

### **3.3 An Integrated Approach to Programming – Using Projects or Events**

An integrated programming approach:

- provides practical training
- produces end products
- encourages students to work to schedule
- encourages students to work with others.

The following suggestions may provide some ideas for projects and events:

- simulations, such as workplace emergencies
- role-plays to simulate meetings and interaction with co-workers
- research projects on the industry, such as industrial relations, workplace illness and injury issues
- design posters and signs for display to encourage a safe workplace
- portfolio of work placement documents and student experience
- participation in school, regional, state and national world skills competition
- workshop projects, such as:
  - metal clamp
  - tool box
  - bag trolley
  - fishing rod holder
  - star post puller
  - ball valve exercise
  - BBQ
  - pizza oven
  - fences
  - gates
  - camping seat
  - tripod
- class projects for the school or community, such as tables, chairs, brackets or security fences
- school-based projects to meet particular needs of the school, such as:
  - picnic table (with or without shelter)
  - garden seat
  - solar shelter
  - shed/room for various departments including agriculture (eg chicken shed or green house), PDHPE (eg change rooms or sports storage facilities), Creative Arts (eg dark room and chemical store) and Science (eg chemical store)
  - pre-fabricated and relocatable garages
- parent and citizen/friends funded projects, such as:
  - work benches
  - metal furnishing.

Project possibilities are as varied as the teacher's imagination. Three important principles for teachers to remember when devising projects:

- stay within your 'skill level'
- don't attempt anything unless you are sure it will be successful
- incorporate student interests wherever possible.

Use of projects, experiences and events allows for the concurrent development and assessment of a number of units and elements of competency. They may be used for the full delivery of a particular unit of competency or to supplement other learning and assessment activities.

The following steps provide a guide to planning and organising such a strategy.

### **Step 1**

Based on knowledge of the course intended for delivery, the interests and experience of students and available resources, devise a project or event that relates to a number of competencies.

### **Step 2**

Use Part B of the Syllabus to map components/activities/products of the project to particular units/elements ensuring that there is opportunity for students to develop competency and demonstrate the performance criteria for each element included. Where necessary, modify the project specifications to address elements/performance criteria.

### **Step 3**

Using the information from step 2, list the elements of competency and identify appropriate assessment strategies. Plan to use a range of assessment instruments over time to validate the evidence collected. Also try to use each assessment opportunity to assess and record evidence of competence for a number of elements. In this way 'overassessment' can be minimised.

### **Step 4**

Draw up a programming sheet to summarise the information. Learning outcomes for components of the project may be defined or included in a separate schedule.

## Sample Program      Workshop project/s

**Rationale:** Through completion of workshop project/s, it is intended students will develop background and underpinning knowledge and skills required to perform engineering measurements using mechanical measuring devices; estimate approximate answers to arithmetical problems; carry out calculations; produce and interpret simple charts and graphs; and interpret technical drawing for a variety of general engineering applications.

**Units of competency:**

MEM09002B	Interpret technical drawing
MEM12023A	Perform engineering measurements
MEM12024A	Perform computations

Use of projects allows for the concurrent learning in, and development and assessment of, a number of units and elements of competency. They may be used for the full delivery of a particular unit of competency - such as the three listed above - and/or to supplement other learning and assessment activities - such as units of competency addressed in the other sample programs within this support document including:

MEM13014A	Apply principals of occupational health and safety in the work environment
MEM14004A	Plan to undertake a routine task
MEM15002A	Apply quality systems
MEM15024A	Apply quality procedures
MEM16007A	Work with others in a manufacturing, engineering or related environment
MEM18001C	Use hand tools
MEM18002B	Use power tools/hand-held operations.

This program is based on three workshop projects.

The projects allow the content to be covered during the production of:

- a toolbox
- a BBQ/pizza oven
- an item/job relevant to the specific industry area (class project).

The points listed in the content column *must be addressed* during delivery of this program. Where the possible learning experiences/activities have been grouped it is intended that the content be covered during completion of one or more of the workshop projects. Where it may be best to stagger the content as relevant to the particular project the learning experiences/activities have been allocated to one of the workshop projects.

It is important when substituting other projects that content is considered and appropriately addressed using the new project.

It is possible that elective units of competency selected by teachers for delivery to meet the 240-hour course requirements may be easily integrated into this sample program. Advice regarding selection of units of competency to meet HSC course requirements and qualification packaging rules is provided in Section 8.1.1 of Part A of the Syllabus and Section 2.2 of this document.

**Key terms and concepts:**

Interpret technical drawing	Perform engineering measurements	Perform computations
<ul style="list-style-type: none"> <li>• amendments</li> <li>• Australian Standards</li> <li>• checking and validating drawings</li> <li>• components, assemblies and objects</li> <li>• dimensions</li> <li>• drawing conventions</li> <li>• instructions contained in drawings</li> <li>• interpret technical drawing</li> <li>• material requirements</li> <li>• safe work practices and procedures</li> <li>• specifications</li> <li>• standard operating procedures (SOP)</li> <li>• symbols</li> <li>• technical drawing</li> <li>• title block</li> <li>• types of technical drawings</li> <li>• version control.</li> </ul>	<ul style="list-style-type: none"> <li>• basic calculations</li> <li>• care and storage of measuring devices/equipment</li> <li>• checking and recording measurements and calculations</li> <li>• conventions</li> <li>• dimensions</li> <li>• freehand sketch</li> <li>• imperial</li> <li>• measurement requirements</li> <li>• measurements</li> <li>• measuring devices/equipment</li> <li>• measuring techniques</li> <li>• metric</li> <li>• readings</li> <li>• routine adjustments/ validation</li> <li>• safe work practices and procedures</li> <li>• selection of measuring devices/equipment</li> <li>• specifications</li> <li>• work instructions and procedures</li> <li>• workplace documentation.</li> </ul>	<ul style="list-style-type: none"> <li>• addition, subtraction, multiplication and division</li> <li>• calculation method</li> <li>• checking and recording calculations</li> <li>• converting units</li> <li>• data</li> <li>• decimals, fractions and percentages</li> <li>• dimensions</li> <li>• estimation</li> <li>• extracting data/information</li> <li>• imperial</li> <li>• metric</li> <li>• obtaining, understanding and clarifying instructions/ procedures</li> <li>• perform calculations</li> <li>• perimeter, area and volume</li> <li>• production of charts and graphs from given information</li> <li>• proportion and ratio</li> <li>• ‘rounding off’</li> <li>• safe work practices and procedures</li> <li>• source, select and apply mathematical formulae</li> <li>• substitution of correct values</li> <li>• trends</li> <li>• units of measurement</li> <li>• whole and mixed numbers</li> <li>• work instructions and procedures</li> <li>• workplace documentation.</li> </ul>

