Australian Government

Department of Education, Employment and Workplace Relations

# PMAOPS241A Operate Joule-Thomson effect device

**Revision Number: 1**

# PMAOPS241A Operate Joule-Thomson effect device

## Modification History

Not applicable.

## Unit Descriptor

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| **Unit descriptor** | This unit of competency covers the operation of a range of equipment generally covered by the title 'Joule-Thomson device'. These are typically encountered in any cryogenic process and are a critical part of the 'cold end' or refrigeration cycle. |

# Application of the Unit

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| **Application of the unit** | In a typical scenario, an operator monitors and operates a cryogenic plant which liquefies hydrocarbons, air or other gas. The purpose of the liquefaction may be to then separate the components by distillation or other means, or there may be other reasons for liquefying the gas (e.g. to reduce volume for shipping). The gas being liquefied may also be the refrigerant fluid used for at least part of the cooling/liquefaction cycle. This may be undertaken in conjunction with other refrigeration and/or cooling processes.<br><br>The operator will typically operate the entire cooling and liquefaction operation and so will also be operating a compressor (*PMAOPS304B Operate and monitor compressor systems and equipment*), a heat exchanger (*PMAOPS205B Operate heat exchangers*), and a dryer (*PMAOPS206B Operate separation equipment*, *PMAOPS326B Produce product using gas absorption*, *PMAOPS327B Produce product using fixed bed dehydration*, or *PMAOPS329B Produce product using liquid extraction* depending on the process).<br><br>The operator would:<br>• identify and take appropriate action on operational problems<br>• contribute to the safe and productive operation of the equipment<br>• monitor, operate and be responsible for the plant.<br><br>Generally the operator would be part of a team during startup and shutdown procedures and would be expected to be capable of demonstrating competence in all parts of this unit. At all times they would be liaising and cooperating with other members of the team.<br><br>This unit does not require the operation of a central control panel, but operating a local or central panel may be part of the job for some (these are covered by separate units).<br><br>This competency covers all Joule-Thomson type devices, |

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| | such as turbo expanders, expansion turbines and expansion engines. |

## Licensing/Regulatory Information

Not applicable.

## Pre-Requisites

| **Prerequisite units** | | |
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## Employability Skills Information

| **Employability skills** | This unit contains employability skills. |
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## Elements and Performance Criteria Pre-Content

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| 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. |

# Elements and Performance Criteria

| ELEMENT | PERFORMANCE CRITERIA |
|---|---|
| 1. Prepare for work | 1.1. Identify work requirements<br>1.2. Identify and control hazards<br>1.3. Coordinate with appropriate personnel |
| 2. Monitor and operate Joule-Thomson device | 2.1. Monitor product produced<br>2.2. Monitor and record critical process variables to procedures<br>2.3. Monitor performance of support units<br>2.4. Monitor performance of ancillary skids<br>2.5. Identify issues requiring action<br>2.6. Take appropriate action to procedures |
| 3. Bring plant on and off line | 3.1. Shut down plant as required<br>3.2. Isolate plant<br>3.3. Make plant safe as required<br>3.4. Check plant is ready to be returned to service<br>3.5. Prepare plant for return to service<br>3.6. Start up plant as required<br>3.7. Changeover online device if required |

# Required Skills and Knowledge

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

Required skills include:

- recognising conditions which will lead to out of specification product or unsafe situation
- implementing the enterprise's procedures within time constraints and in a manner relevant to the correct use of the equipment
- conveying information relevant to the operation clearly and effectively
- maintaining appropriate levels of quality assurance
- reading and numeracy to interpret workplace documents, instrumentation and technical information

**Required knowledge**

Required knowledge includes:

- hazards associated with the process
- cryogenic hazards associated with the process and the materials
- cryogenic materials, their lines and vessels
- metal embrittlement
- application of the hierarchy of control in controlling the hazards
- Joule-Thomson principles
- adiabatic/constant enthalpy expansion, inversion temperature
- principles of operation of particular devices installed on plant
- importance of the temperature range (and other critical variables)
- gas properties (Boyles and Charles laws)
- product dew point (i.e. dew point of the hydrocarbon, air or other gas being condensed)
- importance of (lack of) moisture (and other contaminants) in the process stream
- consequences of deviations from the desired values of critical variables
- safe start-up from different conditions (e.g. warm vs cold starts)

