



**Australian Government**

# **UEENEEJ185A Repair and service carbon dioxide refrigeration systems**

**Release: 3**

# UEENEEJ185A Repair and service carbon dioxide refrigeration systems

## Modification History

Not Applicable

## Unit Descriptor

### Unit Descriptor

1)

#### 1.1) Descriptor

This unit covers specialised procedures for servicing and repairs to achieve the effective and efficient operation of refrigeration equipment using carbon dioxide (CO<sub>2</sub>) as a refrigerant excluding self contained systems. It reinforces safe working practice and encompasses applying specialised knowledge of refrigeration principles that apply to carbon dioxide, following service manuals, testing, locating and rectifying faults and defective components and completing the necessary service documentation.

## Application of the Unit

### Application of the Unit

4)

This competency standard is suitable for employment-based programs under an approved contract of training at the AQF level of the qualification in which the unit is first packaged or higher.

The unit may be selected as an elective from the relevant schedule (see qualification packaging rules) provided that all prerequisite units are undertaken or addressed through recognition processes.

This unit may be included in a skill set provided that it is listed in the schedule of electives (see Qualification Framework) and all prerequisite units are undertaken or addressed through recognition processes.

Delivery and assessment of this unit should be undertaken within regard to the requirements of License to Practice

**Application of the Unit 4)**

(1.2 above), Prerequisite Competencies and Literacy and Numeracy skills (2 above) and the recommendations for concurrent assessment and relationship with other units (9.5 below). Practice in the workplace and during training is also subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

Note:

1. Compliance with permits may be required in various jurisdictions and typically relates to the operation of plant, machinery and equipment such as elevating work platforms, powder operated fixing tools, power operated tools, vehicles, road signage and traffic control and lifting equipment. Permits may also be required for some work environments such as confined spaces, working aloft, near live electrical apparatus and site rehabilitation.
2. Compliance may be required in various jurisdictions relating to currency in First Aid, confined space, lifting, risk safety measures etc.

## Licensing/Regulatory Information

### 1.2) License to practice

The skills and knowledge described in this unit may, in some jurisdictions, require a licence to practise in the workplace subject to regulations for undertaking refrigeration and air conditioning work. Practice in workplace and during training is also subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

Note.

1. Compliance with permits may be required in various jurisdictions and typically relates to the operation of plant, machinery and equipment such as elevating work platforms, powder operated fixing tools, power operated tools, vehicles, road signage and traffic control, lifting equipment. Permits may also be required for some work environments such as confined spaces, working aloft, near live electrical apparatus and site rehabilitation.
2. Compliance may be required in various jurisdictions relating to currency in First Aid, confined space, lifting and risk safety measures.

## Pre-Requisites

**Prerequisite Unit(s)**      2)

### 2.1) Competencies

Granting competency in this unit shall be made only after competency in the following unit(s) has/have been confirmed

UEENEEJ111A	Diagnose and rectify faults in air conditioning and refrigeration systems and components
UEENEEJ113A	Commission air conditioning and refrigeration systems
UEENEEJ184A	Apply safety awareness and legal requirements for carbon dioxide refrigerant
UEENEEE101 A	Apply Occupational Health and Safety regulations, codes and practices in the

<b>Prerequisite Unit(s)</b>	<b>2)</b>	
		workplace
	UEENEEE102 A	Fabricate, assemble and dismantle utilities industry components
	UEENEEE003 B	Solve problems in extra-low voltage single path circuits
	UEENEEE105 A	Fix and secure electrotechnology equipment
	UEENEEE107 A	Use drawings, diagrams, schedules, standards, codes and specifications
	UEENEEE137 A	Document and apply measures to control OHS risks associated with electrotechnology work
	UEENEEJ102A	Prepare and connect refrigerant tubing and fittings
	UEENEEJ103A	Establish the basic operating conditions of vapour compression systems
	UEENEEJ104A	Establish the basic operating conditions of air conditioning systems
	UEENEEJ106A	Install refrigerant pipe work, flow controls and accessories
	UEENEEJ107A	Install air conditioning and refrigeration systems, major components and associated equipment
	UEENEEJ108A	Recover, pressure test, evacuate, charge and leak test refrigerants
	UEENEEJ110A	Select refrigerant piping, accessories and associated controls
	UEENEEJ153A	Find and rectify faults motors and associated controls in refrigeration and air conditioning systems
	UEENEEJ170A	Diagnose and rectify faults in air conditioning and refrigeration control systems

