Title	**Demonstrate knowledge of control system hardware and interfaces for industrial measurement and control systems**		
Level	**5**	**Credits**	**15**

Purpose	This unit standard is intended for use in the training and assessment of industrial measurement and control. People credited with this unit standard are able to demonstrate knowledge of: – hardware platforms for control systems; – industrial data communication systems; – earthing, bonding, and shielding as applied to industrial instrumentation and control systems; – surge and interference protection; and – operator interfaces.

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

Available grade	Achieved

Guidance Information

1 This unit standard has been designed for learning and assessment off-job.

2 Definitions
a.c. – alternating current.
DCS – Distributed control system.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.
LAN – local area network.
MIS – Management information systems.
Over voltage – A 10% or greater increase in voltage outside normal limits.
PAC – Programmable automation system.
PLC – Programmable logic controller.
RF – radio frequency.
Safe and sound practice – relating to the installation of electrical equipment is defined in AS/NZS 3000:2007.
Sag – *a* short-term decrease in voltage lasting less than 1 minute.
SCADA – Supervisory Control and Data Acquisition.
Swell – *a* short-term increase in voltage lasting less than 1 minute.
Transient – a short, sharp, momentary increase in voltage, typically of microsecond duration. Alternative terms – *Spike* and *Surge.*
Under voltage – a 10% or greater decrease in voltage outside normal limits.

3 References

ANSI/ISA-5.1-2009 *Instrumentation symbols and identification*;
AS/NZS 60076.6:2013 *Power transformers Reactors*;
AS 1307.2-1996 (R2015) *Surge arresters – Metal-oxide surge arresters without gaps for a.c. systems*;
AS/NZS 1768:2007 *Lightning protection*;
AS/NZS 3000:2007 *Electrical installations* (*known as the Australian/New Zealand Wiring Rules*);
Boyer, Stuart A. (1999) *SCADA: supervisory control and data acquisition. 4th* ed. Research Triangle Park, N.C.: ISA;
BS EN 60801-2:1993, IEC 60801-2:1991 *Electromagnetic compatibility for industrial-process measurement and control equipment. Electrostatic discharge requirements*;
IEC 61000-2-4:2002 *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*;
IEC 62305-1:2010 *Protection against lightning - Part 1: General principles*;
IEEE C62.41.1-2002 – *Guide on the Surge Environment in Low-voltage (1000 V and Less) Ac Power Circuits;*
ISA-5.5-1985 *Graphic symbols for process displays*;
NFPA 780 (2017) *Standard for the installation of lightning protection systems.* National Fire Protection Association;
and all subsequent amendments and replacements.

4 Range

All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with legislation, policies, procedures, ethical codes and standards, safe and sound practice, and industry practice; and where appropriate, manufacturers' instructions, specifications, and data sheets.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of hardware platforms for control systems.

Range PLC, DCS, PAC, MIS, SCADA, bus-based distributed systems, supervisory system, control system hierarchy.

Performance criteria

1.1 Control and monitoring functions performed at different levels of control system hierarchy are described.

1.2 Properties of hardware platforms are identified and compared.

Range data scan rate, update times, data concentration, configuration and programming formats.

Outcome 2

Demonstrate knowledge of industrial data communication systems.

Performance criteria

2.1 Advantages and disadvantages of network interconnection formats are described.

Range copper, fibre optic, wireless.

2.2 Network topologies are described with reference to their interconnections, advantages, and disadvantages.

Range star, ring, bus.

2.3 Terms used to describe message format for data systems are outlined.

Range baud rate, start bit, stop bit, parity, preamble, header, address, field.

2.4 Network system addressing and configuration is defined.

Range node address, media access control address, internet protocol address, subnet mask, default gateway.

2.5 LAN segmentation and interconnection methods and devices are explained.

Range devices – bridges, routers, repeaters, gateways, hubs.

Outcome 3

Demonstrate knowledge of earthing, bonding, and shielding as applied to industrial instrumentation and control systems.

Performance criteria

3.1 The purpose and method of earthing communication circuits are explained.

Range video, bus systems, millivolt.

3.2 The segregation of instrument and electrical earthing systems, and the requirement for bonding between the two systems, are explained.

3.3 The role of galvanic isolation in achieving segregation of signals is described.

Range fibre optic, opto isolation, transformer coupling.

3.4 Instrument cable shielding practices are outlined.

Range shield bondings, shield design, pass through rooms or walls.

3.5 Bonding practices for electrical equipment and cabinets are outlined.

Range zero signal reference grid, bonding of cabinets to grid, bonding to building structure.

Outcome 4

Demonstrate knowledge of surge and interference protection.

Performance criteria

4.1 The operational principles and application of supply side surge protection using high voltage surge arresters are explained.

4.2 Types of interference are identified and methods of propagation are explained.

Range under voltage, over voltage, swell, sag, transient over voltage, harmonic, switching, RF.

4.3 The operational principles and application of surge protection of a.c. inductive circuits using metal oxide varistors, and resistance/capacitance circuits are explained.

4.4 The operational principles and application of gas arresters are identified and explained.

4.5 The purpose and advantages of using power conditioning devices are explained.

Outcome 5

Demonstrate knowledge of operator interfaces.

Performance criteria

5.1 The principles governing effective operator interface design are described.

Range use of – colours, character font and size, display navigation; consistency, priority indication.

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	21 August 2009	31 December 2027
Rollover and Revision	2	28 June 2018	31 December 2027
Review	3	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.