



**Australian Government**

**Department of Education, Employment and Workplace Relations**

# **PMAOPS302B Operate reactors and reaction equipment**

**Revision Number: 1**

## PMAOPS302B Operate reactors and reaction equipment

### Modification History

Not applicable.

### Unit Descriptor

<b>Unit descriptor</b>	<p>Typically an operations technician would be looking after the operation of a production unit which, as its prime function, causes and controls a chemical reaction. It includes the operation of equipment ancillary to the main reactor. The reactor or reaction equipment includes types of reactors such as:</p> <ul style="list-style-type: none"> <li>• batch</li> <li>• continuous</li> <li>• catalytic</li> <li>• fluidised bed.</li> </ul>
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### Application of the Unit

<b>Application of the unit</b>	<p>The plant technician would:</p> <ul style="list-style-type: none"> <li>• identify and rectify operational problems</li> <li>• run all aspects of the reactor operation, including start-up and shut down</li> <li>• monitor and manage the supply of raw materials and output of product</li> <li>• adjust product properties to meet specifications.</li> </ul> <p>Generally the plant technician would operate independently in a plant with local control or in liaison with the control room operator in a plant with centralised/distributed control system (DCS) type controls. The plant technician would be expected to be capable of performing all parts of this unit. At all times they would be liaising and cooperating with other members of the team.</p> <p>This unit does not require the operation of a central control panel.</p>
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### Licensing/Regulatory Information

Not applicable.

## Pre-Requisites

<b>Pre-requisite units</b>	
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## Employability Skills Information

<b>Employability skills</b>	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. Prepare for work.	1.1. Identify work requirements 1.2. Identify and control hazards 1.3. Coordinate with appropriate personnel
2. Start-up reaction systems.	2.1. Perform pre-start-up checks 2.2. Start up individual items of equipment and the entire reactor system 2.3. Start up from standby and after maintenance 2.4. Build reaction rate steadily and take appropriate action on deviations 2.5. Stabilise reaction system to produce in specification product at specified rates within minimum time.
3. Monitor and control the reaction process.	3.1. Complete routine checks logs and paperwork 3.2. Recognise the signs of potential and actual problems 3.3. Take appropriate action to minimise the impact on safety, health, the environment and the business of potential and actual problems 3.4. Monitor condition of catalyst (if appropriate) and take action to maintain production schedule and quality 3.5. Monitor materials and stock levels of feeds and take action to maintain production schedule and quality 3.6. Trim plant to achieve required rates and quality while maximising plant efficiency.
4. Change production rates and/or product grade/specification.	4.1. Predict from rates and schedule when a transition will be required 4.2. Give advanced notice of transition to work team 4.3. Trim plant in a manner which prepares it for the transition 4.4. Manage transitions smoothly and in a timely manner and take appropriate action to achieve this 4.5. Minimise scrap/off grade as a result of a transition.
5. Maintain plant effectiveness.	5.1. Frequently and critically monitor all plant throughout shift 5.2. Use measured/indicated data and smell, sight, sound and feel as appropriate to monitor plant 5.3. Identify critical equipment/processes and tune their performance 5.4. Identify issues likely to impact on plant

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b>
	performance and take appropriate action 5.5. Predict impact of a change in one unit/area on other plant units/areas and communicate this to relevant people 5.6. Take appropriate action to maintain plant effectiveness.
6. Shut down reaction systems.	6.1. Determine type of shut down required 6.2. Give advance warning of shut down where possible 6.3. Change over individual items of equipment 6.4. Shut down individual items of equipment and the entire reaction system 6.5. Shut down to a stand-by condition if required 6.6. Shut down for maintenance when required. 6.7. Shut down in an emergency when required
7. Clean reactors/vessels.	7.1. Identify cleaning requirements 7.2. Clean to requirements according to procedures.
8. Isolate and de-isolate reactor.	8.1. Isolate plant 8.2. Make safe for required work 8.3. Check plant is ready to be returned to service 8.4. Prepare plant for return to service.

## Required Skills and Knowledge

### REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

#### Required skills

- efficient and effective operation of reactor and ancillary plant/equipment
- hazard analysis
- completing plant records
- communication
- problem solving.

Also the ability to:

- identify all items on a schematic of the reaction system and describe the function of each
- distinguish between elements, compounds and mixtures in their raw materials and products
- describe the nature/condition of materials at each stage of the reaction, the changes which have occurred in that stage and why they have occurred
- describe reaction in chemical terms, including the effect of changing reaction variables, eg temperature, pressure, catalyst, concentration, pH
- describe the reaction(s) using appropriate chemical equations
- state the type of reactor(s) used and their characteristics (advantages and limitations)
- describe the methods of controlling the reaction, including rate and yield.

#### Required knowledge

Competence includes an understanding of the reaction system and its integral equipment to the level needed to control the system and recognise and resolve problems. In particular this includes:

- principles of operation of reactor and ancillary plant/equipment
- physics and chemistry relevant to the process and the materials processed
- process parameters and limits, eg temperature, pressure, flow, pH
- duty of care obligations
- hierarchy of control
- communication protocols, eg radio, phone, computer, paper, permissions/authorities
- routine problems, faults and their resolution
- relevant alarms and actions
- plant process idiosyncrasies
- correct methods of starting, stopping, operating and controlling process
- corrective action appropriate to the problem cause
- function and troubleshooting of major components and their problems
- types and causes of problems within operator's scope of skill level and responsibility.



