



**Australian Government**

**Department of Education, Employment and Workplace Relations**

# **PMBPROD390B Produce composites using filament winding**

**Revision Number: 1**

## **PMBPROD390B Produce composites using filament winding**

### **Modification History**

Not applicable.

### **Unit Descriptor**

#### **Unit descriptor**

This competency covers preparation and operations for forming composite products using filament winding processes and the solving of problems.

### **Application of the Unit**

#### **Application of this unit**

This competency is typically performed by advanced operators applying knowledge of materials, product purpose and processes to the operation of filament winding equipment to produce product conforming to requirements. It also requires using a range of well developed skills requiring some discretion and judgement to recognise and resolve a range of problems. The operator will:

- start up the filament winding machine
- check settings of equipment, dies, mandrels, winders, moulds and formers
- monitor equipment operation
- make appropriate adjustments to correct materials, equipment or process variations
- solve filament winding equipment, material, and process problems, seeking guidance where necessary or appropriate.
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### **Licensing/Regulatory Information**

Not applicable.

## Pre-Requisites

### Prerequisites

This unit has the prerequisite of *PMBPROD290B Operate filament winding equipment*.

## Employability Skills Information

### Employability Skills

This unit contains employability skills.

## Elements and Performance Criteria Pre-Content

| ELEMENT                                                          | PERFORMANCE CRITERIA                                                                                                                                                            |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Elements describe the essential outcomes of a unit of competency | Performance criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the evidence guide. |

## Elements and Performance Criteria

| <b>ELEMENT</b><br><b>ELEMENT</b>                                               | <b>PERFORMANCE CRITERIA</b><br>Performance criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the evidence guide.                                                                                                                                                                                                                                                                                      |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Plan own work requirements.                                                 | 1.1 Identify the most appropriate equipment to be used for production and upstream and downstream operations from production plan or request.<br>1.2 Identify and check materials required including additives and their amounts and percentages.<br>1.3 Implement measures to control identified hazards in line with procedures and duty of care.<br>1.4 Identify requirements for materials, quality, production, and equipment checks.                                                          |
| 2. Start up filament winding process to procedures.                            | 2.1 Identify process settings required for product.<br>2.2 Set process to required settings.<br>2.3 Check materials are correct.<br>2.4 Take appropriate action for non-conforming materials.<br>2.5 Set up date, batch and materials markings to specifications, as required.<br>2.6 Complete other pre-start checks.<br>2.7 Start up filament winding moulding process.                                                                                                                           |
| 3. Operate and make adjustments to the filament winding process to procedures. | 3.1 Operate filament winding process, noting key variables.<br>3.2 Monitor controls/displays/terminals for production and process data.<br>3.3 Take samples as required and identify product out of specification.<br>3.4 Monitor product/process quality.<br>3.5 Make adjustments to remedy faults and nonconformity as required.<br>3.6 Establish a stable filament winding process.<br>3.7 Adjust process to minimise scrap and waste.<br>3.8 Clean, adjust and lubricate equipment as required. |
| 4. Shut down machine to procedures.                                            | 4.1 Determine type of shut down.<br>4.2 Select appropriate mandrel stripping method.<br>4.3 Strip mandrel efficiently and adequately as required.                                                                                                                                                                                                                                                                                                                                                   |

| <b>ELEMENT</b>          | <b>PERFORMANCE CRITERIA</b>                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ELEMENT                 | Performance criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the evidence guide.                                                                                                                                                                                                      |
|                         | 4.4 Leave machine in appropriate condition and with appropriate locks, tags or notices.<br>4.5 Complete relevant documentation.<br>4.6 Ensure area is clean and clear after the shutdown, in readiness for the next start up.                                                                                                                                                        |
| 5. Respond to problems. | 5.1 Recognise a problem or a potential problem.<br>5.2 Determine problems needing priority action.<br>5.3 Refer problems outside area of responsibility to appropriate person.<br>5.4 Seek information and assistance as required to solve problems.<br>5.5 Solve problems within area of responsibility.<br>5.6 Follow through items initiated until final resolution has occurred. |

## Required Skills and Knowledge

This describes the essential skills and knowledge and their level required for this unit.

Application of knowledge of the materials, equipment and process sufficient to recognise material and equipment conditions which may lead to out of specification production. For example, amount of applied tension is dependent on the fibre material, the diameter, and the pattern being wound and, if not correct, can affect the void content and fibre volume.

Therefore, as the spools unwind the fibre the signals received from the tension bars need to be monitored

Knowledge of organization procedures, quality requirements at each production stage and relevant regulatory requirements, and the ability to implement them within appropriate time constraints and work standards.

Skills to identify the range of possible causes of product faults

Application of the knowledge of managing risks using the hierarchy of controls applied to the filament winding process. Application of approved hazard control and safety procedures and the use of PPE in relation to handling materials, equipment operation and cleanup.

Knowledge as a basis for solving processing and material problems including:

- characteristics of materials in relation to temperature, tension and time for a required strength and surface finish of composite structure
- function and operating principles of filament winding equipment, machine components and ancillary equipment including the mechanical, hydraulic, pneumatic, electrical and electronic principles which effect machine operation
- impact of machine speed, temperature, pressure, time during cycles on product quality and production output
- phases of the filament winding cycle and the effect of the key variables on product quality, in order to make appropriate adjustments to machine settings. For example. the resin wiping phase is needed to remove excess resin from the impregnated fibre, too much resin will affect curing time and strength of composite.
- changes to materials at various stages of production
- waste management and importance of non-conforming materials
- impact of variations in raw materials and equipment operation in relation to final product
- material properties and their interactions with process conditions
- relationships between material properties and process conditions
- changes to material properties to better suit process requirements
- product problems related to material properties
- product problems related to process conditions
- adjustments to process conditions to meet material and product requirements.

