



Australian Government

MEM48021 Apply metallurgical principles and techniques in welding and other thermal processes

Release: 1

MEM48021 Apply metallurgical principles and techniques in welding and other thermal processes

Modification History

Release 1. Supersedes and is equivalent to MSATCM510A Apply metallurgical principles and techniques in welding and other thermal processes.

Application

This unit of competency defines the skills and knowledge required to apply metallurgical principles and techniques to welding applications as a member of a design and development team or similar in support of the design and development of welding and other thermal practices in mechanical and manufacturing applications.

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

Pre-requisite Unit

MEM09229 Read and interpret technical engineering drawings
MEM30007 Select common engineering materials
MEM48011 Apply basic chemical principles to metallurgy
MEM48012 Calculate and predict chemical outcomes in metallurgical situations
MEM48016 Select metal joining process

Competency Field

Metallurgy

Elements and Performance Criteria

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Determine job requirements	1.1 Follow standard operating procedures (SOPs) 1.2 Comply with work health and safety (WHS) requirements at all times 1.3 Undertake consultations and briefings with managers, employers and customers to determine welding application requiring metallurgical specification and analysis
2. Select welding or thermal process	2.1 Conduct consultations, briefings and research to determine welding

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
principles and techniques	application, metallurgical specification and analysis required 2.2 Select relevant welding and thermal cutting techniques, principles and associated technologies for application
3. Undertake welding and thermal process analysis and specify welding or other thermal process solutions	3.1 Apply relevant scientific principles in a consistent and appropriate manner to obtain the required welding or thermal process solution 3.2 Use appropriate calculations and coherent units in the solution of engineering calculations 3.3 Use significant figures in engineering calculations 3.4 Apply techniques and associated technologies, software and hardware to obtain the required welding or thermal process solutions 3.5 Report analysis results and recommend welding or thermal process solution

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.	
Sources of information include one or more of the following:	- reference standards and texts - manufacturer catalogues and industrial magazines - websites - phone information gathering - email information gathering.
Welding defects include:	- shape defects including: - excess weld metal - overlap - undercut

	• lack of fusion and penetration including: • incomplete root penetration • lack of root fusion • lack of interrun fusion • lack of side wall fusion • inclusions including: • linear • isolated • oxides • gas porosity including: • worm hole • uniform • restart • surface • solidification porosity including: • crater pipe • shrinkage porosity • solidification cracking including: • hot cracking • lamellar tearing • weldability of aluminium and its alloys including: • inherent problems including: • hydrogen porosity • oxide • their prevention • hot cracking including: • causes • alloys susceptible • alloys resistant • filler metals • weldability of carbon and low steels and the welding zones of steel including: • identification and microstructures • relation to the iron or iron carbide equilibrium diagram • multi-run welds • cold cracking including: • effects of hydrogen • martensite • stress • austenitic stainless steels including: • hot cracking • corrosion
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	• intergranular corrosion • heat affected zone precipitation • carbide stabilisers • extra low carbon stainless.
Other thermal processes include one or more of the following cutting, gouging, shaping or local treatment processes:	• oxyacetylene • oxyhydrogen • plasma • carbon arc.

Unit Mapping Information

Release 1. Supersedes and is equivalent to MSATCM510A Apply metallurgical principles and techniques in welding and other thermal processes.

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 MEM48021 Apply metallurgical principles and techniques in welding and other thermal processes

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include:

- following work instructions, standard operating procedures (SOPs) and safe work practices
- undertaking consultations with relevant personnel and researching other sources of information including industry codes and standards in applying metallurgical principles and techniques to welding and other thermal practices appropriate to the application
- selecting appropriate scientific principles to suit specific welding applications on at least two occasions
- selecting appropriate basic mechanical techniques and associated technologies, software and hardware to suit required applications in welding
- applying and manipulating appropriate formulas for applications involving engineering calculations
- applying appropriate calculations to engineering situations
- referring solutions to the original aim of the welding application
- quoting solutions in appropriate units using appropriate significant figures
- quoting limitations of solutions due to assumptions, scientific principles and techniques used
- reporting test results and presenting and recommending welding or thermal process solution.

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

Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- safe work practices and procedures
- sources of information
- welding principles and processes including:
 - mechanical
 - electrical chemical
 - metallurgical processes associated with welding

- limitations of scientific principles associated with welding
- weld defect description including for C-Mn and low alloy steels
- shape defects
- lack of fusion and penetration
- inclusions
- gas porosity
- solidification porosity
- solidification cracking
- hydrogen heat-affected zone cracking
- reheat cracking
- weldability of aluminium and its alloys
- hot cracking
- heat affected zone cracking
- welding age-hardened alloys
- welding work-hardened alloys
- weldability of carbon and low steels and the welding zones of steel
- hot cracking including carbon-manganese and sulphur ratio
- cold cracking
- calculation of carbon equivalents
- hydrogen content of steel welds and its control
- residual stress avoidance and removal
- calculation of weld pre-heat temperatures
- tests for cold crack susceptibility
- weldability of stainless steels and stainless-steel types
- thermal and electrical conductivity
- thermal expansion
- Schaeffler and Delong diagrams to predict structures
- austenitic stainless steels
- other special grades
- weldability of cast irons
- special techniques
- weldability of the nickel alloys
- filler metals and braze welding
- other thermal processes including:
 - cutting
 - gouging
 - shaping.
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Assessment Conditions

- Assessors must:

- have vocational competency in applying metallurgical principles and techniques in welding and other thermal processes 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.
- Conditions for assessment must include 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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