



Australian Government

PMAOPS241 Operate Joule-Thomson effect device

Release: 1

PMAOPS241 Operate Joule-Thomson effect device

Modification History

Release 1. Supersedes and is equivalent to PMAOPS241A Operate Joule-Thomson effect device

Application

This unit of competency covers the skills and knowledge required to operate a range of equipment generally covered by the title 'Joule-Thomson device'.

This unit of competency covers all Joule-Thomson type devices, such as turbo expanders, expansion turbines and expansion engines. These devices are typically encountered in any cryogenic process and are a critical part of the 'cold end' or refrigeration cycle.

This unit of competency applies to operators who are required to start up and shut down the equipment, monitor its performance, identify operational problems and take appropriate action, and maintain records. Generally any adjustment to the Joule-Thomson device will be made remotely by the control panel operator.

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.

This unit of competency applies to an individual who may work alone although under routine direction and supervision. They may work as part of a team or group and will work in liaison with other shift team members and the control room operator, as appropriate.

The operator will typically operate the entire cooling and liquefaction operation and so will also be operating a compressor, a heat exchanger and a dryer.

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

Pre-requisite Unit

Nil

Competency Field

Operations

Unit Sector

Elements and Performance Criteria

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

- | | | |
|---|--|---|
| 1 | Prepare for work | 1.1 Receive and give shift handover
1.2 Identify work requirements
1.3 Identify and control hazards
1.4 Coordinate with appropriate personnel
1.5 Check for recent work undertaken on Joule-Thomson system
1.6 Note any outstanding/incomplete work
1.7 Check operational status of Joule-Thomson system |
| 2 | Monitor and operate Joule-Thomson device | 2.1 Monitor Joule-Thomson system frequently and critically throughout shift using measured/indicated data and senses as appropriate
2.2 Identify impacts of any changes upstream and downstream
2.3 Recognise situations which may require action
2.4 Resolve routine problems
2.5 Take actions on other abnormal situations to make safe and have the situation resolved |
| 3 | Isolate and de-isolate Joule-Thomson system | 3.1 Complete any required pre-start checks
3.2 Start up/shut down/changeover Joule-Thomson device according to the Joule-Thomson device type and duty in liaison with other personnel
3.3 Isolate Joule-Thomson system
3.4 Make safe for required work |

- 3.5 Check Joule-Thomson system is ready to be returned to service
- 3.6 De-isolate and prepare Joule-Thomson system for return to service

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Regulatory framework

The latest version of all legislation, regulations, industry codes of practice and Australian/international standards, or the version specified by the local regulatory authority, must be used, and include one or more of the following:

- legislative requirements, including work health and safety (WHS)
- industry codes of practice and guidelines
- environmental regulations and guidelines
- Australian and other standards
- licence and certification requirements

All operations to which this unit applies are subject to stringent health, safety and environment (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.

Procedures

All operations must be performed in accordance with relevant procedures.

Procedures are written, verbal, visual, computer-based or in some other

form, and include one or more of the following:

- emergency procedures
- work instructions
- standard operating procedures (SOPs)
- safe work method statements (SWMS)
- formulas/recipes
- batch sheets
- temporary instructions
- any similar instructions provided for the smooth running of the plant

Hazards

Hazards include one or more of the following:

- process hazards
- cryogenic materials and hazards
- cold embrittlement
- electricity
- gas
- gases and liquids under pressure
- structural hazards
- structural collapse
- equipment failures
- industrial (machinery, equipment and product)
- equipment or product mass
- noise, rotational equipment or vibration
- limited head spaces or overhangs
- working at heights, in restricted or confined spaces, or in environments subjected to heat, noise, dusts or vapours
- flammability and explosivity
- hazardous products and materials
- unauthorised personnel
- sharp edges, protrusions or obstructions
- slippery surfaces, spills or leaks
- extreme weather
- other hazards that might arise

Routine problems Routine problems must be resolved by applying known solutions.

Routine problems are predictable and include one or more of the following:

- pressure differential (DP) out of range

- feed/product too warm
- feed/product pressure out of range
- liquid forming in wrong part of system
- lubrication system too hot/cold wrong pressure
- leaking seals/seal gas flow/pressure wrong
- high thrust forces
- excessive vibration

Known solutions are drawn from one or more of the following:

- procedures
- training
- remembered experience

Non-routine problems must be reported according to according to relevant procedures.

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.

