Title	**Demonstrate knowledge of on/off and proportional integral derivative mode control theory and controllers**		
Level	**4**	**Credits**	**8**

Purpose	People credited with this unit standard are able to demonstrate knowledge of: – on/off and proportional integral derivative (PID) control theory; – on/off and PID controllers; and – control loop drawings.

Classification	Industrial Measurement and Control > Industrial Measurement and Control - Theory

Available grade	Achieved

Guidance Information

1 References
ANSI/ISA-5.1-2009 *Instrumentation Symbols and Identification;*
ANSI/ISA-51.1-1979 (R1993) *Process Instrumentation Terminology*;
and all subsequent amendments and replacements.

2 A useful reference to drawing symbols according to the format of the Scientific Apparatus Manufacturer Association (SAMA) will be found in:
Friedmann, P.G. and Stoltenberg, T.P. (eds) Continuous Process Control. (Research Triangle Park, NC: Instrument Society of America, 1996.).

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of on/off and proportional integral derivative (PID) control theory.

Performance criteria

1.1 Define commonly used process control terms and provide an example of each.

Range dead time, first order process, second order process, integrating process (level), non-integrating process (flow), controlled variable, process variable, setpoint, error.

1.2 Describe on/off control and its application.

Range process, temperature, pressure large capacity.

1.3 Describe characteristics of on/off control, and perform calculations relating to a level process with constant load.

Range neutral zone (differential gap), period of oscillation, amplitude of oscillation, dead time.

1.4 Define 'actions' relating to controller output operations.

Range direct acting, reverse acting.

1.5 Define units of proportional only control and the relationship between them.

Range proportional band, gain, bias.

1.6 Explain, using calculations, limitations of proportional only control under load change conditions, on a level process with constant outflow.

Range offset, proportional band setting, process size.

1.7 Define integral (also known as reset) control action and the units used.

Range repeats/minute, minutes/repeat.

1.8 Derivative (also known as rate or pre-act) control action and the derivative limiter coefficient are defined and their uses explained.

Range minutes, speed-up setting of slow moving process, acts on process variable signal in standard controllers.

1.9 Perform calculations and tests to determine the open loop (automatic mode) response of a PID controller to step and ramp inputs.

Range proportional only, proportional and integral, proportional and derivative, proportional and integral and derivative.

1.10 Describe closed loop control response characteristics of the process measurement for a proportional integral and derivative controller.

Range proportional only, proportional and integral, proportional and derivative, proportional, integral and derivative.

1.11 Describe closed loop control response characteristics.

Range critically damped, underdamped, overdamped, quarter amplitude damped.

Outcome 2

Demonstrate knowledge of on/off and PID controllers.

Performance criteria

2.1 Describe on/off controllers.

Range thermostat, level process types, pressure control.

2.2 Describe PID controllers with the aid of diagrams.

Range pneumatic, electronic operational amplifier based, microprocessor.

2.3 Define auto/manual transfer methods used on controllers.

Range bumpless transfer, setpoint tracking of process variable in manual mode.

2.4 Describe reset windup and methods of prevention.

Range saturation of the controller output, external reset feedback.

2.5 Analyse PID control implementations.

Range interacting and non-interacting gains, derivative on setpoint, derivative on error.

Outcome 3

Demonstrate knowledge of control loop drawings.

Performance criteria

3.1 Define control loop schematic drawing symbol formats.

Range symbol formats – ISA, SAMA.

3.2 Construct and interpret a control loop diagram for each of level, temperature, and flow, using standard symbols.

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	31 October 1995	31 December 2013
Revision	2	30 October 1997	31 December 2013
Revision	3	3 April 2001	31 December 2013
Review	4	22 June 2001	31 December 2013
Review	5	19 May 2008	31 December 2019
Review	6	28 November 2013	31 December 2027
Rollover	7	28 June 2018	31 December 2027
Review	8	30 January 2025	31 December 2027

Consent and Moderation Requirements (CMR) reference	0003

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