

Title	Demonstrate knowledge of scientific principles and energy costs that apply to pulp and paper manufacturing		
Level	3	Credits	10

Purpose	People credited with this unit standard are able to: explain the physical principles of the states of matter; demonstrate knowledge of principles of work and energy, and principles of heat, types of forces, and types of simple machines that apply to pulp and paper manufacturing; and demonstrate knowledge of energy costs in pulp and paper manufacturing.
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Classification	Wood Fibre Manufacturing > Pulp and Paper Technology
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Available grade	Achieved
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Guidance Information

All performance criteria must be demonstrated and assessed in accordance with the reference text: *Demonstrate knowledge of principles of heat and work* (Auckland: Competenz, 2000).

Outcomes and performance criteria

Outcome 1

Explain the physical principles of the states of matter as they relate to pulp and paper manufacturing.

Performance criteria

- 1.1 Properties of each state of matter are defined in terms of shape, volume, and compression.
- 1.2 Principles of vapour pressure and its relationship to boiling are explained.
- 1.3 Use of steam to transfer energy, and the principles of the steam cycle and latent heat, are explained using paper and pulp manufacturing industry examples.
- 1.4 Relationship between volume, temperature, and pressure is explained in terms of Charles' and Boyle's laws.

Outcome 2

Demonstrate knowledge of principles of work and energy used in pulp and paper manufacturing.

Performance criteria

- 2.1 Energy, work, and power are defined.
- 2.2 Types of energy including potential, kinetic, thermal, and chemical are defined; sources and applications for each type in pulp and paper manufacturing are explained.
- 2.3 The law of conservation of energy is explained and an energy balance is described for a selected pulp and paper manufacturing operation.

Outcome 3

Demonstrate knowledge of principles of heat that apply to pulp and paper manufacturing.

Performance criteria

- 3.1 The terms 'heat' and 'temperature' are defined and the difference between them is explained.
- 3.2 Changes that occur with the application of heat are explained in terms of latent heat, expansion, and changes of state.
- 3.3 Types of heat transfer including conduction, convection, and radiation are explained using pulp and paper manufacturing examples.

Outcome 4

Demonstrate knowledge of the types of forces encountered in pulp and paper manufacturing.

Performance criteria

- 4.1 Principles of force, equilibrium, gravity, mass, weight, and centripetal force are defined and applied to pulp and paper manufacturing.
- 4.2 Calculations involving the application of force are carried out to measure variables in a pulp and paper manufacturing specific situation.

Outcome 5

Demonstrate knowledge of the types of simple machines used in pulp and paper manufacturing.

Performance criteria

- 5.1 Principles and applications of levers, gears, pulleys, and inclined planes are described in terms of pulp and paper manufacturing.
- 5.2 Calculations involving mechanical advantage and velocity ratio are carried out to measure variables in a pulp and paper manufacturing specific situation.

Outcome 6

Demonstrate knowledge of energy costs in pulp and paper manufacturing.

Performance criteria

- 6.1 The significance of energy costs in pulp and paper manufacturing is explained in terms of purchased fuel consumption, purchased energy costs, and average purchased energy costs.
- 6.2 Methods to minimise energy costs in pulp and paper manufacturing are explained in terms of modification of process and equipment, recovery and reuse of energy, thermodynamic loss control, utilisation of all energy resources available, and cogeneration.

Replacement information	This unit standard was replaced by unit standard 33293. This unit standard replaced unit standard 17861.
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This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	19 March 2015	31 December 2025
Review	2	30 November 2023	31 December 2025

Consent and Moderation Requirements (CMR) reference	0173
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This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.