**Assessment:**

<b>MEM09002B Interpret technical drawing</b>	
<i>Elements</i>	<i>Possible assessment strategy</i>
1. Select correct technical drawing	<ul style="list-style-type: none"> <li>• Tasks 1, 12, 19, 20, 21, 22, 23, 24 and 25</li> </ul>
2. Interpret technical drawing	<ul style="list-style-type: none"> <li>• Tasks 1, 12, 19, 20, 21, 22, 23, 24 and 25</li> </ul>

<b>MEM12023A Perform engineering measurements</b>	
<i>Elements</i>	<i>Possible assessment strategy</i>
1. Select appropriate device or equipment	<ul style="list-style-type: none"> <li>• Students will have several opportunities to demonstrate competency in this element and associated performance criteria during completion of learning activities and assessment tasks throughout the metal and engineering course</li> <li>• Tasks 1, 12, 18, 19, 20, 21, 22, 23, 24 and 25</li> </ul>
2. Obtain measurements using a range of measuring devices	<ul style="list-style-type: none"> <li>• Students will have several opportunities to demonstrate competency in this element and associated performance criteria during completion of learning activities and assessment tasks throughout the metal and engineering course</li> <li>• Tasks 1, 12, 20, 21, 22, 23, 24 and 25</li> </ul>
3. Maintain measuring devices	<ul style="list-style-type: none"> <li>• Tasks 1, 3, 12, 15, 16, 18, 20, 21, 22, 23, 24 and 25</li> </ul>
4. Communicate measurements as required.	<ul style="list-style-type: none"> <li>• Students will have several opportunities to demonstrate competency in this element and associated performance criteria during completion of learning activities and assessment tasks throughout the metal and engineering course</li> <li>• Tasks 1, 9, 11, 12, 20, 21, 22, 23, 24 and 28</li> </ul>

<b>MEM12024A Perform computations</b>	
<i>Elements</i>	<i>Possible assessment strategy</i>
1. Determine work requirement	<ul style="list-style-type: none"> <li>• Students will have several opportunities to demonstrate competency in this element and associated performance criteria during completion of learning activities and assessment tasks throughout the metal and engineering course</li> <li>• Tasks 1, 12, 19, 20, 21, 22, 23, 24,25, 26 and 27</li> </ul>
2. Perform calculations	<ul style="list-style-type: none"> <li>• Students will have several opportunities to demonstrate competency in this element and associated performance criteria during completion of learning activities and assessment tasks throughout the metal and engineering course</li> <li>• Tasks 1, 9, 11, 12, 20, 21, 22, 23, 24, 25 and 26</li> </ul>
2. Produce charts and graphs from given information	<ul style="list-style-type: none"> <li>• Tasks 1, 11, 12, 20, 21, 22, 23, 24 and 27</li> </ul>



	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15	Task 16	Task 17	Task 18	Task 19	Task 20	Task 21	Task 22	Task 23	Task 24	Task 25	Task 26	Task 27	Task 28	
	Work placement activities & journal	Newspaper scrapbook	Extended response – Environmental issues	OHS written test	Workplace inspection – risk assessment	PEE, safety devices & emergency equipment	Scenario – dealing with an emergency	Visual communication test	Work order	Extended response – Quality	Written documentation	Work/job plan – individual & team task	Self & peer evaluation	Quality improvement system	Workshop assistant	Workgroup leader	MSDS	Tools, plant & equipment	Technical drawings	Toolbox	Vice/clamping device	Bush BBQ/pizza oven/camp oven	Industry-specific class project	Measurement & calculation exercises	Materials & components	Job quote	Charts & graphs	Freehand sketches	
<b>MEM12023A Perform engineering measurements</b>																													
<i>1 Select appropriate device or equipment</i>																													
1.1 Measurement requirements are determined from specifications	✓											✓							✓	✓	✓	✓	✓	✓	✓				
1.2 Appropriate device or equipment is selected according to standard operating procedures, to achieve required outcome	✓											✓						✓		✓	✓	✓	✓	✓	✓				
<i>2 Obtain measurements using a range of measuring devices</i>																													
2.1 Correct and appropriate measuring technique is used	✓											✓								✓	✓	✓	✓	✓	✓				
2.2 Measurements are accurately obtained	✓											✓								✓	✓	✓	✓	✓	✓				
2.3 Dimensions are determined or verified using basic calculations, where required	✓											✓								✓	✓	✓	✓	✓	✓				
<i>3 Maintain measuring devices</i>																													
3.1 Routine care and storage of devices is undertaken to manufacturer’s specifications or standard operating procedures	✓		✓									✓			✓	✓		✓		✓	✓	✓	✓	✓					
3.2 Routine adjustments to devices are made and checked	✓											✓			✓	✓		✓		✓	✓	✓	✓	✓					
<i>4 Communicate measurements as required</i>																													
4.1 Measurements are accurately recorded, where required	✓								✓		✓	✓								✓	✓	✓	✓	✓	✓				
4.2 Freehand sketch which depicts required information is prepared, as required	✓							✓			✓									✓	✓	✓	✓	✓	✓				✓