**Prerequisite Unit(s)** 2)

UEENEEJ194A Solve problems in low voltage refrigeration circuits

UEENEEP012 Disconnect / reconnect composite appliances connected to low voltage installation wiring

UEENEEP017 Locate and rectify faults in low voltage composite appliances using set procedures

**Note:**

UEENEEJ111A and UEENEEJ113A - Those holding a 'Certificate III in Refrigeration and Air Conditioning trade qualification or equivalent' meet the requirements of these units and their pre-requisite requirements.

**2.2) Literacy and numeracy skills**

Participants are best equipped to achieve competency in this unit if they have reading, writing and numeracy skills indicated by the following scales. Description of each scale is given in Volume 2, Part 3 'Literacy and Numeracy'

Reading 3      Writing 3      Numeracy 3

## Employability Skills Information

### Employability Skills 3)

This unit contains Employability Skills

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the qualification in which this unit of competency is packaged will assist in identifying Employability Skill requirements.

## Elements and Performance Criteria Pre-Content

6) Elements describe the essential outcomes of a unit

Performance criteria describe the required performance needed to demonstrate achievement of the Element. Assessment of performance must be consistent with the evidence guide.

## Elements and Performance Criteria

### ELEMENT

### PERFORMANCE CRITERIA

1 Prepare to service and repair carbon dioxide refrigeration systems	1.1 OHS procedures for a given work area are identified, obtained and understood through established routines and procedures
	1.2 Established OHS risk control measures and procedures are followed in preparation for the work.
	1.3 Safety hazards which have not previously been identified are reported and advice on risk control measures is sought from the work supervisor.
	1.4 The nature of work is obtained from documentation or from work supervisor to establish the scope of work to be undertaken.
	1.5 Advice is sought from the work supervisor to ensure the work is coordinated effectively with

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b>
	others.
	1.6 Sources of materials that may be required for the work are accessed in accordance with established routines and procedures.
	1.7 Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety
2 Service and repair carbon dioxide refrigeration systems.	2.1 Established OHS risk control measures and procedures for carrying out the work are followed.
	2.2 Measuring system operating parameters is conducted in strict accordance with OHS requirements and established safety procedures
	2.3 Checks are carried out to ensure the system or component parts are isolated, when necessary in strict accordance OHS requirements and procedures.
	2.4 Refrigerant is removed from a system safely in accordance with regulatory requirements and industry practices.
	2.5 Precautions are taken to prevent damage to components while pressure testing the system
	2.6 Pressure testing is conducted at a pressure compatible with carbon dioxide and in accordance with standards
	2.7 Leaks are located and rectified using testing methods appropriate to the system and in accordance with industry practices
	2.8 System is evacuated to the required level and cleaned of all moisture and other contaminants in accordance with industry practices
	2.9 System is charged safely with refrigerant grade carbon dioxide and compatible lubricants in accordance with industry practices
	2.10 Established procedures are used to determine actual and specified range of operating



**ELEMENT****PERFORMANCE CRITERIA**

- conditions from measured and calculated values as they apply to sub critical carbon dioxide vapour compression and liquid recirculation/cascade systems.
- 2.11 Established methods for dealing with unexpected situations are discussed with appropriate person or persons and documented.
- 2.12 Unexpected situations are dealt with safely and with the approval of an authorised person.
- 2.13 Operating conditions are determined without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices.
- 3 Complete work and report on servicing and repairing sub - critical carbon dioxide refrigeration systems.
- 3.1 OHS work completion risk control measures and procedures are followed.
- 3.2 Work site is cleaned and made safe in accordance with established procedures.
- 3.3 Contaminated refrigerant and lubricant is dealt with in accordance with legislative/regulatory requirements
- 3.4 Operation conditions are documented, including identification of any parameter that is not within the specified range for the system.
- 3.5 Work supervisor is notified of the completion of the work in accordance with established procedures.

