



Australian Government

MEM29004 Analyse and problem solve a PLC based industrial control system

Release: 1

MEM29004 Analyse and problem solve a PLC based industrial control system

Modification History

Release 1. New unit.

Application

This unit defines the skills and knowledge required to analyse the role of programmable logic controllers (PLCs) in Industry 4.0 workplace environments, including implementing PLC applications, testing and problem-solving a PLC-based Industry 4.0 related industrial control system (including setting up, testing and documenting the PLC program) and ensuring integration with other Industry 4.0 systems in a workplace. PLC controller functions and software may be local or cloud- based.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Nil

Competency Field

Applied technologies

Elements and Performance Criteria

Elements	Performance Criteria
Elements describe the essential outcomes.	Performance criteria describe the performance needed to demonstrate achievement of the element.
1. Identify the control and networking requirements for the PLC application	1.1 Identify the control system specifications and PLC application requirements from documentation, work request or discussion with relevant personnel 1.2 Analyse PLC application requirements and identify the relationship to the broader Industry 4.0 systems and environment in the enterprise 1.3 Analyse PLC application requirements for workplace health and safety (WHS) and risk control implications 1.4 Analyse control system specifications and PLC application requirements and determine the extent of local and cloud-based processing and programming required 1.5 Identify and select resources and equipment requiring local

Elements	Performance Criteria
Elements describe the essential outcomes.	Performance criteria describe the performance needed to demonstrate achievement of the element.
	installation that are consistent with PLC application requirements and manufacturer's specifications
2. Set up a PLC-based industrial control system	2.1 Apply WHS procedures and risk control measures associated with PLC application 2.2 Consult with appropriate personnel to ensure planned work is coordinated effectively with others and downtime is minimised 2.3 Check tools and equipment for serviceability and rectify or report any faults prior to commencement 2.4 Install required PLC modules, connectors, and other equipment according to manufacturer's specifications and PLC application requirements 2.5 Program PLC locally or via cloud according to manufacturer's specifications and PLC application requirements
3. Test and verify PLC program	3.1 Check equipment and machinery is isolated according to safety requirements before commencing PLC testing process 3.2 Test the function and operations of the PLC program 3.3 Resolve faults and other non-conformances including seeking expert assistance when needed 3.4 Verify test results and other diagnostic findings
4. Complete work and document PLC program	4.1 Advise appropriate personnel when PLC based industrial control system is completed and equipment and machinery can be released from isolation 4.2 Document PLC program and function test according to workplace procedures 4.3 Complete workplace documentation according to established procedures

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

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|--|---|
| Industry 4.0 systems include one or more of the following: | <ul style="list-style-type: none">• industrial internet of things (IIoT) devices• collaborative robots• networked and cloud connected traditional robots and other industrial automation• networked and cloud connected supervisory control and data acquisition systems (SCADA)• networked and cloud connected enterprise resource planning (ERP) systems• networked and cloud connected CAD and CAM systems• digital twins• augmented and virtual reality systems• networked and cloud connected CNC and additive manufacturing machines• networked and cloud connected data storage and processing facilities• networked and cloud connected edge devices• other networked and cloud connected digital devices and systems relevant to the workplace. |
| WHS procedures and risk control measures include one or more of the following: | <ul style="list-style-type: none">• personal protective equipment (PPE)• job safety analysis (JSA) worksheets• material safety data sheet (MSDS)• safety equipment and devices• safety signs /symbols. |
| PLCs include: | <ul style="list-style-type: none">• local PLCs where all PLC components, data transmission, programming and control functions are located within the workplace• hybrid PLCs where some programming software and controller functions are local and some are cloud based• software defined controllers (virtual PLCs) featuring one or more of:<ul style="list-style-type: none">• programming and controller functions are cloud based• networking via the cloud with other controllers and enterprise supervisory systems. |
| PLC modules include one or more of the following: | <ul style="list-style-type: none">• central processing unit (CPU) module• interface module• communication module• power supply module |

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- input/output (I/O) module.