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15	Task 16	Task 17	Task 18	Task 19	Task 20	Task 21	Task 22	Task 23	Task 24	Task 25	Task 26	Task 27	Task 28	
	Work placement activities & journal	Newspaper scrapbook	Extended response – Environmental issues	OHS written test	Workplace inspection – risk assessment	PEE, safety devices & emergency equipment	Scenario – dealing with an emergency	Visual communication test	Work order	Extended response – Quality	Written documentation	Work/job plan – individual & team task	Self & peer evaluation	Quality improvement system	Workshop assistant	Workgroup leader	MSDS	Tools, plant & equipment	Technical drawings	Toolbox	Vice/clamping device	Bush BBQ/pizza oven/camp oven	Industry-specific class project	Measurement & calculation exercises	Materials & components	Job quote	Charts & graphs	Freehand sketches	
<b>MEM12024A Perform computations</b>																													
<i>1 Determine work requirements</i>																													
1.1	Required outcomes are established from job instructions	✓										✓								✓	✓	✓	✓	✓	✓	✓	✓		
1.2	Data is obtained from relevant sources and interpreted correctly	✓										✓								✓	✓	✓	✓	✓	✓	✓	✓	✓	
1.3	Required calculation method is determined to suit the application, including selection of relevant arithmetic operations and/or formulae	✓										✓								✓	✓	✓	✓	✓	✓	✓	✓		
1.4	Expected results are estimated, including rounding off, as appropriate	✓										✓								✓	✓	✓	✓	✓	✓	✓	✓		
<i>2 Perform calculations</i>																													
2.1	Calculation method is applied correctly	✓										✓									✓	✓	✓	✓	✓	✓	✓		
2.2	Correct answer is obtained	✓										✓									✓	✓	✓	✓	✓	✓	✓		
2.3	Answer is checked against estimation	✓								✓	✓	✓								✓	✓	✓	✓	✓	✓	✓	✓		
<i>3 Produce charts and graphs from given information</i>																													
3.1	Data is transposed accurately to produce charts or graphs	✓									✓	✓									✓	✓	✓	✓	✓			✓	
3.2	Charts or graphs accurately reflect data on which they are based	✓										✓									✓	✓	✓	✓	✓			✓	

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities			
		Tool box	BBQ/Pizza Oven	Industry-specific class project	
	<b>Introduction to the project</b>	[Task 20]	[Task 22]	[Task 23]	
		<i>Display an example of the finished product – drawing, photo, model/prototype or actual finished sample.</i>			
<p><i>MEM09002B Interpret technical drawing</i></p> <p><b>1 Select correct technical drawing</b></p> <p>1.1 Drawing is checked and validated against job requirements or equipment.</p> <p><i>MEM12023A Perform engineering measurements</i></p> <p><b>1 Select appropriate device or equipment</b></p> <p>1.1 Measurement requirements are determined from specifications.</p> <p><i>MEM12024A Perform computations</i></p> <p><b>1 Determine work requirement</b></p> <p>1.1 Required outcomes are established from job instructions.</p>	<p><b>Safety in the workplace</b></p> <p>An awareness of safe work practices and procedures for a workplace within the manufacturing, engineering and related services industries:</p> <ul style="list-style-type: none"> <li>• occupational health and safety (OHS) induction training (general, work activity and site-specific)</li> <li>• selection, use and maintenance of personal protective equipment (PPE)</li> <li>• selection of appropriate tools for the task</li> <li>• correct use, maintenance and storage of tools, equipment and machinery</li> <li>• correct handling, application, transport and storage of hazardous and non-hazardous materials</li> <li>• safe posture (sitting, standing, bending and lifting)</li> <li>• correct manual handling (lifting and transferring)</li> <li>• hazard identification and risk control</li> <li>• procedures to follow in the event of an emergency</li> <li>• basic first aid training and access to first aid kits</li> <li>• correct use of fire fighting equipment: <ul style="list-style-type: none"> <li>- fire blanket</li> <li>- fire extinguishers</li> <li>- fire hydrant and hose</li> </ul> </li> <li>• effective communication and teamwork</li> <li>• adherence to work instructions, workplace policies and standard operating procedures</li> <li>• housekeeping/clean-up procedures with due consideration to OHS and the environment.</li> </ul>	<p>Content covered in sample program <i>Safety in the workplace</i>.</p> <p>Revise and contextualise to the units of competency covered in this program and the projects undertaken.</p> <p><i>For each project:</i></p> <ul style="list-style-type: none"> <li>• identify any legislation or regulation and/or code of practice that applies</li> <li>• consider risk management (identify hazards, assess associated risks and consider appropriate control measures)</li> <li>• if required, undertake any school workshop safety tests</li> <li>• if appropriate, propose environment protection requirements/strategies</li> <li>• consider strategies to meet quality assurance/project quality requirements (including recognition of their role)</li> <li>• identify standard operating procedures for <ul style="list-style-type: none"> <li>- correct handling, transport and storage of materials and components required</li> <li>- correct use, maintenance and storage of tools and equipment required.</li> </ul> </li> </ul>	<p>Provide students with a safe work method statement for this project.</p>	<p>Teacher and students prepare a safe work method statement for this project.</p>	<p>Students prepare a safe work method statement for this project.</p> <p>Teacher checks statement prior to students commencing the project.</p>

