



Australian Government

PMBTECH510 Analyse failure in polymeric materials

Release: 1

PMBTECH510 Analyse failure in polymeric materials

Modification History

Release 1. Supersedes and is equivalent to PMBTECH510A Analyse failure in polymeric materials

Application

This unit of competency covers the skills and knowledge required to analyse failure in polymeric materials. It applies to polymer compounds, such as crystalline and amorphous polymers, reinforced (fillers or fibres) and filled compounds, crosslinked and uncrosslinked polymers.

This unit of competency applies to experienced technicians or those in similar roles who are required to apply in-depth knowledge of materials, process, equipment and problem solving in order to analyse the mechanical/physical responses of different polymers, compounds and physical shapes to different applications of stress and strain and identify options for modifying these responses to suit different applications.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Nil

Competency Field

Technical

Unit Sector

Not applicable

Elements and Performance Criteria

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

1	Analyse response to steady and static loads	1.1	Determine stress strain response
		1.2	Determine tear/notch failures
		1.3	Identify modulus and yield
		1.4	Identify creep and stress relaxation

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| | | 1.5 | Determine stiffness |
| | | 1.6 | Identify applications where the typical viscoelastic response of polymers is an advantage |
| | | 1.7 | Identify applications where the typical viscoelastic response of polymers must be modified and common methods of modification |
| 2 | Analyse response to time varying loads | 2.1 | Determine hysteresis in tensile and shear loadings |
| | | 2.2 | Determine the effect of slow/rapid (impact) loading |
| | | 2.3 | Identify failure modes in flex cycling |
| | | 2.4 | Identify fatigue failure |
| | | 2.5 | Identify failures in sinusoidal loadings |
| | | 2.6 | Identify applications where the typical viscoelastic response of polymers is an advantage |
| | | 2.7 | Identify applications where the typical viscoelastic response of polymers must be modified and common methods of modification |
| 3 | Analyse the effect of environment/history on mechanical response | 3.1 | Determine effect of temperature on response |
| | | 3.2 | Determine effect of surface degradation on response |
| | | 3.3 | Determine effect of molecule/fibre/filler orientation on response |
| | | 3.4 | Determine the effect of environmental degradation on failure |
| | | 3.5 | Identify applications where the typical response of polymers is an advantage |
| | | 3.6 | Identify applications where the typical response of polymers must be modified and common methods of modification |
| 4 | Analyse the effect | 4.1 | Determine the effect of shape on the stress/strain |

of shape on mechanical response		relationship (triaxiality)
	4.2	Determine the effect of shape on stiffness
	4.3	Determine the effect of shape on response to cyclical loads
	4.4	Determine the effect of shape on creep and relaxation
	4.5	Identify applications where the typical response of polymers is an advantage
	4.6	Identify applications where the typical response of polymers must be modified and common methods of modification

Foundation Skills

This section describes those required skills (language, literacy and numeracy) that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Regulatory framework The latest version of all legislation, regulations, industry codes of practice and Australian/international standards, or the version specified by the local regulatory authority, must be used.

Applicable legislation, regulations, standards and codes of practice include:

- health, safety and environmental (HSE) legislation, regulations and codes of practice relevant to the workplace, materials and processes being used and products being made
- Australian/international standards relevant to the materials and products being tested
- any relevant licence and certification requirements.

All operations to which this unit applies are subject to stringent HSE requirements, which may be imposed through state/territory or federal

legislation, and these must not be compromised at any time. Where there is an apparent conflict between performance criteria and such requirements the legislative requirements take precedence.

Procedures All operations must be performed in accordance with relevant procedures.

Procedures are written, verbal, visual, computer-based or in some other form, and include one or any combination of:

- test procedures
- technical specifications
- technical drawings
- emergency procedures
- work instructions
- standard operating procedures (SOPs)
- safe work method statements (SWMS)
- formulae/recipes
- batch sheets
- temporary instructions
- any similar instructions provided for the smooth running of the plant.

Tools and equipment

Tools and equipment include:

- stress/strain testers
- impact testers
- cycling testers
- environmental ageing equipment
- basic length/thickness measuring equipment.

Hazards

Hazards must be identified and controlled. Identifying hazards requires consideration of:

- stored energy (e.g. in stressed test samples)
- test preparation equipment
- conditions and materials used for causing sample degradation
- hazardous products and materials
- other hazards that might arise.

