the moulding/laminating procedure, and its 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 pre-preg laminating 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.

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Specific Standard Requirements

In order to prove your ability to combine different pre-preg laminating operations, at least one of the components produced must be of a significant nature, and must have a minimum of **three** of the features listed in scope 6.

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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 moulding/laminating activities before you start them
 - P3 prepare the moulds, jigs or formers ready for the manufacturing operations
 - P4 mix and prepare the required materials
 - P5 carry out the moulding/laminating activities, using the correct methods and techniques
 - P6 remove the mouldings from the formers, and trim/finish them to specification
 - P7 check that all the required operations have been completed to specification
 - P8 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
 - P9 leave the work area in a safe and tidy condition on completion of the moulding activities

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Knowledge and understanding

You need to know and understand:

- K1 Health and safety precautions to be taken, and procedures used, when working with composite materials, consumables, tools and equipment in the specific work area
- K2 The hazards associated with carrying out Pre-preg laminating techniques, and with the composite materials, consumables, tools and equipment used, and how to minimise these and reduce any risks
- K3 Protective equipment (PPE) that is needed for personal protection and, where required, the protection of others
- K4 The application of COSHH regulations in relation to the storage, use and disposal of composite materials and consumables
- K5 The specific environmental conditions that must be observed when producing composite mouldings (such as temperature, humidity, fume/dust extraction systems and equipment)
- K6 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
- K7 How to interpret drawings/lay up manuals, imperial and metric systems of measurement, workpiece reference/datum points and system of tolerancing
- K8 Quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification) and the completion of such documents
- K9 Conventions and terminology used for pre-preg laminating techniques (such as material orientation, material identification, material templates, ply lay-up, pressure plates, vacuum bagging, cure cycles, exotherm)
- K10 The different types of resins, reinforcement, catalysts, accelerators and additives used, and their applications
- K11 The different types of fibre materials, fabrics, orientations, their combinations and applications
- K12 Building up laminates (including orientation and balance of plies) to minimise spring and distortion in composite mouldings
- K13 Different core, insert and filler materials, and their applications
- K14 The visual identification of both raw and finished composite materials
- K15 Identification of materials by product codes
- K16 Different types of production tooling used for producing composite mouldings, and their applications
- K17 The identification and rectification of defects in production tooling
- K18 Methods of preparation for patterns, moulds and tooling, including the correct selection and use of surface sealers and release agents
- K19 The correct methods of storage, thawing and handling of pre-preg materials (including monitoring temperature, storage life and out-life)
- K20 Methods used in the application of pre-preg materials to tooling surfaces (including methods of tailoring and cutting)
- K21 Correct methods of storage and handling of ancillary and consumable materials
- K22 Selection and use of ancillary and consumable materials (such as release films, breather fabrics, bagging films, tapes) to meet

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- performance requirements (such as temperature and compatibility)
- K23 The tools and equipment used in the pre-preg laminating activities, and their care, preparation and control procedures
- K24 The problems that can occur during the lay-up process (including modifications to the ply lay-up, and defects such as contamination and distortion)
- K25 The cure cycles (including temperature and pressure ramps, dwell times, post curing)
- K26 The need for monitoring the cure cycle (using thermocouples, probes, chart recorders and data logs)
- K27 Procedures and methods used for removing mouldings from production tooling
- K28 The identification of defects in the composite moulding (such as delamination, voids, contaminants)
- K29 The care and safe handling of production tooling and composite mouldings throughout the production cycle
- K30 The production controls used in the work area, and actions to be taken for unaccounted items
- K31 How the composite moulding relates to its own quality documents, and the production tooling used
- K32 The extent of your own responsibility and to whom you should report if you have problems that you cannot resolve

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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 moulding 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, drawings, process specifications and moulding/laminating procedures
 - 1.3. ensure that all equipment and tools used are in a safe and serviceable condition
 - 1.4. return all tools and equipment to the correct location on completion of the moulding/laminating activities

- 2 Carry out **all** of the following activities when preparing production tooling:
 - 2.1. check that tooling is correct and complete
 - 2.2. clean tooling and remove resin build-ups
 - 2.3. check for surface defects
 - 2.4. correctly apply sealers/release agents
 - 2.5. clean and store tooling suitably after use

- 3 Carry out **all** of the following activities to prepare materials for production:
 - 3.1. obtain correct materials for the activity
 - 3.2. thaw material removed from freezer storage
 - 3.3. identifying defects in pre-preg materials
 - 3.4. check that materials are fit for purpose and in life
 - 3.5. check availability of ancillary materials required
 - 3.6. cut materials to correct shape and orientation
 - 3.7. check materials when provided in kit form
 - 3.8. identify and protect materials in the work area