Monitor

Product produced will be monitored for the following:

- value of critical variables
- state (liquid/vapour)
- production rate (e.g. volume or mass flow rate)
- other properties as defined in job specifications/procedures

Critical variables to be monitored include one or more of the following:

- temperature
- pressure
- pressure drops
- purity/contaminants
- inlet guide vane (IGV) blade angles (where appropriate to the device)
- speed of rotation (where appropriate to the device)
- other variables (where appropriate to the device)

Joule-Thomson system	The Joule-Thomson system includes the Joule-Thomson device itself and one or more of the following: • lubricating oil • dry gas seals • other seals • safety and shutdown systems
Action on abnormal situations	Action on abnormal situations includes the following: • recognising actual and potential problems • determining problems needing action • determining possible fault causes • rectifying problem using appropriate solution within area of responsibility • following through items initiated until final resolution has occurred • reporting problems outside area of responsibility to designated person
Start up/shut down as required	Start up/shut down as required includes the following: • start up and shut down to/from normal operating conditions • start up and shut down to/from isolated, cold and empty • start up and shut down to/from other conditions/situations experienced on the plant

Unit Mapping Information

Release 1. Supersedes and is equivalent to PMAOPS241A Operate Joule-Thomson effect device

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=9fc2cf53-e570-4e9f-ad6a-b228ffdb6875>

Assessment Requirements for PMAOPS241 Operate Joule-Thomson effect device

Modification History

Release 1. Supersedes and is equivalent to PMAOPS241A Operate Joule-Thomson effect device

Performance Evidence

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

- start up/shut down the Joule-Thomson system
- monitor the system
- recognise early warning signs of equipment/processes needing attention or with potential problems
- determine the most likely cause of routine problems
- take appropriate action to ensure a timely return to full performance
- isolate and de-isolate equipment
- identify hazards and apply hazard control procedures.

Knowledge Evidence

Evidence must be provided that demonstrates knowledge of:

- cryogenic hazards associated with the process and the materials, including metal embrittlement
- cryogenic materials, their lines and vessels
- Joule-Thomson principles
- physics relevant to Joule-Thomson system, including Boyles and Charles laws, adiabatic/constant enthalpy expansion, inversion temperature and product dew point (i.e. dew point of the hydrocarbon, air or other gas being condensed)
- importance of the temperature range, (lack of) moisture (and other contaminants) in the process stream, and other critical variables
- hierarchy of control
- hazards that may arise in the job/work environment, and:
 - their possible causes
 - potential consequences
 - appropriate risk controls.

Assessment Conditions

- The unit should be assessed holistically and the judgement of competence based on a holistic assessment of the evidence.

- The collection of performance evidence:
 - should occur over a range of situations which include typical disruptions to normal, smooth operation of an operating plant
 - will typically include a supervisor/third-party report or other evidence, focusing on consistent performance and problem recognition and solving. A supervisor/third-party report must be prepared by someone who has a direct, relevant, current relationship with the person being assessed and who is in a position to form a judgement on workplace performance relevant to the unit of competency
 - must include the use of an appropriate industrial item of equipment requiring demonstration of operation, start-up and shutdown procedures and responding to problems
 - may use industry-based simulation for part only of the unit where safety, lack of opportunity or significant cost is an issue.
- Assessment should occur in operational workplace situations. Where this is not possible, or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment reflecting realistic operational workplace conditions. This must cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- Assessment in a simulated environment should use evidence collected from one or more of:
 - walk-throughs
 - pilot plant operation
 - demonstration of skills
 - industry-based case studies/scenarios
 - 'what ifs'.
- Knowledge evidence may be collected concurrently with performance evidence (provided a record is kept) or through an independent process, such as workbooks, written assessments or interviews (provided a record is kept).
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
- Conditions for assessment must include access to all tools, equipment, materials and documentation required, including relevant workplace procedures, product and manufacturing specifications associated with this unit.
- The regulatory framework will be reflected in workplace policies and procedures and is not required to be independently assessed.
- Foundation skills are integral to competent performance of the unit and should not be assessed separately.
- Assessors must satisfy the assessor competency requirements that are in place at the time of the assessment as set by the VET regulator.
- In addition, the assessor or anyone acting in subject matter expert role in assessment must demonstrate both technical competency and currency. If the assessor cannot demonstrate technical competency and currency they must assess with a subject matter expert who does meet these requirements.
- Technical competence can be demonstrated through one or more of:

- relevant VET or other qualification/Statement of Attainment
- appropriate workplace experience undertaking the type of work being assessed under routine and non-routine conditions
- appropriate workplace experience supervising/evaluating the type of work being assessed under routine and non-routine conditions
- Currency can be demonstrated through one or more of:
 - being currently employed undertaking the type of work being assessed
 - being employed by the organisation undertaking the type of work being assessed and having maintained currency in accordance with that organisation's policies and procedures
 - having consulted/had contact with an organisation undertaking the type of work being assessed within the last twelve months, the consultation/contact being related to assessment
 - conducting on-the-job training/assessments of the type of work being assessed
 - being an active member of a relevant professional body and participating in activities relevant to the assessment of this type of work.

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=9fc2cf53-e570-4e9f-ad6a-b228ffdb6875>