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
<p><i>MEM12023A Perform engineering measurements</i></p> <p><b>1 Select appropriate device or equipment</b></p> <p>1.1 Measurement requirements are determined from specifications.</p> <p><i>MEM12024A Perform computations</i></p> <p><b>1 Determine work requirement</b></p> <p>1.1 Required outcomes are established from job instructions.</p> <p>1.2 Data is obtained from relevant sources and interpreted correctly.</p>	<p><b>Instructions and specifications</b></p> <p>A range of sources for work instructions and procedures:</p> <ul style="list-style-type: none"> <li>• work schedules</li> <li>• job card/sheet/plans/specifications</li> <li>• standard operating procedures (SOP)</li> <li>• standard operation sheets</li> <li>• Material Safety Data Sheets (MSDS)</li> <li>• diagrams/sketches</li> <li>• regulations/legislation</li> <li>• manufacturer/workplace guidelines, policies and procedures</li> <li>• Australian Standards.</li> </ul> <p>A definition of:</p> <ul style="list-style-type: none"> <li>• specification/s.</li> </ul> <p>Strategies for obtaining, understanding and clarifying instructions/procedures and specifications for task outcomes:</p> <ul style="list-style-type: none"> <li>• correct sourcing and selection of information</li> <li>• consult appropriate personnel</li> <li>• active listening</li> <li>• open and closed questions.</li> </ul>	<p>Content covered in sample program <i>Plan and carry out quality work</i>.</p> <p>Revise and contextualise to the units of competency covered in this program and the projects undertaken.</p>		
		<p>Class discussion – scenario – ‘I want to build a ...’, consider;</p> <ul style="list-style-type: none"> <li>• what do I need to know?</li> <li>• where do I begin?</li> <li>• who do I need to see?</li> <li>• what do I need to have?</li> </ul>		
		<p>Content covered in sample program <i>Plan and carry out quality work</i>.</p> <p>Revise and contextualise to the units of competency covered in this program and the projects undertaken.</p>		
		<p>Class discussion.</p>		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
	<p>Extracting data/information from a range of relevant sources:</p> <ul style="list-style-type: none"> <li>• diagrams</li> <li>• graphs</li> <li>• charts</li> <li>• measurement data</li> <li>• reference manuals</li> <li>• specifications.</li> </ul>	<p><i>Students should have access to a range of sources of information and opportunities to extract data/information throughout the metal and engineering course.</i></p>		
		<p><i>For each project:</i></p> <p>Provide work instructions (via a variety of communication modes – including written and verbal).</p> <p>Determine task/job outcomes, including measurement and calculations requirements from specifications.</p> <p>At appropriate times throughout the project, demonstrate manufacture techniques and assembly sequence.</p>		
<p><i>MEM09002B Interpret technical drawing</i></p> <p><b>1 Select correct technical drawing</b> 1.1 Drawing is checked and validated against job requirements or equipment.</p>	<p><b>Technical drawing</b></p> <p>An understanding of the purpose of technical drawing.</p> <p>Consideration of the audience when determining selection of drawing type:</p> <ul style="list-style-type: none"> <li>• client</li> <li>• engineer</li> <li>• trades person.</li> </ul> <p>An awareness of the use/functions of a range of technical drawings:</p> <ul style="list-style-type: none"> <li>• assembly</li> <li>• detail</li> <li>• sub-assembly</li> <li>• sectional</li> <li>• pictorial</li> <li>• exploded views.</li> </ul>	<p>Brainstorm:</p> <ul style="list-style-type: none"> <li>• why use technical drawings?</li> <li>• purpose of technical drawings</li> <li>• types of technical drawings</li> <li>• matching audience when selecting drawing type.</li> </ul> <p>Visual stimulus – samples of a range of technical drawings used in the manufacturing, engineering and related services industries.</p>		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
	Relationship between views contained in technical drawings.	<p>As appropriate to each project, introduce each type of technical drawing (listed in the content column) to the class. Provide a handout including:</p> <ul style="list-style-type: none"> <li>• a minimum of one sample</li> <li>• brief definition/explanation</li> <li>• use/function in industry</li> <li>• benefits and limitations</li> <li>• relationship between views.</li> </ul> <p>Provide students with technical drawings for each project. Ensure a range of technical drawings are covered. Discuss their purpose in relation to the project.</p> <p>Consider the use of scale drawings for material lists and cutting plans.</p>		
<p><i>MEM09002B Interpret technical drawing</i></p> <p><b>1 Select correct technical drawing</b></p> <p>1.1 Drawing is checked and validated against job requirements or equipment.</p> <p>1.2 Drawing version is checked and validated.</p>	<p><b>Australian standards and drawing conventions</b></p> <p>A basic knowledge of Australian Standards:</p> <ul style="list-style-type: none"> <li>• AS1100 <ul style="list-style-type: none"> <li>- AS1100.101</li> </ul> </li> <li>• AS1102.</li> </ul>	<p>Visual stimulus – AS1100 and AS1102.</p> <p>Define:</p> <ul style="list-style-type: none"> <li>• Australian Standard.</li> </ul> <p>Class discussion:</p> <ul style="list-style-type: none"> <li>• why the need for a standardised approach to drawing conventions within the manufacturing, engineering and related services industries?</li> <li>• what could result if standardisation didn't occur?</li> </ul>		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
	<p>A basic knowledge of drawing conventions (symbols/abbreviations/terminology) to AS1100.101 to indicate:</p> <ul style="list-style-type: none"> <li>• version</li> <li>• dimensions</li> <li>• scale</li> <li>• components/assemblies or objects</li> <li>• materials</li> <li>• tolerance</li> <li>• instructions.</li> </ul>	<p>Guest speaker eg draftsman or designer to:</p> <ul style="list-style-type: none"> <li>• outline the processes involved in the development of drawings/plans and specifications</li> <li>• explain symbols/abbreviations/terminology used</li> <li>• outline key features and procedures for confirmation of amendment status</li> </ul> <p>or industry-specific manager/team leader to:</p> <ul style="list-style-type: none"> <li>• discuss the importance of/need for personnel in the manufacturing, engineering and related services industries to be able to read and interpret plans and specifications.</li> </ul>		
		<p>Provide students with a glossary containing symbols common to the manufacturing, engineering and related services industries.</p>		<p>Develop a symbol glossary appropriate to the industry area/field of employment.</p>
		<p>Worksheet – with a range of common symbols/abbreviations/terminology – students to identify and label. [Link to Task 19]</p>		
		<p>Identification of the components of the title block:</p> <ul style="list-style-type: none"> <li>• date/version</li> <li>• drawing number</li> <li>• site location</li> <li>• drawn by</li> <li>• client</li> <li>• scale</li> <li>• number of pages</li> <li>• tolerances.</li> </ul>	<p>Class discussion and accompanying notes:</p> <ul style="list-style-type: none"> <li>• what is the purpose of the following on a drawing <ul style="list-style-type: none"> <li>- legend?</li> <li>- title block/panel?</li> <li>- job specifications?</li> </ul> </li> <li>• what information is found in the title block of a drawing?</li> </ul>	

