Title	**Perform heat transfer calculations for plastics processing**		
Level	**5**	**Credits**	**8**

Purpose	People credited with this unit standard are able to: describe and interpret the thermal properties of molten polymers; explain and calculate heat transfer factors applicable to plastics processing; and calculate the energy balance in plastics processing production systems.

Classification	Plastics Processing Technology > Plastics Processing - General

Available grade	Achieved

Entry information	
Recommended skills and knowledge	Competence in the transposition of formulae, the manipulation of equations, and the use of trigonometric functions; and have an understanding of fundamental concepts of physics (mass, length, and time) and derived concepts including pressure, force, gravitational effect, velocity, acceleration, and energy.

Explanatory notes

None.

Outcomes and evidence requirements

Outcome 1

Describe and interpret the thermal properties of molten polymers.

Range common plastics materials – low and high density polyethylene, polypropylene, polyacetal, polycarbonate, polystyrene, polyvinyl chloride;
evidence is required for two common plastics materials.

Evidence requirements

1.1 The specific heat and latent heat of fusion of plastics materials are defined, and changes in these properties as the plastics materials are raised to, and lowered from, typical processing temperatures are described.

1.2 The heat content of plastics materials is defined, and graphical representations describing changes in heat content for common plastics materials as they are raised to typical processing temperatures are interpreted.

Outcome 2

Explain and calculate heat transfer factors applicable to plastics processing.

Evidence requirements

2.1 The common heating sources and methods used in plastics processing are identified, and their effectiveness, efficiency and control are compared and contrasted.

Range heating sources and methods – electrical conductive (injection moulding, blow moulding, extrusion, welding), electrical radiant (thermoforming), steam conductive (expanded polystyrene), hot air convective (rotational moulding, welding), wavelength/infrared (laminating and joining), laser (welding), ultrasonic (welding), vibration (welding);
evidence is required for two heating sources and methods.

2.2 The common cooling sources and methods used in plastics processing are identified, and their effectiveness, efficiency and control are compared and contrasted.

Range cooling sources and methods – water and oil conductive (injection moulding, blow moulding, thermoforming), water convective (extrusion), air convective (blown film, rotational moulding, thermoforming, blow moulding);
evidence is required for two cooling sources and methods.

2.3 Heating and cooling examples of conductive heat transfer are identified and heat flow rates are calculated for them.

Range examples are – multiple parallel and cylindrical walls;
conductive heat transfer – steady and unsteady state, laminar and turbulent flow;
evidence is required for one heat flow rate calculation for each type of conductive heat transfer.

2.4 Heating and cooling examples of convective heat transfer are identified and heat flow rates are calculated for them.

Range convective heat transfer – natural and forced;
evidence is required for one heat flow rate calculation.

2.5 An example of radiant heat transfer is identified and its heat flow rate is calculated.

2.6 An example of combined convective and radiant heat transfer is identified and its heat flow rate is calculated.

Outcome 3

Calculate the energy balance in plastics processing production systems.

Range plastics processing production systems – extrusion, blown film extrusion, injection moulding, blow moulding, thermoforming, rotational moulding.

Evidence requirements

3.1 The components which make up the energy balance existing in an example of a plastics processing production system are identified.

3.2 The energy value is calculated for each of the components which make up the energy input to, and energy output from, an example of a plastics processing production system.

Planned review date	31 December 2021

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	27 May 2002	31 December 2019
Rollover and Revision	2	25 September 2006	31 December 2019
Review	3	11 December 2009	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 if you wish to suggest changes to the content of this unit standard.