## Evidence Guide

### EVIDENCE GUIDE

The Evidence Guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for the Training Package.

#### Overview of assessment

Assessment of this unit should include demonstrated competence on actual plant and equipment in a work environment. The unit will be assessed in as holistic a manner as is practical and may be integrated with the assessment of other relevant units of competency. Assessment will occur over a range of situations, which will include disruptions to normal, smooth operation.

Simulation may be required to allow for assessment of parts of this unit. Simulation should be based on the actual plant and will include walk-throughs of the relevant competency components. Simulations may also include the use of case studies/scenarios and role plays.

This unit of competency requires a significant body of knowledge which will be assessed through questioning and the use of what-if scenarios both on the plant (during demonstration of normal operations and walk-throughs of abnormal operations) and off the plant.

#### Critical aspects for assessment and evidence required to demonstrate competency in this unit

Competence must be demonstrated in the ability to recognise and analyse potential situations requiring action and then in implementing appropriate corrective action. The emphasis should be on the ability to stay out of trouble rather than on recovery from a disaster.

Consistent performance should be demonstrated. In particular look to see that:

- early warning signs of equipment/processes needing attention or with potential problems are recognised
- the range of possible causes can be identified and analysed and the most likely cause determined
- appropriate action is taken to ensure a timely return to full performance
- obvious problems in related plant areas are recognised and an appropriate contribution made to their solution

These aspects may be best assessed using a range of



<b>EVIDENCE GUIDE</b>	
	scenarios/case studies/what-ifs as the stimulus with a walk-through forming part of the response. These assessment activities should include a range of problems, including new, unusual and improbable situations, which may have been generated from the past incident history of the plant, incidents on similar plants around the world, hazard analysis activities and similar sources.
<b>Context of and specific resources for assessment</b>	Assessment will require access to an operating plant over an extended period of time, or a suitable method of gathering evidence of operating ability over a range of situations. A bank of scenarios/case studies/what-ifs will be required as will a bank of questions which will be used to probe the reasoning behind the observable actions.
<b>Method of assessment</b>	<p>In all plants it may be appropriate to assess this unit concurrently with relevant teamwork and communication units.</p> <p>In a major hazard facility, it may be appropriate to assess this unit concurrently with:</p> <ul style="list-style-type: none"> <li>• <i>MSAPMOHS200A Work safely.</i></li> </ul>
<b>Guidance information for assessment</b>	Assessment processes and techniques must be culturally appropriate and appropriate to the oracy, language and literacy capacity of the assessee and the work being performed.

## Range Statement

<b>RANGE STATEMENT</b>	
<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. Add any 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.</p>	
<b>Codes of practice/ standards</b>	Where reference is made to industry codes of practice, and/or Australian/international standards, the latest version must be used.
<b>Context</b>	<p>This competency unit includes all such items of equipment and unit operations which form part of the reaction system. Typically this will include:</p> <ul style="list-style-type: none"> <li>• pumps</li> <li>• valves</li> <li>• mixers and</li> <li>• heat exchangers/jackets/coils.</li> </ul> <p>and may also include other equipment as well as the reaction vessel itself.</p>
<b>Typical problems</b>	<p>Typical problems include:</p> <ul style="list-style-type: none"> <li>• variations in catalyst activity</li> <li>• control of exotherm/endothrm</li> <li>• adjustments to meet product specifications</li> <li>• variations in feed rates/quality.</li> <li>• raw materials variations</li> <li>• instrument failure/wrong reading</li> <li>• equipment failure (electrical/mechanical)</li> <li>• mechanical failure</li> <li>• operational problems.</li> </ul>
<b>Appropriate action</b>	<p>Appropriate action includes:</p> <ul style="list-style-type: none"> <li>• determining problems needing action</li> <li>• determining possible fault causes</li> <li>• rectifying problem using appropriate solution within area of responsibility</li> <li>• following through items initiated until final resolution has occurred</li> <li>• reporting problems outside area of responsibility to designated person.</li> </ul>
<b>Procedures</b>	<p>Procedures may be written, verbal, computer-based or in some other form. They include:</p> <ul style="list-style-type: none"> <li>• all work instructions</li> </ul>

<b>RANGE STATEMENT</b>	
	<ul style="list-style-type: none"> <li>• standard operating procedures</li> <li>• formulas/recipes</li> <li>• batch sheets</li> <li>• temporary instructions</li> <li>• any similar instructions provided for the smooth running of the plant.</li> </ul> <p>For the purposes of this Training Package, 'procedures' also includes good operating practice as may be defined by industry codes of practice (eg Responsible Care) and government regulations.</p>
<b>Health, safety and environment (HSE)</b>	<p>All operations to which this unit applies are subject to stringent health, safety and environment requirements, which may be imposed through State or Federal legislation, and these must not be compromised at any time. Where there is an apparent conflict between Performance Criteria and HSE requirements, the HSE requirements take precedence.</p> <p>Plant technicians should be able to determine safe working practice using the relevant materials safety data sheets (MSDSs).</p>

## Unit Sector(s)

<b>Unit sector</b>	Operational/technical
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## Competency field

<b>Competency field</b>	
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## Co-requisite units

<b>Co-requisite units</b>		
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