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
<p><i>MEM09002B Interpret technical drawing</i></p> <p><b>1 Select correct technical drawing</b></p> <p>1.1 Drawing is checked and validated against job requirements or equipment.</p> <p>1.2 Drawing version is checked and validated.</p>	<p><b>Amendments and version control</b></p> <p>The importance of:</p> <ul style="list-style-type: none"> <li>• version control</li> <li>• ensuring all amendments to specifications are current.</li> </ul> <p>Acknowledgement of Australian Standard AS1100 in relation to title and revision panels for drawings.</p> <p>Standard operating procedures (SOP) for:</p> <ul style="list-style-type: none"> <li>• checking and validating drawings</li> <li>• confirmation of amendment status on drawings.</li> </ul>		<p>Class discussion:</p> <ul style="list-style-type: none"> <li>• who has authority to make amendments to drawings and specifications?</li> <li>• what are the procedures for changes to occur?</li> <li>• who needs to be made aware of changes?</li> <li>• what are the possible consequences if a drawing or specifications are wrongly identified as ‘for manufacture’?</li> </ul>	
<p><i>MEM09002B Interpret technical drawing</i></p> <p><b>2 Interpret technical drawing</b></p> <p>2.1 Components, assemblies or objects are recognised as required.</p> <p>2.2 Dimensions are identified as appropriate to field of employment</p> <p>2.3 Instructions are identified and followed as required.</p> <p>2.4 Material requirements are identified as required.</p> <p>2.5 Symbols are recognised in the drawing as appropriate.</p>	<p><b>Interpret technical drawing</b></p> <p>Appropriate units of measurement to the field of employment.</p> <p>Extracting data/information from drawings:</p> <ul style="list-style-type: none"> <li>• recognition of symbols used</li> <li>• identification of <ul style="list-style-type: none"> <li>- units of measurement used in the preparation of the drawing</li> <li>- dimensions of key features</li> <li>- limits and tolerances</li> </ul> </li> </ul>	<p>Handout – units of measurement common to the manufacturing, engineering and related services industries.</p>		<p>Handout – units of measurement to the specific industry area.</p>
		<p>For each project using the technical drawings provided, students are required to:</p> <ul style="list-style-type: none"> <li>• recognise the type of drawing</li> <li>• identify information provided in the title block, and the drawing itself</li> <li>• determine amendment status</li> <li>• understand instructions contained in the drawing and actions to be taken in response.</li> </ul>		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
	<ul style="list-style-type: none"> <li>- components/assemblies/objects represented in the drawing</li> <li>- number of components/assemblies/objects contained in the drawing</li> <li>- materials and their characteristics</li> <li>- treatments and/or finishes</li> <li>- instructions contained in the drawing</li> <li>- actions to be taken in response to these instructions</li> <li>- standards of work.</li> </ul>	[Task 19]		
<p><i>MEM12023A Perform engineering measurements</i></p> <p><b>4 Communicate measurements as required</b></p> <p>4.2 Freehand sketch which depicts required information is prepared, as required.</p>	<p><b>Freehand sketching</b></p> <p>An awareness of different conventions used in manufacturing, engineering and related services industries including those related to:</p> <ul style="list-style-type: none"> <li>• dimensions</li> <li>• instructions</li> <li>• base line or datum points.</li> </ul> <p>Freehand sketching techniques appropriate to manufacturing, engineering and related services industries.</p>	<p>Handout –conventions and freehand sketching techniques appropriate to the manufacturing, engineering and related services industries.</p> <p><i>For each workshop project:</i></p> <p>Prepare freehand sketches which depict required information including:</p> <ul style="list-style-type: none"> <li>• dimensions</li> <li>• instructions</li> <li>• base line or datum points.</li> </ul> <p>[Task 28]</p>		
<p><i>MEM09002B Interpret technical drawing</i></p> <p><b>2 Interpret technical drawing</b></p> <p>2.2 Dimensions are identified as appropriate to field of employment.</p> <p><i>MEM12023A Perform engineering measurements</i></p>	<p><b>Measurement and calculations</b></p> <p>An awareness of the consequences of incorrect calculations for:</p> <ul style="list-style-type: none"> <li>• the client</li> <li>• the organisation/company</li> <li>• the environment.</li> </ul> <p>Importance of accurate measurements.</p>	<p><i>It is intended that the following learning experiences/activities be covered during completion of one or more of the workshop projects:</i></p> <p>Class discussion:</p> <ul style="list-style-type: none"> <li>• consequences of incorrect measurements and calculations (for client, organisation/company and environment)</li> <li>• the importance of                             <ul style="list-style-type: none"> <li>- checking measurements and calculations</li> </ul> </li> </ul>		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
<p><b>2 Obtain measurements using a range of measuring devices</b> 2.2 Measurements are accurately obtained.</p> <p><b>4 Communicate measurements as required</b> 4.1 Measurements are accurately recorded, where required.</p> <p><i>MEM12024A Perform computations</i></p> <p><b>1 Determine work requirement</b> 1.2 Data is obtained from relevant sources and interpreted correctly.</p> <p><b>2 Perform calculations</b> 2.2 Correct answer is obtained. 2.3 Answer is checked against estimation.</p>	<p>The importance of checking measurements and calculations.</p> <p>The importance of recording information that is:</p> <ul style="list-style-type: none"> <li>• clear</li> <li>• legible</li> <li>• accurate</li> <li>• concise</li> <li>• appropriate in terms of industry terminology and abbreviations.</li> </ul> <p>An understanding of:</p> <ul style="list-style-type: none"> <li>• estimations</li> <li>• tolerances</li> <li>• ‘rounding off’</li> <li>• project quality requirements</li> <li>• waste minimisation.</li> </ul>	<ul style="list-style-type: none"> <li>- being accurate with measurements and calculations</li> <li>- clearly recording measurements and calculations</li> <li>• reinforce the ‘measure twice cut once’ rule.</li> </ul>		
		<p>Handout and discussion with brief explanation of:</p> <ul style="list-style-type: none"> <li>• estimation</li> <li>• tolerance (‘error of measurement’)</li> <li>• ‘rounding off’.</li> </ul>		
		<p><i>For each workshop project:</i></p> <p>Identify project quality requirements.</p> <p>(Note that quality systems and procedures are covered in sample program <i>Plan and carry out quality work</i>. Revise and contextualise to the projects undertaken in this program.)</p> <p>Investigation of standard stock sizes of materials and components</p> <p>Discuss the need to select ‘appropriate’ sizes to ensure minimal wastage of materials.</p> <p>Propose strategies for waste minimisation.</p>		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
<p><i>MEM12023A Perform engineering measurements</i></p> <p><b>4 Communicate measurements as required</b> 4.1 Measurements are accurately recorded, where required.</p> <p><i>MEM12024A Perform computations</i></p> <p><b>2 Perform calculations</b> 2.3 Answer is checked against estimation.</p>	<p><b>Recording measurements and calculations</b></p> <p>Recording measurements and calculations.</p> <p>Documentation typical to the workplace for recording task/project measurements and calculations.</p>	<p><i>It is intended that the following learning experience/activity be covered during completion of one or more of the workshop projects.</i></p> <p>View samples of documentation.</p> <p><i>Encourage neat and accurate recording of measurements and calculations throughout the metal and engineering course.</i></p> <p>[Link to Tasks 1, 11, 20, 21, 22, 23 and 24.]</p>		
<p><i>MEM12023A Perform engineering measurements</i></p> <p><b>1 Select appropriate device or equipment</b> 1.1 Measurement requirements are determined from specifications.</p> <p><i>MEM12024A Perform computations</i></p> <p><b>1 Determine work requirement</b> 1.2 Data is obtained from relevant sources and interpreted correctly. 1.3 Required calculation method is determined to suit the application, including selection of relevant arithmetic operations and/or formulae.</p>	<p><b>Measurement</b></p> <p>An awareness of the two common systems of measurement used in the manufacturing, engineering and related services industries:</p> <ul style="list-style-type: none"> <li>• metric</li> <li>• imperial.</li> </ul> <p>Units of measurement for:</p> <ul style="list-style-type: none"> <li>• length</li> <li>• pressure</li> <li>• volume</li> <li>• temperature</li> <li>• area</li> <li>• angle</li> <li>• velocity</li> <li>• mass</li> <li>• force.</li> </ul>	Handout/class notes.		
