



Australian Government

Department of Education, Employment and Workplace Relations

MSL965003A Construct, modify and maintain high vacuum systems

Revision Number: 1

MSL965003A Construct, modify and maintain high vacuum systems

Modification History

Not applicable.

Unit Descriptor

Unit descriptor	This unit of competency covers the ability to construct, monitor, modify and maintain high vacuum systems. Personnel are required to use advanced bench/hand glasswork techniques and equipment to fabricate glass apparatus.
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Application of the Unit

Application of the unit	<p>This unit of competency is applicable to skilled and experienced scientific glassblowers. They will apply specialised technical knowledge and precise technical skills and considerable planning and judgement in their work.</p> <p>Industry representatives have provided case studies to illustrate the practical application of this unit of competency and to show its relevance in a workplace setting. These can be found at the end of this unit of competency under the section 'This competency in practice'.</p>
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Prerequisite units		
	MSL963001A	<i>Operate basic handblowing</i>

Prerequisite units		
		<i>equipment</i>
	MSL963002A	<i>Repair glass apparatus using simple glassblowing equipment</i>

Employability Skills Information

Employability skills	This unit contains employability skills.
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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.
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Construct high vacuum systems	1.1. Consult with clients regarding design specifications and cost 1.2. Identify or prepare appropriate blueprints, drawings, sketches and designs 1.3. Identify hazards and enterprise safety requirements 1.4. Prepare equipment in accordance with job requirements 1.5. Construct and install vacuum apparatus 1.6. Trial and commission vacuum apparatus 1.7. Use leak detection equipment to vacuum check system 1.8. Complete records and file in the reporting system
2. Modify high vacuum systems	2.1. Identify opportunities to improve efficiency of vacuum system 2.2. Use leak detection equipment to vacuum check system 2.3. Identify gaps and deficiencies which limit system's usefulness 2.4. Confirm modification requirements with appropriate personnel 2.5. Modify system to meet requirements
3. Maintain high vacuum systems	3.1. Identify maintenance procedures and appropriate records 3.2. Plan and evaluate maintenance according to appropriate quality standards 3.3. Identify, document and report need for maintenance for faulty or damaged equipment 3.4. Maintain vacuum and associated systems as per standard procedures 3.5. Use leak detection equipment to vacuum check system
4. Monitor and finetune vacuum operation	4.1. Monitor system to determine whether equipment is operating to specification 4.2. Evaluate equipment outputs to determine nature of problem 4.3. Define nature of sub-standard performance clearly 4.4. Finetune system to restore system to specification
5. Maintain a safe work	5.1. Follow established safe work practices and personal protective equipment to ensure safety of self and

ELEMENT	PERFORMANCE CRITERIA
environment	other workers 5.2. Minimise the generation of wastes 5.3. Ensure the safe disposal of wastes 5.4. Clean, care for and maintain work area, equipment and tools 5.5. Report any hazards or incidents according to enterprise procedures
6. Maintain records	6.1. Record data as per enterprise requirements 6.2. Maintain glass apparatus and system equipment logs as per enterprise requirements 6.3. Maintain security and confidentiality of enterprise information

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

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

Required skills

Required skills include:

- preparing and interpreting blueprints, drawings, sketches, designs and customer requirements
- applying theoretical concepts and practical principles to constructing, modifying and maintaining vacuum systems
- evaluating and making recommendations for modifications to vacuum systems
- modifying high vacuum systems to meet new requirements
- using appropriate procedures to monitor and maintain high vacuum systems
- following enterprise procedures to document and communicate work details

Required knowledge

Required knowledge includes:

- principles of design of high vacuum apparatus
- principles of working with high vacuum systems
- theoretical and practical knowledge of glassworking methods and procedures
- practices to control stress and strain in glass systems
- theory of equipment operation and use
- characteristics, capabilities and limitations of glassblowing techniques
- properties of glass and specific ways to join glass for high vacuum applications
- ideal joint placement for high vacuum systems
- ultra cleaning procedures for glass in high vacuum systems
- preparation and use of glass to metal seals
- safety procedures relevant to constructing and working with high vacuum systems

Evidence Guide

EVIDENCE GUIDE	
<p>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.</p>	
Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	<p>Assessors should ensure that candidates can:</p> <ul style="list-style-type: none"> • prepare and interpret blueprints, drawings, sketches, designs and customer requirements • apply theoretical concepts and practical principles to construct, modify and maintain vacuum systems • evaluate and make recommendations for modifications to vacuum systems • modify high vacuum systems to meet new requirements • use appropriate procedures to monitor and maintain high vacuum systems • use advanced bench/hand glasswork techniques and equipment to fabricate glass apparatus • follow enterprise procedures to document and communicate work details.
Context of and specific resources for assessment	<p>This unit of competency is to be assessed in the workplace or simulated workplace environment.</p> <p>It is strongly recommended that assessment is conducted through observation over time. The timeframe must allow for adequate assessment of operation under all normal and a range of abnormal conditions. Where this is not practical additional assessment techniques must be used.</p> <p>This unit of competency may be assessed with:</p> <ul style="list-style-type: none"> • <i>MSL965001A Design and manufacture glass apparatus and glass systems</i> • <i>MSL965002A Perform glass coating, grinding and finishing operations.</i> <p>Resources may include:</p> <ul style="list-style-type: none"> • access to a scientific glassblowing facility, appropriate equipment, materials and procedures which will allow for appropriate and realistic simulation • access to more than one workplace or simulated

