Australian Government

Department of Education, Employment and Workplace Relations

MEM234007A Design fluid power systems

Release: 1

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Modification History

New unit

Unit Descriptor

This unit of competency covers the design of fluid power systems, including pneumatic multi-actuator control systems; hydraulic systems, including hydrostatic transmissions, proportional and servo valve control, and programmable logic controllers (PLC). It includes occupational health and safety (OHS), regulatory requirements, automation safety and systematic design processes. Design considerations include dynamic loads and optimised control system response and stability.

Application of the Unit

This unit applies to fluid power systems across all forms of manufacturing and engineering. Design activities may also include reverse engineering, design rectification or modifications of an existing design. It is suitable for fluid power system and automation designers and maintenance personnel, and those pursuing engineering or related qualifications and careers.

Prior experience in evaluation of fluid power systems and hydrodynamics, mathematics, computer techniques, basic electrical and controllers is required.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

1	Interpret design brief for fluid power systems	1.1	Confirm the design brief and operational requirements with the client
		1.2	Establish technical, commercial and environmental parameters to the brief or contract
		1.3	Determine stakeholders to be consulted in design process
		1.4	Consider regulatory, sustainability or environmental issues relevant to the briefs
		1.5	Provide preliminary advice to client on the feasibility for realising the fluid power system design
2	Prepare concept proposal	2.1	Analyse and establish worksite requirements for fluid power system realisation in conjunction with the client
		2.2	Undertake initial design investigations for fluid power system capacity and responsiveness
		2.3	Carry out required modelling, simulation and calculations using appropriate software, and test equipment to determine fluid power system, function, behaviour and safety
		2.4	Generate a range of possible solutions to the design
		2.5	Check feasibility and validate solutions against design criteria ensuring conformity to OHS requirements and relevant standards
		2.6	Determine social and sustainability implications of solutions

		2.7	Review concept proposals with client to identify preferred solution
3	Design fluid power system	3.1	Develop selected fluid power design to meet specifications, including dimensioning, sizing and positioning of system components
		3.2	Evaluate sequence and mode control methods for multi-actuator circuit, stand alone and network designs for implementation
		3.3	Determine options for design of compressed air supply for a multi-application facility, if applicable
		3.4	Ensure that design solution is optimised with respect to the system specifications
		3.5	Develop fluid power design documentation, including drawings, circuit diagrams, specifications, operating instructions, manuals and training materials, if appropriate
		3.6	Check that the final design meets all required specifications and operational capabilities
		3.7	Consult with client and stakeholders to obtain sign-off on design

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required skills

Required skills include:

- determining features of fluid power systems, including OHS, regulatory and risk management requirements
- interpreting parameters to the brief or contract
- researching trends and techniques in:
  - fluid power design
  - reverse engineering
  - sustainability issues and implications
  - materials and components
  - assembly, fabrication and construction techniques
  - lean and other quality techniques
  - latest relevant modelling, simulation and validation techniques, and other software
- investigating and presenting options
- investigating faults in existing designs and propose solutions
- selecting and using software and validation techniques, including 2-D and 3-D modelling
- creating optimised design solutions for fluid power systems
- evaluating fluid power solutions for feasibility against design criteria, including relevant engineering and financial calculations and analysis
- communicating, negotiating and reviewing with stakeholders and clients throughout process to obtain agreement of proposal and sign-off on design
- documenting design with drawings, specifications and instructions

Required knowledge

Required knowledge includes:

- fluid power design methods
- current options and trends in design, performance analysis, modelling and simulation software, including underpinning program techniques and software validation techniques
- research and investigations methods
- techniques for:
  - continuous improvement
  - problem solving and decision making
  - root cause analysis (RCA) or failure mode and effects analysis (FMEA) or design review

based on failure mode (DRBFM), and Pareto analysis

- principles of fluid power designs
- dimensions, capacity and position of system components
- system responsiveness
- electrical and mechanical behaviours of fluid power systems
- hydraulics and designing with hydraulics components
- applications and characteristics of servo valves
- electronic controllers for proportional and servo valves
- sensor/transducer/amplifiers
- pneumatics and designing with pneumatic components
- multiple actuator control circuits
- compressed air system design
- OHS and regulatory requirements, codes of practice, standards, risk minimisation and registration requirements