# Evidence Guide

| EVIDENCE GUIDE | |
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| 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. | |
| **Overview of assessment** | |
| **Critical aspects for assessment and evidence required to demonstrate competency in this unit** | It is essential that the equipment be understood and that the importance of critical properties, settings and readings is known. Competence must be demonstrated in the operation of all ancillary equipment to the level required for this unit of competency.<br><br>Competence must be demonstrated in the ability to recognise and analyse potential situations requiring action and then in implementing appropriate corrective action.<br><br>Consistent performance should be demonstrated. In particular look to see that:<br>• hazards are identified and controlled<br>• product properties are kept within limits<br>• quality is monitored to minimise wastage<br>• process measurements/observations are continually made<br>• all HSE requirements are followed<br>• problems are anticipated and appropriate action is taken (i.e. problem fixed or reported). |
| **Context of and specific resources for 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.<br><br>Simulation may be required to allow for assessment of parts of this unit. Simulation should be based on the actual plant and include walk-throughs of the relevant competency components. Simulations may also include the use of case studies/scenarios, role plays and 3D virtual reality interactive systems. In the case of evacuation training or training for competencies practised in life-threatening situations, simulation may be |

| EVIDENCE GUIDE | |
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| | used for the bulk of the training.<br><br>A bank of scenarios/case studies/what-ifs and questions will be required to probe the reasoning behind observable actions. |
| **Method of assessment** | In all plants it may be appropriate to assess this unit concurrently with relevant teamwork and communication units.<br>Individual enterprises may choose to add prerequisites and co-requisites relevant to their processes. |
| **Guidance information for assessment** | Assessment processes and techniques must be culturally appropriate and appropriate to the language and literacy capacity of the candidate and the work being performed. |

# Range Statement

| RANGE STATEMENT | |
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| 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. | |
| **Procedures** | All operations are performed in accordance with standard procedures. Procedures may be written, verbal, computer-based or in some other form. They include:<br>• all work instructions<br>• standard operating procedures<br>• formulas/recipes<br>• batch sheets<br>• temporary instructions<br>• any similar instructions provided for the smooth running of the plant<br>For the purposes of this Training Package, 'procedures' also includes good operating practice as may be defined by industry codes of practice (e.g. Responsible Care) and government regulations |
| **Joule-Thomson device** | A Joule-Thomson device is any device which requires a gas/vapour to do work, typically by expanding, so cooling the vapour (i.e. uses the Joule-Thomson effect). While the vapour will not usually condense in the Joule-Thomson device it will often condense immediately on leaving the device. Some devices may be constructed to allow for condensation to occur within the device, this is sometimes also called the Joule-Kelvin effect |
| **Hazards** | Hazards include:<br>• process hazards<br>• cryogenic materials<br>• cryogenic hazards<br>• cold embrittlement<br>• other hazards |
| **Product produced** | Product produced will typically be monitored for: |

| **RANGE STATEMENT** | |
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| | • value of critical variables<br>• state (liquid/vapour)<br>• production rate (e.g. volume or mass flow rate)<br>• other properties |
| **Critical variables** | Critical variables will typically include:<br>• temperature<br>• pressure<br>• pressure drops<br>• purity/contaminants<br>and may include:<br>• inlet guide vane (IGV) blade angles<br>• speed of rotation<br>• other variables |
| **Support units** | Support units include:<br>• lubricating oil<br>• dry gas seals<br>• other seals<br>• other units |
| **Ancillary equipment** | This unit also covers ancillary equipment which forms part of the Joule-Thomson system |
| **Appropriate action** | Appropriate action includes:<br>• recognising actual and potential problems<br>• determining problems needing action<br>• determining possible fault causes<br>• rectifying problem using appropriate solution within area of responsibility<br>• following through items initiated until final resolution has occurred<br>• reporting problems outside area of responsibility to designated person |
| **Start up/shut down as required** | Start up/shut down as required includes:<br>• start up and shut down to/from normal operating conditions<br>• start up and shut down to/from isolated, cold and empty<br>• all other conditions experienced on the plant (i.e. from any condition to any condition |

| RANGE STATEMENT | |
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| | experienced on the plant) |
| **Health**, **safety and environment** (**HSE**) | All operations to which this unit applies are subject to stringent HSE requirements, which may be imposed through state, territory 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 |

# Unit Sector(s)

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| **Unit sector** | Operational/technical |

# Competency field

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| **Competency field** | |

# Co-requisite units

| **Co-requisite units** | | |
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