Australian Government

Department of Education, Employment and Workplace Relations

PMBTECH510A Analyse failure in polymeric materials

Revision Number: 1

PMBTECH510A Analyse failure in polymeric materials

Modification History

Not applicable.

Unit Descriptor

Unit descriptor

This competency covers the viscoelastic response of polymeric materials to stress and strain under various conditions. It covers the response of different polymers, compounds and physical shapes with different applications of stress and strain.

Application of the Unit

Application of this unit

This competency applies to technicians who are required to differentiate between products and compounds based on their response to applied stress/strain.
It includes:

- crystalline and amorphous polymers
- reinforced (fillers or fibres) and filled compounds
- crosslinked and uncrosslinked polymers
- impact, steady and repeated application
- application under different physical and chemical conditions
- response of different shapes
- applications of this to typical products/situations.
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Prerequisites
This unit has **no** prerequisites.

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

ELEMENT	PERFORMANCE CRITERIA
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.
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. 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

ELEMENT ELEMENT	PERFORMANCE CRITERIA Performance criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the evidence guide.
	methods of modification.
4. Analyse the effect of shape on mechanical response.	4.1 Determine the effect of shape on the stress/strain 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.

Required Skills and Knowledge

This describes the essential skills and knowledge and their level required for this unit.
Competence in this unit requires the ability to apply and explain:

- classical (ie elastic) stress and strain
- classical (ie elastic) Young's modulus and Poisson ratio
- stress, compression, shear and torsion
- stiffness and bending moments
- application of the above for viscoelastic bodies
- models of viscoelasticity
- creep and relaxation
- effects of temperature (above and below the glass transition point)
- effects of degradation, eg 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

Language, **literacy and numeracy requirements**
This unit requires the ability to interpret and apply technical information.
Reading is required to the level of reading and applying technical brochures, books and other information.
Numeracy is required to the level of applying technical information and calculating stress/strain and related data, drawing and interpreting graphs.

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

- explain test results in terms which are appropriate to the polymeric material of the sample
- apply the results of the analyses to typical applications
- identify applications where typical polymer properties are an advantage
- distinguish between applications where polymers may be used satisfactorily (although without an inherent advantage) and those where it has an inherent advantage.

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

- the model(s) of viscoelasticity can be consistently applied to a range of likely situations

- the response to the application of stress in a range of circumstances can be explained
- the effect of shape can be predicated and explained for different stress application situations.

Context of assessment
This unit will require an assessment of the underpinning principles and should also include practical analyses as indicated by the elements. Such practical would typically be undertaken in a laboratory, either in an industry workplace or a teaching facility
Competence in this unit may be assessed:

- in a teaching facility laboratory
- in an industrial laboratory
- in a situation where the tests can be done
- using suitable simulation and/or a range of case studies/scenarios
- through a combination of these techniques.

Method of assessment
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. Bold italicised wording in the Performance Criteria is detailed below. 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 technicians who are required to analyse the mechanical/ physical responses of polymer structures and components. These may include:

- large structural beams,

- small mechanical components,
- damping products such as bridge or acoustic bearings
- other items where the mechanical/physical properties are important.

It includes a wide range of polymer compounds including:

- crystalline and amorphous polymers
- reinforced (fillers or fibres) and filled compounds
- crosslinked and uncrosslinked polymers.

However, the properties of these polymers is not the prime focus of this unit.

Procedures

All operations are performed in accordance with procedures.

Procedures means all relevant workplace procedures, work instructions, temporary instructions and relevant industry and government codes and standards. ASNZ/ISO standards for mechanical/physical testing of polymers will be relevant here and appropriate standards should be followed.

Tools and equipment

This competency includes use of equipment and tools such as:

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

Hazards

Typical hazards include:

- stored energy (eg in stressed test samples
- test preparation equipment
- conditions and materials used for causing sample degradation.
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Unit Sector(s)

Not applicable.