		Handout/class notes.		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
<p><i>MEM12023A Perform engineering measurements</i></p> <p><b>1 Select appropriate device or equipment</b></p> <p>1.2 Appropriate device or equipment is selected according to standard operating procedures, to achieve required outcome.</p> <p><b>2 Obtain measurements using a range of measuring devices</b></p> <p>2.1 Correct and appropriate measuring technique is used.</p> <p>2.2 Measurements are accurately obtained.</p> <p><b>3 Maintain measuring devices</b></p> <p>3.1 Routine care and storage of devices is undertaken to manufacturers' specifications or standard operating procedures.</p> <p>3.2 Routine adjustments to devices are made and checked.</p>	<p><b>Measuring devices/equipment and measurement techniques</b></p> <p>A basic knowledge of a range of measuring devices/equipment:</p> <ul style="list-style-type: none"> <li>• name</li> <li>• characteristics</li> <li>• application</li> <li>• standard operating procedures (SOP) for correct use</li> <li>• limitations</li> <li>• maintenance/basic care and storage.</li> </ul> <p>A range of measuring devices/equipment:</p> <ul style="list-style-type: none"> <li>• rule</li> <li>• tape</li> <li>• protractor</li> <li>• set square</li> <li>• combination square</li> <li>• dial indicator</li> <li>• thermometer</li> <li>• micrometer</li> <li>• vernier calliper</li> <li>• feeler gauge</li> <li>• engineers square</li> <li>• surface plate.</li> </ul> <p>Validation of measuring devices:</p> <ul style="list-style-type: none"> <li>• zeroing</li> <li>• scale adjustment</li> <li>• test piece.</li> </ul> <p>Consideration/s for the selection of measuring device/equipment:</p> <ul style="list-style-type: none"> <li>• skills/training</li> <li>• appropriateness for purpose</li> </ul>	<p><i>It is intended that the following learning experiences/activities be covered during completion of one or more of the workshop projects.</i></p> <p>Handout – addressing each dot point for the measuring devices/equipment listed in the content column.</p> <p>Teacher demonstration at the time the device/equipment is introduced to the class:</p> <ul style="list-style-type: none"> <li>• correct techniques for using each measuring device/equipment</li> <li>• validation of measuring device/equipment.</li> </ul> <p>Class discussion:</p> <ul style="list-style-type: none"> <li>• appropriateness of device/equipment to a range of situations in the manufacturing, engineering and related services industries (eg ruler versus tape measure)</li> <li>• consideration/s for the selection of measuring device/equipment.</li> </ul> <p>Practical activity – students undertake validation of measuring devices including zeroing, scale adjustment and test piece. (For example, students calibrate a 0-25 and a 25-50 micrometer.)</p>		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
	<ul style="list-style-type: none"> <li>• time</li> <li>• cost</li> <li>• limits and tolerances</li> <li>• job specification</li> <li>• work environment (production environment or workstation).</li> </ul>			
	A range of measurements: <ul style="list-style-type: none"> <li>• length</li> <li>• width/breadth</li> <li>• depth</li> <li>• height</li> <li>• angle</li> <li>• squareness</li> <li>• flatness</li> <li>• roundness</li> <li>• temperature</li> <li>• clearances.</li> </ul>	Handout/class notes with brief explanation of each content point.		
	Industry-accepted techniques to obtain a range of measurements.	<p><i>It is intended that the following learning experience/activity be covered during completion of one or more of the workshop projects.</i></p> <p>A range of measurement exercises (incorporating all measurements listed in the content column) typical to a manufacturing, engineering and related industries environment. [Task 24]</p> <p><i>For each workshop project:</i></p> <p>Use a variety of measuring devices/equipment and techniques ensuring accurate measurements.</p>		
	Issues relating to the storage of measuring devices including: <ul style="list-style-type: none"> <li>• security</li> </ul>	Class discussion at the time the device is introduced to the class in relation to storage and access of measuring devices.		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
	<ul style="list-style-type: none"> <li>• climatic effects</li> <li>• OHS considerations</li> <li>• stability</li> <li>• ease of access.</li> </ul> <p>Methods for storage and access of basic measuring devices.</p>	[Link to Tasks 15 and 16]		
<p><i>MEM12023A Perform engineering measurements</i></p> <p><b>2 Obtain measurements using a range of measuring devices</b></p> <p>2.3 Dimensions are determined or verified using basic calculations, where required.</p> <p><i>MEM12024A Perform computations</i></p> <p><b>1 Determine work requirement</b></p> <p>1.3 Required calculation method is determined to suit the application, including selection of relevant arithmetic operations and/or formulae.</p> <p>1.4 Expected results are estimated, including rounding off, as appropriate.</p>	<p><b>Mathematical concepts, formulae and calculations</b></p> <p>A basic understanding of the mathematical concepts:</p> <ul style="list-style-type: none"> <li>• whole numbers</li> <li>• mixed numbers</li> <li>• percentages</li> <li>• decimal</li> <li>• fractions</li> <li>• ratio</li> <li>• proportions.</li> </ul> <p>Application of the four basic arithmetic operations:</p> <ul style="list-style-type: none"> <li>• addition</li> <li>• subtraction</li> <li>• multiplication</li> <li>• division.</li> </ul> <p>Manipulation of:</p> <ul style="list-style-type: none"> <li>• whole numbers</li> <li>• mixed numbers</li> <li>• decimals</li> <li>• fractions.</li> </ul> <p>Techniques for estimating approximate answers.</p> <p>Procedures for ‘rounding off’ figures when estimating approximate answers.</p>	Handout/class notes with brief explanation of each concept.		
		<p><i>It is intended that the following learning experiences/activities be covered during completion of one or more of the workshop projects:</i></p> <p>A range of exercises typical to a manufacturing, engineering and related industries environment including:</p> <ul style="list-style-type: none"> <li>• application of basic arithmetic operations</li> <li>• manipulation of numbers, decimals and fractions</li> <li>• determining percentages</li> <li>• conversions of decimals, fractions and percentages</li> <li>• calculation of proportions, ratios and averages</li> <li>• ‘rounding off’ and estimating approximates.</li> </ul> <p>[Task 24]</p>		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
	<p>Determining percentages.</p> <p>Conversion of:</p> <ul style="list-style-type: none"> <li>• decimals and fractions to percentages</li> <li>• percentages to decimals and fractions.</li> </ul> <p>Calculation of proportions, ratios and averages.</p>			
	<p>A basic understanding of the mathematical concepts:</p> <ul style="list-style-type: none"> <li>• perimeter</li> <li>• area</li> <li>• volume.</li> </ul>	Class notes and discussion – perimeter and area.	Class notes and discussion – volume.	
	<p>An understanding of the reasons for using dimensions with the same units when calculating</p> <ul style="list-style-type: none"> <li>• length</li> <li>• perimeter</li> <li>• area</li> <li>• volume.</li> </ul>	Class notes and accompanying discussion in relation to length, perimeter and area.	Class notes and accompanying discussion in relation to volume.	
	<p>Determine:</p> <ul style="list-style-type: none"> <li>• perimeter and area of                             <ul style="list-style-type: none"> <li>- a circle</li> <li>- a square</li> <li>- a rectangle</li> <li>- a triangle</li> <li>- a trapezium</li> </ul> </li> <li>• volume of                             <ul style="list-style-type: none"> <li>- a cube</li> <li>- a cone</li> <li>- a cylinder.</li> </ul> </li> </ul>	Exercises measuring and calculating the perimeter and area of the following shapes: <ul style="list-style-type: none"> <li>• circle</li> <li>• square</li> <li>• rectangle</li> <li>• triangle</li> <li>• trapezium.</li> </ul>	Exercises measuring and calculating the volume of the following solids: <ul style="list-style-type: none"> <li>• cube</li> <li>• cone</li> <li>• cylinder.</li> </ul>	Class discussion and exercises involving measuring and calculating areas of geometric shapes and volumes of solids found in manufacturing, engineering and related services industries work. [Task 24]

