Overview

This standard identifies the competences you need to produce aircraft composite mouldings using filament winding moulding techniques, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft mouldings. You will be required to use appropriate drawings, specifications and documentation to produce various mouldings, using the correct filament winding production techniques.

You will be expected to prepare a range of tooling, prepare and apply composite materials. You will be expected to setup the filament winding equipment to produce a range of mouldings incorporating a variety of winding patterns and moulded features. Mouldings produced will include laminates using a range of resin and fibres.

Your responsibilities will require you to comply with organisational policy and procedures for the setup and production activities undertaken, and to report any problems with the equipment setup, production activities or materials that you cannot personally resolve, or that 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 applying filament winding techniques and procedures. You will understand the setup and production techniques used, and their application, in adequate depth to provide a sound basis for carrying out the activities, correcting faults, and ensuring that the work output is to the required specification.

You will understand the safety precautions required when carrying out the moulding 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 equipment operating parameters required for the filament winding moulding operation
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, equipment and materials
7. carry out the moulding activities using the correct methods and techniques
8. check that the equipment operates within the operating parameters set
9. produce mouldings to the required specification
10. check that all the required operations have been completed to specification
11. complete relevant documentation in accordance with organisational requirements
12. deal promptly and effectively with problems within your control and report those that cannot be solved
13. 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 aircraft composite materials, consumables, tools and equipment in the specific work area
2. the hazards associated with carrying filament winding techniques, and with the composite materials, consumables, tools and equipment used, and how to minimise these and reduce any risks in the work area
3. the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
4. the protective equipment (PPE) that is needed for personal protection and, where required, the protection of others
5. the application of COSHH regulations in relation to the storage, use and disposal of composite materials and consumables
6. the specific environmental conditions the must be observed when producing composite mouldings (such as temperature, humidity, fume extraction systems and equipment)
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 drawings/lay-up manuals, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
9. the quality procedures used in the workplace to ensure production control (in relation to currency, issue, meeting specification), and the completion of such documents
10. the conventions and terminology used for filament winding techniques (such as material identification, lay-up specifications, resin/catalyst ratios, winding angle, winding tension, curing temperature, gel time, cure time, exotherm)
11. the safety mechanisms on the machine, and the procedure for checking that they function correctly
12. operation of the machine controls, and how to stop the machine in an emergency
13. the parts and functions of the filament winding machines (to include machine controls; hydraulic, pneumatic and electricity
Supplies; mandrel drive; carriage drive; winding heads; controls; material delivery systems; mandrel extraction systems)

14. The various machine operating parameters that may require adjusting prior to filament winding activities (such as resin/catalyst ratio, accelerators mandrel speed, carriage speed, fibre tension, fibre angle, resin/fibre ratio, moulding temperature, material positioning and weight), and how these are achieved

15. The effects that changes to these settings will have on the quality of the components produced

16. The different types of resins, reinforcement, catalysts, accelerators and additives used, and their applications

17. The different types of winding combinations and applications

18. The visual identification of both raw and finished composite materials

19. Different types of production tooling used for producing composite mouldings

20. The identification of defects in production tooling

21. Methods of preparation for moulds and tooling (including the correct selection and use of release films/agents)

22. Methods for handling, preparation and application of the reinforcing fibres and fabrics

23. The tools and equipment used in the filament winding activities, and their care, preparation and control procedures

24. The problems that can occur during the filament winding process (including defects such as contamination, exotherm, porosity, resin rich, fibre deviation, broken tows)

25. The procedures and methods used for removing mouldings from production mandrels

26. The identification of defects in the composite mouldings (such as porosity, contaminants, fibre deviation, tension variation)

27. The care and safe handling of mandrel tooling and composite mouldings throughout the production cycle

28. The production controls used in the work area, and actions to be taken for unaccounted items

29. How the composite component relates to its own quality documents and the production tooling used

30. The extent of your own responsibility and to whom you should report if you have problems that you cannot resolve
1. Carry out all of the following during the moulding 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, COSHH, 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 setting and moulding 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, tested and usable condition
   5. ensure that there are appropriate facilities for storing the completed mouldings (where applicable)
   6. follow safe practice/approved setting and moulding techniques at all times
   7. ensure moulding materials are prepared and laid up according to the part specification
   8. return all tools and equipment to the correct location on completion of the setting and moulding activities
   9. segregate and dispose of waste materials using the correct procedure

