



Australian Government

MEM05061 Apply basic metallurgy principles to welding applications

Release: 1

MEM05061 Apply basic metallurgy principles to welding applications

Modification History

Release 1. New unit.

Application

This unit of competency was developed for post trade engineering fabrication trade training and the recognition of post trade skills in applying basic metallurgy principles to welding applications.

It defines the skills and knowledge required to support a range of advanced welding functions including welding inspection, welding supervision, advanced weld repair and coded welding associated with welding processes and procedures covered by Australian and international welding and related standards and codes as defined in the unit in conjunction with its prerequisites.

The unit scope includes applying knowledge of the general structure of metals and alloys, weldability, welding faults, and the effects of heat treatment of metals and alloys and the interaction of metals and alloys with other materials and consumables used in welding to decisions affecting welding applications.

This unit must be selected in combination with one of the following units:

- MEM05079 Perform welds to code standards using flux core arc welding process
- MEM05080 Perform welds to code standards using gas metal arc welding process
- MEM05081 Perform welds to code standards using gas tungsten arc welding process
- MEM05082 Perform pipe welds to code standards using manual metal arc welding process
- MEM05083 Perform welds to code standards using manual metal arc welding process
- MEM05088 Perform welds to code standards using oxy fuel gas welding process
- MEM05069 Undertake advanced weld repair and maintenance.

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

Band: B

Unit Weight: 8

Pre-requisite Unit

MEM11011 Undertake manual handling

MEM12023 Perform engineering measurements

MEM12024 Perform computations

MEM13015 Work safely and effectively in manufacturing and engineering

MEM14006 Plan work activities

MEM16006 Organise and communicate information

Competency Field

Fabrication

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. Review design specifications and referenced standards and codes for metallurgical requirements	1.1 Review design documents and drawings and identify material, welding process, consumables, standards and codes specifications 1.2 Review specified standards and codes for metallurgical requirements 1.3 Identify metallurgical and welding related defect risks for specified base, filler and consumables
2. Check base metals and alloys for consistency with specifications	2.1 Check provided metal or alloy materials for consistency with specifications 2.2 Identify any faults in materials and assess potential implications for weldability and task suitability 2.3 Arrange for any sampling, pre-welding tests or test welds in accordance with SOPs to determine weldability
3. Apply metallurgical principles to welding and heat treatment	3.1 Monitor weld pool formation and solidification processes for consistency with metallurgical requirements and standard operating procedures 3.2 Monitor and adjust welding parameters to suit metallurgical requirements of material being welded 3.3 Ensure welding related heat treatment is performed consistent with metallurgical principles and standard operating procedures
4. Apply metallurgical principles to inform mitigation strategies to avoid common weld cracks or defects	4.1 Identify suitable methods for residual stress control 4.2 Check selection of welding consumables and parameters to ensure hydrogen content is consistent with avoidance of weld cracks or other defects in different metals 4.3 Ensure distortion minimisation techniques are applied to mitigate metallurgical effects of heating and welding on parent metal properties

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.

Standards and codes include Australian or international standards and codes associated with:	- welding processes - welding consumables - materials used in fabrication related projects or products.
Weldability of a metal or alloy:	weldability is the term used in this unit to describe whether a base material can be reliably welded under normal fabrication workshop and/or field conditions to the specifications in a design and/or Australian or international welding standard or code.
Parent material properties include one or more of the following:	- elemental form (allotrope) - alloy chemical composition - carbon equivalence - microstructure - surface oxides - strength - hardenability - thermal and electrical conductivity - method of manufacture.
Heat treatment related techniques include one or more of the following:	- pre and post weld heating - annealing - normalising - quenching - stress relieving - soak to remove hydrogen.
Weld pool formation and solidification factors include:	- composition of the base metal and filler metal - shielding gas and slag composition - welding process - weld preparation

	• temperature • pre-heating • single or multi run welds • welding speed • inclusions • turbulence • size and shape of the base metal mould.
Welding parameters include one or more of the following:	• pass number • welding process • filler material • material diameter • current • voltage • polarity • wire feed speed • travel speed • heat input.
Welding cracks and defects include one or more of the following:	• base material cracks • weld metal cracks • craters • inclusions • porosity • lack of penetration or fusion • imperfect weld size and/or shape • incorrect fabrication dimension • distortion • excess penetration • excess weld metal • stray arc strikes • undercut.

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 MEM05061 Apply basic metallurgy principles to welding applications

Modification History

Release 1. New unit.

Performance Evidence

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

- confirm the weldability of at least one grade each of carbon steel and stainless steel, aluminium or an aluminium alloy, and one other non-ferrous metal or alloy
- monitor and identify factors that could adversely affect heat input on deposited metal
- monitor and identify the factors associated with the heat affected zone that could adversely affect the welding of at least two of carbon and low alloy steels, stainless steels, aluminium, and nickel, copper and manganese metal and alloys.

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:

- parameters used for the grouping of base metals
- microstructures of common ferrous and non-ferrous metals and alloys
- iron-carbon diagram and its use in welding and related processes
- the classification of carbon, manganese and low alloy steels
- effects of common alloying elements on material properties and weldability
- mechanical properties of carbon and low alloy steels including hardness and ductility
- factors affecting base metal quality
- factors affecting the weldability of carbon and low alloy steels
- weld defects in carbon and low alloy steels including:
 - distortion
 - lack of fusion
 - penetration defects including incomplete root penetration, lack of root fusion, lack of inter-run fusion, lack of side wall fusion
 - inclusions
 - porosity
 - fatigue
 - intergranular and stress corrosion

- cracking including solidification cracking, hydrogen heat affected zone cracking, and reheat cracking
- factors affecting weldability of alloy, quenched and tempered steels including:
 - welding zones
 - microstructures of base and filler metals and implications for welding
 - carbon equivalence
 - hydrogen content and control
 - residual stress avoidance
 - weld preheat temperatures.
- cold cracking including test methods for susceptibility
- factors affecting the weldability of stainless steels
- factors affecting the weldability of aluminium and aluminium alloys
- weldability of non-ferrous metals and their alloys including copper, nickel, magnesium
- weldability of cast irons
- causes and control of distortion in welding including the relationship between a material's coefficient of thermal expansion per unit volume of heat and distortion
- types of electrodes used in welding and their classification
- effects of moisture on electrode performance
- potential sources of hydrogen and effects of hydrogen diffuseness in welding
- hydrogen control techniques for welding processes
- methods of residual stress control including welding technique, peening, heat treatment,
- the basic metallurgical changes that occur in carbon steel during normalising
- heat treatment methods including normalising, annealing, quenching, stress relieving, tempering, pre-heating, and post weld heat treatment
- shielding gases and their application to welding processes
- sources for further metallurgical professional and technical advice
- welding terminology including codes and symbols.

Assessment Conditions

- Assessors must:
 - have vocational competency in applying basic metallurgy principles to welding applications at least to the level being assessed
 - 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.
- Assessment must occur in a functioning workplace. Where assessment in the workplace would be unsafe, impractical or threatens the environment, assessment must occur in a sufficiently rigorous simulated environment that reflects the circumstances that would be experienced in a functioning workplace. Assessment must cover all aspects of workplace performance, including task skills, task management skills, contingency management skills and job role environment skills.

- Reports required to be provided by the applicant can be either reports on actual welded fabrications or test pieces.
- Knowledge assessment may be either verbal or written but must adequately reflect the knowledge requirements of the unit in a functioning workplace.
- 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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