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
	<p>Calculations involving regular and irregular geometric shapes found in work tasks.</p> <p>How to source appropriate formulae.</p> <p>An understanding of the reasons for ensuring the units of each term are consistent with the formulae selected.</p> <p>Procedures for converting given units to those required for use in formulae.</p> <p>Substitution of correct values for each term in the relevant formulae.</p> <p>Application of mathematical formulae.</p>	<p>Calculation exercises involving regular geometric shapes.</p> <p>[Link to Task 24]</p>		<p>Calculation exercises involving irregular geometric shapes.</p> <p>[Link to Task 24]</p>
		<p><i>It is intended that the application of mathematical formulae occur during completion of the workshop projects.</i></p> <p>Project work should include:</p> <ul style="list-style-type: none"> <li>• sourcing formulae</li> <li>• appropriate use of formula</li> <li>• converting and substituting units/values.</li> </ul> <p>[Link to Tasks 20, 21, 22, 23 and 24.]</p>		
<p><i>MEM12023A Perform engineering measurements</i></p> <p><b>2 Obtain measurements using a range of measuring devices</b></p> <p>2.2 Measurements are accurately obtained.</p> <p>2.3 Dimensions are determined or verified using basic calculations, where required.</p> <p><i>MEM12024A Perform computations</i></p>	<p><b>Measurements and calculations for work tasks/projects</b></p> <p>Readings of all measurements accurately for a range of tasks/projects to the finest graduation.</p> <p>Performance of calculations using:</p> <ul style="list-style-type: none"> <li>• pen and paper</li> <li>• a calculator.</li> </ul> <p>Identification and selection of appropriate methods to perform a range of calculations suitable for a variety of applications/tasks/projects of varying</p>	<p>Practical exercises:</p> <ul style="list-style-type: none"> <li>• students select appropriate measuring device for task/project, use appropriate measuring technique and take accurate measurements to the finest graduation</li> <li>• students select appropriate calculation method and/or formulae and perform calculations using both pen and paper and a calculator.</li> </ul> <p>Link to all practical tasks/projects.</p> <p>[Task 24]</p>		