Unit Mapping Information

Release 1. Supersedes and is equivalent to PMBTECH510A Analyse failure in polymeric materials

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=932aacef-7947-4c80-acc6-593719fe4090>

Assessment Requirements for PMBTECH510 Analyse failure in polymeric materials

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria and demonstrate the ability to:

- read and interpret test results, technical information, technical drawings, graphs, equipment specifications and instruments/control panels
- determine and analyse the viscoelastic response of polymer materials/components to various stress and strain conditions, including:
 - impact, steady and repeated application
 - application under different physical and chemical conditions
 - response of different shapes
 - response of different polymers
- identify applications where these responses are advantageous
- identify options for modifying these responses to suit different applications
- communicate technical information verbally and in writing
- calculate stress/strain and related data.

Knowledge Evidence

Must provide evidence that demonstrates knowledge relevant to their job sufficient to fulfil their job role, including knowledge of:

- models of viscoelasticity
- classical (i.e. elastic) stress and strain
- classical (i.e. elastic) Young's modulus and Poisson ratio
- stress, compression, shear and torsion
- stiffness and bending moments
- creep and relaxation
- effects of temperature (above and below the glass transition point)
- effects of degradation, e.g. surface oxidation (such as UV, O₃); swelling (such as solvent, chemical)
- three dimensional responses to stress
- responses to stress cycling, including heat build up
- mechanical responses to changing the properties of polymer structures and components
- relationship of polymer viscoelastic responses to product applications

- applications where typical polymer properties are an advantage
- common methods of modifying response to suit different applications
- methods for determining polymer viscoelastic response to stress and strain under various conditions, including:
 - impact, steady and repeated application
 - application under different physical and chemical conditions
 - response of different shapes
 - response of different polymers
- organisation procedures relevant to the work environment/job role
- hierarchy of control
- hazards that may arise in the job/work environment and:
 - their possible causes
 - potential consequences
 - appropriate risk controls.

Assessment Conditions

- The unit should be assessed holistically and the judgement of competence shall be based on a holistic assessment of the evidence.
- The collection of performance evidence is best done from a report and/or folio of evidence drawn from:
 - a single project which provides sufficient evidence of the requirements of all the elements and performance criteria
 - multiple smaller projects which together provide sufficient evidence of the requirements of all the elements and performance criteria.
- A third-party report, or similar, may be needed to testify to the work done by the individual, particularly when the project has been done as part of a project team.
- Assessment should use a real project in an operational workplace. Where this is not possible or where personal safety or environmental damage are limiting factors assessment must occur using a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions. This must cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- Assessment in a simulated environment should use evidence collected from demonstration of skills and one or more of:
 - walk-throughs
 - pilot plant operation
 - industry-based case studies/scenarios
 - ‘what ifs’.
- Knowledge evidence may be collected concurrently with performance evidence or through an independent process, such as workbooks, written assessments or interviews.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

- Conditions for assessment must include access to all tools, equipment, materials and documentation required, including relevant workplace procedures, product and manufacturing specifications associated with this unit.
- Foundation skills are integral to competent performance of the unit and should not be assessed separately.
- Assessors must satisfy the assessor competency requirements that are in place at the time of the assessment as set by the VET regulator.
- In addition the assessor or anyone acting in subject matter expert role in assessment shall demonstrate both technical competency and currency. If the assessor cannot demonstrate technical competency and currency they shall assess with a subject matter expert who does meet these requirements.
- Technical competence can be demonstrated through one or more of:
 - relevant VET or other qualification/Statement of Attainment
 - appropriate workplace experience undertaking the type of work being assessed under routine and non-routine conditions
 - appropriate workplace experience supervising/evaluating the type of work being assessed under routine and non-routine conditions
- Currency can be demonstrated through one or more of:
 - being currently employed undertaking the type of work being assessed
 - being employed by the organisation undertaking the type of work being assessed and having maintained currency in accordance with that organisation's policies and procedures
 - having consulted/had contact with an organisation undertaking the type of work being assessed within the last twelve months, the consultation/contact being related to assessment
 - conducting on the job training/assessments of the type of work being assessed
 - being an active member of a relevant professional body and participating in activities relevant to the assessment of this type of work.

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