Competence also includes the ability to:

- plan own work, including predicting consequences and identifying improvements
- maintain output and product quality using appropriate instruments, controls, test information and readings
- identify and describe own role and role of others involved directly in the process
- identify factors which may affect product quality or production output and appropriate remedies
- identify when assistance is required to solve problems.

### Language, literacy and numeracy requirements

This unit requires the ability to read and interpret typical product specifications, job sheets and material labels as provided to operators.

Writing is required to the level of completing workplace forms and production reports.

Numeracy is required to the level of determining required weights/volumes of materials in a resin mix for different circumstances (say using a data sheet), number of layers of impregnated matrix required to yield the required product laminate thickness, and similar activities.

## Evidence Guide

The Evidence Guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, the range statement and the assessment guidelines for this training package.

### Overview of assessment

A holistic approach should be taken to the assessment.

Assessors must be satisfied that the person can consistently perform the unit as a whole, as defined by the Elements, Performance Criteria and skills and knowledge.

Where the assessee does not currently possess evidence of competency in *PMBPROD290B Operate filament winding equipment*, it may be co-assessed with this unit.

### Critical aspects for assessment and evidence required to demonstrate competency in this unit

It is essential that competence is demonstrated in the knowledge and skills defined in this unit. These may include the ability to:

- identify critical materials properties and filament winding composites process variables in relation to the process requirements and the end product
- make adjustments to the process as required
- identify and take appropriate action on problems and potential problems.

Consistent performance should be demonstrated. For example, look to see that:

- the process runs consistently and smoothly with minimum need for operator intervention
- all safety procedures are followed.

### Assessment method and context

Assessment will occur on an industrial filament winding machine(s) equipment and will be undertaken in a work-like environment.

Competence in this unit may be assessed:

- by use of an appropriate, industrial moulding machine requiring demonstration of start up, operation and shut down procedures
- in a situation allowing the generation of evidence of the ability to recognise, anticipate and resolve problems
- by use of a suitable simulation and/or a range of case studies/scenarios
- by a combination of these techniques

In all cases it is expected that practical assessment will be combined with targeted questioning to assess the underpinning knowledge and theoretical assessment will be combined with appropriate practical/simulation or similar assessment. Assessors need to be aware of any cultural issues that may affect responses to questions.

Assessment processes and techniques must be culturally appropriate and appropriate to the oracy, language and literacy capacity of the assessee and the work being performed.

### **Specific resources for assessment**

This section should be read in conjunction with the Range Statement for this unit of competency. Resources required include suitable access to an operating plant or equipment that allows for appropriate and realistic simulation. A bank of case studies/scenarios and questions will also be required to the extent that they form part of the assessment method. Questioning may take place either in the workplace, or in an adjacent, quiet facility such as an office or lunchroom. No other special resources are required.

Access must be provided to appropriate learning and/or assessment support when required. Where applicable, physical resources should include equipment modified for people with disabilities.

## **Range Statement**

### **RANGE STATEMENT**

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts. Where reference is made to industry codes of practice and/or Australian/international standards, the latest version must be used.

### **Context**

This competency applies to the production of composite products by filament winding processes within the plastics and rubber industries. It includes the operation of all relevant additional equipment where that equipment is integral to the composites forming process.

### **Procedures**

All operations are performed in accordance with procedures.

Procedures include all relevant workplace procedures, work instructions, temporary instructions and relevant industry and government codes and standards.

### **Tools and equipment**

This competency includes use of equipment and tools such as:

- filament winding machines - electrical, pneumatic, mechanical, electromechanical and hydraulic
- dies, moulds, mandrels, formers
- hand tools, eg knives, cutters
- equipment for filament winding equipment and curing
- relevant personal protective equipment.

### **Hazards**

Typical hazards may include:

- hazardous vapours
- hazardous materials

- slip and fall
- manual handling hazards
- moving machinery hazards
- temperature
- equipment operations.

**Problems**

'Anticipate and solve problems' means resolve a wide range of routine and non-routine problems, using product and process knowledge to develop solutions to problems which do not have a known solution/a solution recorded in the procedures.

Typical routine faults may include:

- voids
- poor surface finish
- colour contamination
- curing damage
- distorted winding angle pattern.

Typical non-routine faults may include:

- damage from mandrel stripping
- warping or cracking after moulding
- inconsistent fibre spread
- filament breakage and fuzz generation.

Typical process and product problems may include:

- cracks, dents or imperfections of the mandrel, former, die
- variations in materials, colour, consistency or mix
- adjustment and settings of the equipment (such as creel-to-head transfer problems)
- contamination of materials
- curing conditions
- variations in materials and/or contamination of materials
- processing problems.

Appropriate action for problems outside of area of responsibility may be reporting to an appropriate person.

Appropriate action for solving problems within area of responsibility includes asking questions and seeking assistance from appropriate persons/sources.

**Variables**

Key variables to be monitored include:

- operating temperatures
- speeds, including the rotating speed of the mandrel
- spool tension
- colour
- cycle time
- output rate
- product weight
- product integrity and general conformance to specification/sample.
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## **Unit Sector(s)**

Not applicable.