- 4 Produce a range of mouldings, using **one** of the following types of production tool:
 - 4.1. pattern
 - 4.2. mandrels
 - 4.3. metal
 - 4.4. tooling block
 - 4.5. glass pre-preg
 - 4.6. carbon pre-preg
 - 4.7. female tooling
 - 4.8. male tooling
 - 4.9. multi-part tools
 - 4.10. matched tooling
 - 4.11. closed tooling

- 5 Produce a range of mouldings incorporating **two** of the following in the lay-

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- up:
 - 5.1. butt joins
 - 5.2. overlap joins
 - 5.3. staggered joins
 - 5.4. orientated plies
 - 5.5. inverted plies
 - 5.6. balancing plies
 - 5.7. inserts
 - 5.8. fixtures

- 6 Produce a range of mouldings incorporating **four** of the following shape features:
 - 6.1. internal corners
 - 6.2. external corners
 - 6.3. horizontal surface
 - 6.4. vertical surface
 - 6.5. double curvature
 - 6.6. concave surface
 - 6.7. convex surfaces
 - 6.8. return surfaces
 - 6.9. joggle details
 - 6.10. nett edges

- 7 Produce a range of mouldings using **one** type of resin from:
 - 7.1. bio resin
 - 7.2. thermoplastic
 - 7.3. epoxy
 - 7.4. phenolic
 - 7.5. bismaleimide
 - 7.6. cyanate ester
 - 7.7. other (to be specified)

- 8 Produce a range of mouldings using techniques for **one** type of fibre from:
 - 8.1. natural fibre
 - 8.2. thermoplastic
 - 8.3. glass
 - 8.4. aramid
 - 8.5. carbon
 - 8.6. hybrid
 - 8.7. other (to be specified)

- 9 Produce a range of mouldings using **one** type of reinforcement from:
 - 9.1. continuous
 - 9.2. uni-directional
 - 9.3. tapes
 - 9.4. tissues/veils
 - 9.5. woven
 - 9.6. braids
 - 9.7. multi-axis

- 10 Produce a range of mouldings using **one** type of core material (**where applicable to the Sector or process**):

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- 10.1. solid timber
 - 10.2. end grain balsa
 - 10.3. thermoplastic core
 - 10.4. rigid foam
 - 10.5. syntactic core
 - 10.6. expanding core
 - 10.7. fibrous honeycomb
 - 10.8. aluminium honeycomb
 - 10.9. other (to be specified)
- 11 Use **one** of the following methods when using core materials (**where applicable to the Sector or process**):
- 11.1. core templates
 - 11.2. pre-shaping core
 - 11.3. core chamfers
 - 11.4. core splicing
 - 11.5. peel plies
 - 11.6. bonding paste
 - 11.7. edge filling
 - 11.8. adhesive/resin films
 - 11.9. potting/filler compound
 - 11.10. single stage curing
 - 11.11. multi-stage curing
- 12 Prepare the moulding for temperature curing using **one** of the following methods:
- 12.1. oven
 - 12.2. autoclave
 - 12.3. heated tools/moulds
 - 12.4. heat mats
 - 12.5. heated press
 - 12.6. curing lamps
 - 12.7. infrared heating
 - 12.8. UV curing
 - 12.9. electro-magnetic inductance
 - 12.10. micro-wave
 - 12.11. other (to be specified)
- 13 Preparing the moulding for pressure consolidation using **one** of the following methods:
- 13.1. vacuum bags
 - 13.2. hot de-bulk
 - 13.3. pressure de-bulk
 - 13.4. pressure bags
 - 13.5. thermal mould expansion
 - 13.6. fibre tensioning
 - 13.7. press
 - 13.8. autoclave
- 14 Remove composite moulding and carryout **all** of the following:
- 14.1. visually check that the moulding is complete and free from defects
 - 14.2. use appropriate equipment/gauges to check for dimensional accuracy

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(such as overall dimensions, thickness of material/moulding, geometric features)

- 14.3. mark out the mouldings for trimming of excess material
 - 14.4. cut/trim the mouldings using appropriate tools and equipment (such as cutting wheels/discs, routers, saws)
 - 14.5. carry out repairs (where appropriate)
 - 14.6. finish the mouldings, using appropriate tools and equipment (such as rubbing blocks, diamond files, disc or belt sanders, pencil grinders)
 - 14.7. polish the mouldings using appropriate tools and equipment (such as wet sanding , cutting compounds)
- 15 Produce mouldings which comply with **one** of the following standards:
- 15.1. components are dimensionally accurate, within specification requirements
 - 15.2. finished components meet the required shape/geometry (such as square, straight, angle, free from twists)
 - 15.3. completed components are free from defects, sharp edges or slivers
 - 15.4. components meet company standards and procedures

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