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
<p><b>1 Determine work requirement</b> 1.3 Required calculation method is determined to suit the application, including selection of relevant arithmetic operations and/or formulae.</p> <p><b>2 Perform calculations</b> 2.1 Calculation method is applied correctly.</p>	<p>complexity in the manufacturing, engineering and related services industry.</p>			
		<p>Provide students with a materials estimation to complete the tool box (show all working – measurements and calculations).</p> <p>[Link to Task 25]</p>	<p>Worksheet – provide students with the measurements required for the basic BBQ/pizza oven. Students make adjustments according to any personal modifications for their project, and then select appropriate formulae/calculations to determine material quantities.</p> <p>Teacher checks prior to students commencing the project.</p> <p>[Link to Task 25]</p>	<p>Class practical activity:</p> <ul style="list-style-type: none"> <li>• students take measurements from a sample</li> <li>• students select appropriate formulae/calculations to determine material quantities for one</li> <li>• students calculate material quantities for more than one (ie to a customer work order) allowing for an appropriate amount of wastage materials due to defects, cutting, etc</li> <li>• provide the class with accurate working to compare and check their workings</li> <li>• develop a materials list</li> <li>• complete an order form [Link to Task 11].</li> </ul> <p>[Link to Task 25]</p>

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
<p><i>MEM12024A Perform computations</i></p> <p><b>1 Determine work requirement</b> 1.2 Data is obtained from relevant sources and interpreted correctly.</p> <p><b>3 Produce charts and graphs from given information</b> 3.1 Data is transposed accurately to produce charts or graphs. 3.2 Charts or graphs accurately reflect data on which they are based.</p>	<p><b>Charts and graphs</b></p> <p>A range of simple charts and graphs:</p> <ul style="list-style-type: none"> <li>• histogram</li> <li>• charts                             <ul style="list-style-type: none"> <li>- control</li> <li>- pie</li> </ul> </li> <li>• graphs                             <ul style="list-style-type: none"> <li>- line</li> <li>- column.</li> </ul> </li> </ul> <p>An understanding of:</p> <ul style="list-style-type: none"> <li>• scales (in relation to charts/graphs)</li> </ul> <p>Scales applicable to the axes of the charts/graphs.</p> <p>The importance of:</p> <ul style="list-style-type: none"> <li>• appropriate and correctly labelled axes</li> <li>• clear and accurately marked coordinates</li> <li>• clearly marked, appropriate limits.</li> </ul> <p>An awareness of:</p> <ul style="list-style-type: none"> <li>• upper and lower limits of acceptability applicable to data</li> <li>• the trends indicated by the slope or gradient of a graph</li> <li>• the actions to be taken when given trends occur or set limits are approached on charts/graphs.</li> </ul> <p>Procedures for drawing ‘lines of best fit’.</p>			<p><i>It is intended that the following learning experiences/activities be covered during completion of one or more of the workshop projects.</i></p> <p>Visual stimulus – use of simple charts and graphs in manufacturing, engineering and related services industries.</p> <p>Handout covering:</p> <ul style="list-style-type: none"> <li>• differences between and benefits and limitations of histograms, charts and graphs</li> <li>• scales</li> <li>• labelling axes</li> <li>• marking coordinates</li> <li>• upper and lower limits</li> <li>• ‘lines of best fit’.</li> </ul> <p>Class discussion:</p> <ul style="list-style-type: none"> <li>• the importance of                             <ul style="list-style-type: none"> <li>- selecting the most appropriate chart or graph to represent the data</li> <li>- accurately transposing data</li> </ul> </li> <li>• determining required information from charts/graphs</li> <li>• trends indicated by slope/gradient in chart/graph</li> <li>• actions to be taken as a result of information presented in the chart/graph.</li> </ul> <p>Application of a minimum of three types of simple charts and/or graphs used in manufacturing, engineering or related services industries including:</p> <ul style="list-style-type: none"> <li>• producing simple charts/graphs from given</li> </ul>

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
			information or observations made <ul style="list-style-type: none"> <li>• selecting appropriate scales and using them in the production of charts/graphs</li> <li>• marking appropriate limits clearly on the chart/graph</li> <li>• if appropriate, entering upper and lower limits of acceptability</li> <li>• procedures for drawing ‘lines of best fit’.</li> </ul> [Task 27]	
	<b>Project work plan</b>	Provide students with a work order for this project.	Teacher and students prepare a work order for this project.  [Link to Task 9]	Students prepare a work order for this project.  Teacher checks work order prior to students commencing the project.  [Link to Task 9]
			Teacher and students to develop a formal quote for this project.  [Link to Task 26]	Students prepare a job quote for this project.  [Task 26]
		Provide students with a work/job plan for this project.	Teacher and students prepare a work/job plan for this project.  [Task 12]	Students prepare a work/job plan for this project.  Teacher checks work/job plan prior to students commencing the project.  [Task 12]

Unit / Element of competency / Performance criteria	Content	Possible learning experiences / activities		
		Tool box	BBQ/Pizza Oven	Industry-specific class project
	<b>Evaluation</b>	<p>At the conclusion of each project each student is to complete a self-evaluation of their project as well as a peer evaluation of a randomly allocated project.</p> <p>At the conclusion of the class project each student is to conduct a personal evaluation of the project as well as participate in a whole-class evaluation of the project.</p> <p>[Task 13]</p>		