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • interpret features of plant and equipment and parameters to the brief or contract • advise client based on discipline knowledge and OHS and regulatory standards • research sustainability implications and current industrial design techniques • determine OHS, regulatory and risk management requirements • investigate options for fluid power design • measure, model, calculate, analyse and use software and validation techniques • generate and evaluate a range of solutions for feasibility against design criteria • design optimum fluid power system solution • communicate, negotiate and review with stakeholders and client throughout process to obtain agreement on proposal and sign-off on design • document design with drawings, circuit diagrams, specifications and instructions.
Context of and specific resources for assessment	• This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is, the candidate is not in productive work, then a simulated working environment must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. • Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability. • Access must be provided to appropriate learning and/or assessment support when required. Where applicable, physical resources should include equipment modified for people with disabilities.
Method of assessment	• Assessment must satisfy the endorsed Assessment Guidelines of the MEM05 Metal and Engineering Training Package. • Assessment methods must confirm consistency and accuracy of performance (over time and in a range of workplace relevant

	contexts) together with application of underpinning knowledge. • Assessment methods must be by direct observation of tasks and include questioning on underpinning knowledge to ensure its correct interpretation and application. • Assessment may be applied under project-related conditions (real or simulated) and require evidence of process. • Assessment must confirm a reasonable inference that competency is able not only to be satisfied under the particular circumstance, but is able to be transferred to other circumstances. • Assessment may be in conjunction with assessment of other units of competency where required.
Guidance information for assessment	Assessment processes and techniques must be culturally appropriate and appropriate to the language and literacy capacity of the candidate and the work being performed.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Parameters to the brief or contract	The design brief may include the design of new equipment or fault analysis, rectification or modification to an existing design. Parameters to the design brief may include: • design cost and system capital cost • maintainability, product life cycle cost • durability, function, performance and aesthetics • energy and environmental sustainability and social issues • equipment availability and worksite restrictions • other special features and limits in the design brief
Sustainability	Sustainability may include: • resources and energy • social and economic • life cycle design of product raw material, solids and hazardous waste, and production by-products • contamination of land, air and stormwater pollutants, and discharge to sewerage

	• climate change
Appropriate software	Appropriate software may include software for: • computer-aided design (CAD) • circuit design and analysis • animation • simulation • modelling • performance analysis
Validation techniques	Validation techniques include: • comparison of traditional solutions for simple design problems with software solutions to the same design problems • review of previously implemented designs which were completed using the software • use of FMEA
Design criteria	Design criteria may include: • essential criteria, such as OHS and environmental criteria, which are pass/fail criteria for design option selection • desirable criteria, such as simplicity of design, which may be rated or scored to aid selection of design amongst options
OHS requirements	OHS requirements may include: • OHS Acts and regulations • relevant standards • industry codes of practice • risk assessments • registration requirements • safe work practices • state and territory regulatory requirements
Standards	Standards may include: • AS 4024.1-2006 Series Safety of machinery • AS/NZS ISO 31000:2009 Risk management – Principles and guidelines • NOHSC:1010 National standard for plant • NOHSC:1014 National standard for the control of major hazard facilities • AS 61508.1-2011 Functional safety of electrical/electronic/programmable electronic safety-related systems – General requirements

Sequence and mode control methods for multi-actuator circuit	Sequence may include: • sequential operations with or without conditional jumps • optimisation techniques • functions, such as: • timing, counting, stop start, cycle selection and boundary conditions Control methods may include: • pneumatic and electrical relay cascade control • pneumatic and electrical relay step-sequenced control • PLC control • microcontrollers for special purpose machines
Stand alone and network control	Options for stand alone and network control of fluid power systems may include: • compressor control and application control • fluid powered machine control, including proportional-integral-derivative (PID) parameter control from remote host controller • communications bus systems and serial systems • distributed control systems (DCS) • system control and data acquisition (SCADA) • computer-integrated manufacture (CIM) options

Unit Sector(s)

Engineering practice

Custom Content Section

Not applicable.