## Required Skills and Knowledge

### REQUIRED SKILLS AND KNOWLEDGE

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

Evidence must show that knowledge has been acquired of safe working practices and determining the operating conditions of both sub - critical vapour compression and liquid recirculating carbon dioxide refrigerating systems.

All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies.

#### **KS01-EJ185 Servicing and repair techniques for carbon dioxide refrigeration Systems**

Evidence shall show an understanding of carbon dioxide refrigeration systems, operation, components, service and repair techniques, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

##### T1 Carbon Dioxide Refrigeration Systems

- Introduction to Carbon Dioxide refrigeration System
- Benefits of using Carbon Dioxide as a Refrigerant
- Thermophysical Properties
- Introduction to Liquid recirculation /Cascade system employing Carbon Dioxide refrigerant at Sub-Critical condition.
  - Systems and Major components
  - Basic operation
  - Typical applications

##### T2 Operating conditions of carbon dioxide Refrigeration Systems

- CO2 Refrigeration Compressors and lubricants
  - Types, construction and their applications (reciprocating, screw, )
  - Types of compatible compressor oil (POE), (PAO)
  - Safe handling of lubricants for CO2 applications (MSDS - POE's, PAO)
- System components, construction and operation
  - CO2 Low temperature evaporators design features
  - Medium Temperature Liquid re-circulation evaporators
  - Hand expansion valves (medium temp.)
  - Electronic expansion valves (low temp)

## REQUIRED SKILLS AND KNOWLEDGE

- Cryogenic pressure relief devices
- Plate heat exchangers
- Liquid –Suction heat exchangers
- Liquid CO<sub>2</sub> Refrigerant Pumps
- "Q" Min and "Q" Max valves
- Interconnecting piping
- Refrigerant receiver
- Isolation valves
- Applicable Standards and Codes
  - Hazards associated with Carbon Dioxide (MSDS)
  - AS/NZS 1677
  - AS/NZS 1571
  - IIAR Bulletins
  - ANSI/ASHRAE Standards
  - IOR Safety code for Refrigerating Systems utilising Carbon Dioxide

### T3 Servicing and repair techniques for carbon dioxide refrigeration systems

- Service Gauges
  - Appropriate Type
  - Care and Maintenance of Gauges and hoses
- Service procedures
  - Charging CO<sub>2</sub> into a system in both vapour and liquid form
  - Discharging CO<sub>2</sub> from a system safely
  - Pressure testing
  - System and component isolation
  - Leak detection methods for CO<sub>2</sub>
- Cylinder Regulators CO<sub>2</sub>
  - All currently available regulators provide vapour feed only
  - Pressure readings (bottle and line)
- Refrigerant Cylinders CO<sub>2</sub>
- Refrigerant conditions
  - Hazards and related safe working practices (dangerous system pressures)
  - Pressure to temperature conversion (Saturated P/T is only between 430 kPa and 4399kPa)
- System standing pressure as a result of power loss.
- Moisture problems with CO<sub>2</sub> systems

## Evidence Guide

### EVIDENCE GUIDE

9) 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 this Training Package. .

The Evidence Guide forms an integral part of this unit. It must be used in conjunction with all parts of this unit and performed in accordance with the Assessment Guidelines of this Training Package.

#### Overview of Assessment

##### 9.1)

Longitudinal competency development approaches to assessment, such as Profiling, require data to be reliably gathered in a form that can be consistently interpreted over time. This approach is best utilised in Apprenticeship programs and reduces assessment intervention. It is the industry-preferred model for apprenticeships. However, where summative (or final) assessment is used it is to include the application of the competency in the normal work environment or, at a minimum, the application of the competency in a realistically simulated work environment. In some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accordance with industry and regulatory policy.

Methods chosen for a particular assessment will be influenced by various factors. These include the extent of the assessment, the most effective locations for the assessment activities to take place, access to physical resources, additional safety measures that may be required and the critical nature of the competencies being assessed.

The critical safety issues inherent in working with electricity, electrical equipment, gas or any other hazardous substance/material present a challenge for those determining competence. Sources of evidence need to be 'rich' in nature to minimise error in judgment.