2. Prepare the filament winding machine for use, to include carrying out all of the following:
   1. ensure all services are connected and operational (such as electrical, hydraulic, pneumatic)
   2. check the mandrel is correct, complete, clean and free from damage
   3. ensure the mandrel is correctly and securely mounted between the headstock and tailstock
   4. ensure all guards, screens and safety mechanisms are in place and in good working order
   5. ensure the deposition carriage operates correctly
   6. ensure the winding head functions correctly
   7. set up the mandrel and deposition carriage operating conditions to suit the moulding being produced (such as mandrel rotational speed, carriage speed, deposition angle),
including alarm conditions
8. check that all the machine controls are operational and function correctly

3. Prepare the mandrel tooling for production, to include carrying out all of the following:
   1. check that tooling is correct and complete
   2. clean tooling and remove resin build-ups
   3. check for surface defects
   4. correctly apply release films/agents

4. Prepare the material delivery systems, to include carrying out all of the following where applicable:
   1. ensure there are sufficient raw materials available and that they meet the component specification (such as resin, catalyst, additives, fibres)
   2. set and check that the resin/catalyst feed and mixing systems are operating correctly (such as collection tubes, mixing heads, dispensing heads/injectors), where fitted
   3. correctly select, remove from freezer and defrost pre-catalysed materials where required
   4. correctly set up fibre materials on racks/creels as required and splice together as required
   5. feed the fibres through the correct guides and winding comb/head in sequence to suit the part being produced
   6. check the correct fibre deposition rate, winding angle and tension prior to winding production parts

5. Produce composite mouldings using two of the following winding patterns:
   1. hoop winding
   2. helical winding
   3. longitudinal winding
   4. winding combination

6. Produce composite mouldings, using four of the following mandrel types:
   1. straight mandrel
   2. multiple spindles/mandrels
   3. circular mandrels
4. non-circular mandrels
5. split/segmented mandrels
6. integrated mandrels
7. mandrels with connections/bosses
8. other (to be specified)

7. Produce composite mouldings, using two types of resin from:
   1. bio resin
   2. thermoplastic
   3. polyester
   4. vinyl ester
   5. epoxy
   6. phenolic
   7. other (to be specified)

8. Produce composite mouldings, using two types of fibre from:
   1. natural fibre
   2. thermoplastic
   3. glass
   4. aramid
   5. carbon
   6. hybrid
   7. other (to be specified)

9. Produce a range of mouldings using four types of reinforcement from:
   1. uni-directional tows
   2. unidirectional tapes
   3. tissues/veils
   4. woven fabrics
   5. multi-axis fabrics
   6. chopped strand with resin spray
   7. pre-impregnated tows/tapes
   8. thermoplastic powder impregnated fabric
   9. co-mingled thermoplastic fabric
   10. other (to be specified)

10. Use two of the following for applying temperature during the cure cycle:
    1. room temperature
2. oven
3. heated tools/moulds
4. deposition head heater
5. curing lamps
6. heat mats
7. autoclave
8. other (to be specified)

11. Remove completed mouldings from mandrels using two of the following methods (where applicable):
   1. reciprocating extraction
   2. continuous extraction
   3. stripper plate
   4. electric ram
   5. pneumatic ram
   6. hydraulic ram
   7. anchored mandrel & part puller/lifter
   8. mandrel segment removal
   9. other (to be specified)

12. Visually inspect a number of sample or trial mouldings, and identify two of the following:
   1. mouldings which meet the required specification
   2. mouldings which have defects
   3. mouldings that require further investigation

13. Produce mouldings which comply with one of the following standards:
   1. Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
   2. Ministry of Defence (MoD)
   3. Military Aviation Authority (MAA)
   4. Federal Aviation Authority (FAA)
   5. Aerospace Quality Management Standards (AS)
   6. BS, ISO or BSEN standards and procedures
   7. customer standards and requirements
   8. company standards and procedures
   9. manufacturers standards and procedures

14. Complete the relevant paperwork, to include one from the
following and pass it to the appropriate people:
1. build records
2. job cards
3. log cards
4. aircraft log
5. other specific recording method
Behaviours

You will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as:

- strong work ethic
- positive attitude
- team player
- dependability
- responsibility
- honesty
- integrity
- motivation
- commitment
**Developed by**  
Semta

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**Relevant Occupations**  
Engineer; Engineering; Engineering and manufacturing technologies; Engineering Technicians

**Suite**  
Aeronautical Engineering Suite 3

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