PLCs are one or more of the following:

- original i.e. built in from equipment first manufacture
- retrofitted after manufacture to enhance equipment control.

Unit Mapping Information

No equivalent unit

Links

Companion Volume Implementation Guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b7050d37-5fd0-4740-8f7d-3b7a49c10bb2>

Assessment Requirements for MEM29004 Analyse and problem solve a PLC based industrial control system

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Performance Evidence

There must be evidence the candidate demonstrated the ability to:

- analyse complex information and documentation from at least two sources for PLC application requirements
- install at least two PLCs according to manufacturer's specifications and PLC application requirements including:
 - installing required modules, connectors, and other equipment
 - installing PLC protection equipment including:
 - over-voltage and over-current
 - physical shielding
 - magnetic shielding
 - physical security and access barriers/equipment
 - using appropriate testing equipment for PLC applications
 - taking accurate measurements during set up and implementation of at least two PLC-based industrial control systems
 - documenting PLC programs and function tests
- install, test and debug PLC code for at least one local and one cloud-based PLC
- research technology developments in PLC based industrial control systems for own area of responsibility
- locate hardware and software faults in at least two already installed PLCs
- produce logic flow diagrams and state diagrams.

Note: Where a volume and/or frequency is not specified, demonstration must be provided at least once.

Knowledge Evidence

There must be evidence the candidate has knowledge of:

- work health and safety (WHS) requirements relevant to PLC-based industrial control systems
- sources of technical information relating to PLC-based industrial control systems including manufacturer's specifications, workplace procedures and other relevant sources
- features of programmable controllers including:
 - relay control, static logic control and programmable control
 - programmable controller block diagram (inputs and outputs)

- programmable controller symbols
- programmable controller functions
- numbering systems start-up procedures
- special units
- advantages of distributed control PLCs in Industry 4.0 including:
 - shorter communication loops
 - facilitation of redundancy and backup
 - increased opportunity for incremental improvement to operations
- types of local and remote PLC connectivity including:
 - sensor-PLC
 - PLC – supervisory control and data acquisition (SCADA) system
 - PLC – enterprise resource planning system (ERP)
 - PLC – human machine interface
 - PLC – non-manufacturing-based programs
- ethernet and WiFi protocols relevant to PLCs
- relay logic circuits including:
 - series
 - parallel
 - combination of series and parallel
 - interlocking
- programmable logic including:
 - on state instruction
 - series equivalent circuits
 - parallel equivalent circuits
 - combination series/parallel
 - off state instruction
- control relay logic conversion
- fail safe including:
 - identifying need for fail safe
 - programming fail safe
 - hardware fail safe
 - program editors
 - Grafcet
 - statement list
 - ladder
 - graphical
- advanced logic concepts including:
 - move
 - block transfer
 - compare

- block compare
- and words
- mask
- maths function
- scaling and unscaling
- shift register
- multiplexing
- sequencer encompassing:
 - application
 - event
 - time driven
- Boolean algebra
- counters and timers
- bit operations
- data protocols
- cyber-security procedures and protocols relevant to PLCs
- diagnostic and troubleshooting procedures for PLC-based industrial control systems and their components
- procedures for documenting and reporting PLC program and test outcomes.
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Assessment Conditions

- Assessors must:
 - have vocational competency in problem solving PLC based industrial control system at least to the level being assessed with relevant industry knowledge and experience
 - satisfy the assessor requirements in the *Standards for Registered Training Organisations 2015* or its replacement and comply with the *National Vocational Education and Training Regulator Act 2011*, its replacement or equivalent legislation covering VET regulation in a non-referring state/territory as the case requires.
- Where possible, assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions that cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- There must be access to all tools, equipment, materials and documentation required, including relevant workplace procedures, product and manufacturing specifications.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
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