Activities associated with normal everyday work have a bearing on the decision as to how much and how detailed the data gathered will contribute to its 'richness'. Some skills are more critical to safety and operational requirements while the same skills may be more or less frequently practised. These points are raised for the assessors to consider when choosing an assessment method and developing assessment instruments. Sample assessment instruments are included for Assessors in the Assessment Guidelines of this Training Package.

#### Critical aspects of 9.2)

## EVIDENCE GUIDE

### evidence required to demonstrate competency in this unit

Before the critical aspects of evidence are considered all prerequisites must be met.

Evidence for competence in this unit must be considered holistically. Each element and associated performance criteria must be demonstrated on at least two occasions in accordance with the 'Assessment Guidelines - UEE07'. Evidence must also comprise:

- A representative body of work performance demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this must incorporate evidence that shows a candidate is able to:
  - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the performance criteria and range statement
  - Apply sustainable energy principles and practices as specified in the performance criteria and range statement
  - Demonstrate an understanding of the essential knowledge and associated skills as described in this unit. It may be required by some jurisdictions that RTOs provide a percentile graded result for the purpose of regulatory or licensing requirements.
  - Demonstrate an appropriate level of skills enabling employment
  - Conduct work observing the relevant Anti Discrimination legislation, regulations, policies and workplace procedures
- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
  - Pressure testing, charging/discharging refrigerant/lubricants and determining the operating conditions of Carbon Dioxide vapour compression and volatile secondary (liquid recirculation) system as described in 8) and including:
    - A Selecting and using appropriate measuring devices correctly
    - B Recording measurements
    - C Using calculation methods accurately

## EVIDENCE GUIDE

- D Discharging / charging refrigerant / lubricants and pressure testing the system without damage to components
- E Locating and rectifying leaks
- F Decontaminating and evacuating the system
- G Identifying the conditions of the refrigerant (R744) at various locations in the vapour compression and volatile secondary (liquid recirculation) system
- H Documenting operating conditions correctly
- I Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in a holistic assessment with the above listed items

### Context of and specific resources for assessment

#### 9.3)

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OHS policy and work procedures and instructions.
- Suitable work environment, facilities, equipment and materials to undertake actual work as prescribed by this unit.

These should be part of the formal learning/assessment environment.

Note:

Where simulation is considered a suitable strategy for assessment, conditions must be authentic and as far as possible reproduce and replicate the workplace and be consistent with the approved industry simulation policy.

The resources used for assessment should reflect current industry practices in relation to servicing and repairing as well as determining the operating conditions of Carbon Dioxide vapour compression and liquid recirculation/cascade system.

## EVIDENCE GUIDE

### Method of assessment

#### 9.4)

This unit shall be assessed by methods given in Volume 1, Part 3 'Assessment Guidelines'.

#### Note:

Competent performance with inherent safe working practices is expected in the Industry to which this unit applies. This requires assessment in a structured environment which is intended primarily for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.

### Concurrent assessment and relationship with other units

#### 9.5)

There are no concurrent assessment recommendations for this unit.

The critical aspects of occupational health and safety covered in unit UEENEEEE001B and other discipline specific occupational health and safety units shall be incorporated in relation to this unit..

## Range Statement

### RANGE STATEMENT

8) This relates to the unit as a whole providing the range of contexts and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

This unit must be demonstrated in relation to determining operating conditions using measurement and basic calculation methods of carbon dioxide vapour compression and volatile secondary (liquid recirculation) system. These conditions include suction and discharge pressures, ambient, evaporator and condensing temperatures, evaporator, and condenser temperature difference, critical point, triple point, trans critical and sub-critical refrigerant conditions of carbon dioxide (R744). Further, this unit must be demonstrated in relation to charging and discharging a carbon dioxide (R744) system with refrigerant and lubricant in a safe and environmentally responsible manner. This excludes self contained systems.

Generic terms used throughout this Vocational Standard shall be regarded as part of the Range Statement in which competency is demonstrated. The definition of these and other terms that apply are given in Volume 2, Part 2.1.

## Unit Sector(s)

Not Applicable

## Competency Field

Competency Field

5)

Refrigeration and Air Conditioning