

<b>Title</b>	<b>Explain the influence of polymer morphology on properties and processing of plastics materials</b>		
<b>Level</b>	<b>4</b>	<b>Credits</b>	<b>7</b>

<b>Purpose</b>	People credited with this unit standard are able to explain: polymer morphology; the properties of polymers in relation to their morphology; physical failure in polymers; and plastics materials test methods and property data.
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<b>Classification</b>	Plastics Processing Technology > Plastics Materials
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<b>Available grade</b>	Achieved
<b>Recommended skills and knowledge</b>	Unit 23131, <i>Compare melt flow and dimensional stability of plastics materials.</i>

### Explanatory notes

- 1 Reference will be required to the following types of international testing standards:
  - a American Society for Testing and Materials (ASTM);
  - b British Standards (BS);
  - c Deutsches Institut für Normierung (DIN);
  - d International Standards Organisation (ISO).
  
- 2 Descriptions of polymer morphology are limited to commonly accepted diagrammatic representations, without references to the chemical form and structure of polymer molecules.

### Outcomes and evidence requirements

#### Outcome 1

Explain polymer morphology.

#### Evidence requirements

- 1.1 The explanation uses phase diagrams to describe the effect of changes in molecular weight and temperature on amorphous and crystalline polymers.
  
- 1.2 The explanation uses phase diagrams to identify the glass transition temperature and melting point relative to ambient temperature for amorphous and crystalline polymers.

Range            amorphous and crystalline polymers – polyethylene, nylon, polystyrene, polycarbonate.

- 1.3 The explanation uses phase diagrams to describe the morphological changes occurring to polymers as the temperature is raised to typical moulding conditions.
- Range typical moulding conditions – melt processing, thermoforming.
- 1.4 The explanation describes the effect of cooling rate on polymer morphology.
- Range nucleation rate, crystal growth rate, degree of crystallisation, crystal size.
- 1.5 The explanation describes why molecular orientation occurs during all stages of processing.
- 1.6 The explanation describes potential product dimension changes due to internal stresses resulting from molecular orientation.
- 1.7 The explanation describes the effect of post-mould annealing on the degree of crystallisation and crystal size.

## Outcome 2

Explain the properties of polymers in relation to their morphology.

### Evidence requirements

- 2.1 The explanation describes the effect of temperature on the physical properties of crystalline and amorphous polymers.
- Range physical properties – tensile strength, rigidity, impact strength.
- 2.2 The explanation describes the effect of the degree and size of crystallisation on the physical properties of polymers.
- Range physical properties – tensile strength, rigidity, impact strength, melting point, clarity.
- 2.3 The explanation describes the effect of molecular orientation on the physical properties of crystalline and amorphous polymers.
- Range physical properties – tensile strength, rigidity, impact strength, clarity.
- 2.4 The explanation describes the factors affecting shrinkage for crystalline and amorphous polymers, in relation to their morphology.
- Range factors affecting shrinkage – coefficient of thermal expansion, cooling rate, post-mould cooling, molecular orientation.

**Outcome 3**

Explain physical failure in polymers.

**Evidence requirements**

3.1 The explanation describes conditions that may result in physical failure.

Range conditions – short term loading, long term loading, cyclic loading, operational environment, environmental stress cracking (ESC).

3.2 The explanation describes how physical failure is affected by polymer molecular weight and morphology.

Range physical failure – impact, tensile, ESC.

**Outcome 4**

Explain plastics materials test methods and property data.

**Evidence requirements**

4.1 The explanation describes the relationship and limitations of flow data to the melt flow properties of plastics materials.

Range limitations – variable test conditions;  
flow data – intrinsic viscosity, K-value, melt flow index or rate;  
plastics materials – polyolefins, polystyrenes, PVCs, polyesters.

4.2 The explanation describes the principles of physical test methods.

Range tests – impact, tensile, water absorption, density.

4.3 The explanation identifies international standards and demonstrates an awareness of possible variations between standards for the testing of physical properties.

Range tests – impact, tensile, water absorption, density;  
international standards – ASTM, DIN, ISO, BS.

4.4 The explanation describes the significance of a variation in material test data for different grades of the same material.

Range tests – impact, tensile (yield strength, modulus of elasticity, percentage of elongation), water absorption, density, flow data.

<b>Planned review date</b>	31 December 2021
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**Status information and last date for assessment for superseded versions**

Process	Version	Date	Last Date for Assessment
Registration	1	21 March 1997	31 December 2019
Revision	2	15 November 2002	31 December 2019
Review	3	24 August 2006	31 December 2019
Review	4	15 September 2016	N/A

**Consent and Moderation Requirements (CMR) reference**

0013

This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.

**Please note**

Providers must be granted consent to assess against standards (accredited) by NZQA, before they can report credits from assessment against unit standards or deliver courses of study leading to that assessment.

Industry Training Organisations must be granted consent to assess against standards by NZQA before they can register credits from assessment against unit standards.

Providers and Industry Training Organisations, which have been granted consent and which are assessing against unit standards must engage with the moderation system that applies to those standards.

Requirements for consent to assess and an outline of the moderation system that applies to this standard are outlined in the Consent and Moderation Requirements (CMR). The CMR also includes useful information about special requirements for organisations wishing to develop education and training programmes, such as minimum qualifications for tutors and assessors, and special resource requirements.

**Comments on this unit standard**

Please contact Competenz [qualifications@competenz.org.nz](mailto:qualifications@competenz.org.nz) if you wish to suggest changes to the content of this unit standard.