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	learning environment if the primary workplace or learning environment is unable to provide a suitable range of equipment.
Method of assessment	<p>The following assessment methods are suggested:</p> <ul style="list-style-type: none"> • inspection of examples of glasswork and workplace documentation completed by the candidate • analysis of the candidate's work records over a period of time to ensure accurate and consistent work is obtained within required timelines • feedback from peers and supervisors • oral/written questioning. <p>In all cases, practical assessment should be supported by questions to assess underpinning knowledge and those aspects of competency which are difficult to assess directly.</p> <p>Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability.</p> <p>Access must be provided to appropriate learning and/or assessment support when required.</p> <p>The language, literacy and numeracy demands of assessment should not be greater than those required to undertake the unit of competency in a work like environment.</p>
This competency in practice	<p>Industry representatives have provided the case study below to illustrate the practical application of this unit of competency and to show its relevance in a workplace setting.</p> <p>Education</p> <p>A major research organisation has requested assistance with the design and construction of an ultra high vacuum line to work in conjunction with a recently purchased mass spectrometer. The scientific glassblower identifies the location of the backing pump, vapour jet pump, turbo-molecular pump and getter pumps. After finalising the design, they manufacture the main components in the glassblowing workshop. They then take the portable glassblowing station, including hand torch, gas supplies and hand tools to the research laboratory and proceed to link these components with various sizes of glass tubing</p>

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and transition glass/metal vacuum flanges. Having completed the vacuum system, the glassblower assists with checking all joints and seals under vacuum conditions and undertakes any repairs and modifications. Finally they dispose of all waste appropriately and return the equipment to the workshop.

Range Statement

RANGE STATEMENT	
<p>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.</p>	
Codes of practice	Where reference is made to industry codes of practice, and/or Australian/international standards, it is expected the latest version will be used
Standards, codes, procedures and/or enterprise requirements	<p>Standards, codes, procedures and/or enterprise requirements may include:</p> <ul style="list-style-type: none"> • calibration and maintenance schedules • enterprise recording and reporting procedures • equipment manuals • equipment startup, operation and shutdown procedures • industry codes of practice • material safety data sheets (MSDS) • material, production and product specifications • national environment protection measures • occupational health and safety (OHS) national standards and codes of practice • production and laboratory schedules • quality manuals • standard operating procedures (SOPs)
Tools and equipment	<p>Tools and equipment may include:</p> <ul style="list-style-type: none"> • leak detection equipment • pumps and lubricants • pressure measuring equipment • bench, handlamp and ribbon burners, gas supplies and gas economisers • glass working lathes • annealing ovens • measuring and recording equipment • hand tools, such as carbon paddles and mandrels, range of forceps, glass tubing gauges, angle setting jigs, calipers, glass support rollers, brass shapers, carbon rods,

RANGE STATEMENT	
	<p>glass knife, stainless steel gauze, vernier calipers and other measuring tools, and strain viewer</p> <ul style="list-style-type: none"> • mechanical glass cutters and saws • mechanical glass grinding equipment
Vacuum apparatus	<p>Vacuum apparatus includes items, such as:</p> <ul style="list-style-type: none"> • manometers • vacuum traps • vacuum manifolds • vacuum distillation apparatus • gas handling systems
Maintenance procedures	<p>Maintenance procedures may include:</p> <ul style="list-style-type: none"> • cleaning and maintaining work area, equipment and tools • checking and maintaining gas manifolds, cylinders and pumps • ensuring safety of vacuum and related equipment • evaluating and troubleshoot high vacuum systems • evaluating and restoring efficiency of systems
Hazards	<p>Hazards may include:</p> <ul style="list-style-type: none"> • sharps and broken glassware • residues on used glassware, such as mercury • heat sources, such as burners and ovens • fluids under pressure (acetylene and oxygen) • glass dust • cuts associated with glass grinders and cutters • manual handling of heavy sample bags and containers
Safety practices	<p>Safety practices may include:</p> <ul style="list-style-type: none"> • use of personal protective equipment, such as heat resistant gloves, safety glasses, goggles, face guards, coveralls, respirators and safety boots • correct labelling of reagents and hazardous materials • handling, and storing hazardous materials and equipment in accordance with labels, MSDS,

RANGE STATEMENT	
	<p>manufacturer's instructions, and enterprise procedures and regulations</p> <ul style="list-style-type: none"> regular cleaning and/or decontamination of equipment and work areas
Occupational health and safety (OHS) and environmental management requirements	<p>OHS and environmental management requirements</p> <ul style="list-style-type: none"> all operations must comply with enterprise OHS and environmental management requirements, which may be imposed through state/territory or federal legislation - these requirements must not be compromised at any time all operations assume the potentially hazardous nature of samples and require standard precautions to be applied where relevant, users should access and apply current industry understanding of infection control issued by the National Health and Medical Research Council (NHMRC) and State and Territory Departments of Health

Unit Sector(s)

Unit sector	Scientific glassblowing
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Competency field

Competency field	
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Co-requisite units

Co-requisite units	

