



**Australian Government**

# **UEENEEJ127A Establish the thermodynamic parameters of refrigeration and air conditioning systems**

**Release: 3**

## **UEENEEJ127A Establish the thermodynamic parameters of refrigeration and air conditioning systems**

### **Modification History**

Not Applicable

### **Unit Descriptor**

#### **Unit Descriptor**

1)

#### **1.1) Descriptor**

This unit covers the determination of the thermodynamic parameters of refrigeration and air conditioning systems. It encompasses working safely, determining thermodynamic parameters of using measurement and basic calculation methods and documenting results.

### **Application of the Unit**

#### **Application of the Unit**

4)

This unit is intended as an additional competency to relevant competencies previously acquired. It is suitable for employment-based programs under an approved contract of training or institutional based delivery at the aligned AQF 4 level.

## Licensing/Regulatory Information

### 1.2) License to practice

The skills and knowledge described in this unit require a license to practice in the workplace where plant and equipment operate at voltage above 50 V a.c. or 120 V d.c. In some States/Territories a licence is required to practise this unit in the workplace subject to regulations for undertaking refrigeration and air conditioning work and in particular working with refrigerants. 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.

UEENEEJ192A Analyse the psychrometric performance of HVAC/R systems

UEENEEJ193A Analyse the thermodynamic performance of HVAC/R systems

OR

UEENEEJ109A Verify functionality and compliance of refrigeration and air conditioning installations

UEENEEE101A Apply Occupational Health and Safety regulations, codes and practices in the workplace

**Prerequisite Unit(s)**

**2)**

UEENEEE102A Fabricate, assemble and dismantle utilities industry components

UEENEEE003B Solve problems in extra-low voltage single path circuits

UEENEEE105A Fix and secure electrotechnology equipment

UEENEEE107A Use drawings, diagrams, schedules, standards, codes and specifications

UEENEEE137A 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

UEENEEJ111A Diagnose and rectify faults in air conditioning and refrigeration systems and components

UEENEEJ113A Commission air conditioning and refrigeration systems

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

UEENEEJ194A Solve problems in low voltage refrigeration circuits

UEENEEP012A Disconnect / reconnect composite appliances connected to low voltage installation wiring

UEENEEP017A Locate and rectify faults in low voltage

|                             |                                                                                                                      |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Prerequisite Unit(s)</b> | <b>2)</b>                                                                                                            |
|                             | composite appliances using set procedures                                                                            |
|                             | UEENEEP024A Attach cords and plugs to electrical equipment for connection to a single phase 230 Volt supply          |
|                             | UEENEEP025A Attach cords, cables and plugs to electrical equipment for connection to 1000 Va.c. or 1500 Vd.c. supply |

## Employability Skills Information

|                             |                                                                                                                                                                                                                                                                               |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Employability Skills</b> | <b>3)</b>                                                                                                                                                                                                                                                                     |
|                             | 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

|                                                              |                                                                                                                                                                                    |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>6) Elements describe the essential outcomes of a unit</b> | Performance criteria describe the required performance needed to demonstrate achievement of the element.<br>Assessment of performance is to be consistent with the evidence guide. |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## Elements and Performance Criteria

| <b>ELEMENT</b>                                                                        | <b>PERFORMANCE CRITERIA</b>                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 Prepare to determine thermodynamic parameters of refrigeration and air conditioning | <p>1.1 OHS procedures for a given work area are identified, identified, obtained and understood</p> <p>1.2 Established OHS risk control measures and procedures are followed in preparation for the work.</p> |

| ELEMENT                                                                            | PERFORMANCE CRITERIA                                                                                                                                                                                               |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| systems                                                                            |                                                                                                                                                                                                                    |
|                                                                                    | 1.3 The expected operating conditions are obtained from documentation or from work supervisor to establish the scope of work to be undertaken.                                                                     |
|                                                                                    | 1.4 Advice is sought from the work supervisor to ensure the work is coordinated effectively with others.                                                                                                           |
|                                                                                    | 1.5 Tools, equipment and testing devices needed to determine the basic operating conditions are obtained and checked for correct operation and safety                                                              |
|                                                                                    | 1.6 The expected operating conditions are obtained from documentation or from work supervisor to establish the scope of work to be undertaken.                                                                     |
| 2 Determine thermodynamic parameters of refrigeration and air conditioning systems | 2.1 Established OHS risk control measures and procedures for carrying out the work are followed.                                                                                                                   |
|                                                                                    | 2.2 Measurement of thermodynamic system operating parameters is conducted in strict accordance with OHS requirements and established safety procedures                                                             |
|                                                                                    | 2.3 System is checked and isolated where necessary, in strict accordance OHS requirements and procedures                                                                                                           |
|                                                                                    | 2.4 Established procedures are used to determine actual and specified range of thermodynamic parameters from measured and calculated values as they apply to particular refrigeration or air conditioning systems. |
|                                                                                    | 2.5 Established methods for dealing with unexpected situations are discussed with appropriate person or persons and documented.                                                                                    |
|                                                                                    | 2.6 Unexpected situations are dealt with safely and with the approval of an authorised person.                                                                                                                     |
|                                                                                    | 2.7 Thermodynamic parameters are determined without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices.                                                 |

| ELEMENT |                                              | PERFORMANCE CRITERIA |                                                                                                                                          |
|---------|----------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 3       | Document determined thermodynamic parameters | 3.1                  | OHS work completion risk control measures and procedures are followed.                                                                   |
|         |                                              | 3.2                  | Work site and equipment is cleaned and made safe in accordance with established procedures.                                              |
|         |                                              | 3.3                  | Thermodynamic parameters are documented including identification of any parameter that is not within the specified range for the system. |
|         |                                              | 3.4                  | Work supervisor is notified of the completion of the work in accordance with established procedures.                                     |



## REQUIRED SKILLS AND KNOWLEDGE

- Area and perimeter mensuration on above figures.

### T4 Coordinate geometry

- 2D plane; x-y axes, s-t axes
- Graph of linear function,  $y = ax + b$ . Functional notation,  $y = f(x)$
- Straight line given slope and one point or given two points
- Linear equations: solving algebraically and geometrically
- Solving 2 linear functions simultaneously, algebraically and geometrically
- Line segment: length and mid point.

### T5 Engineering mechanics

- mass/density
- weight
- forces
- specific gravity
- equilibrium
- momentum
- friction loss
- velocity and speed
- energy in all forms
- mechanical advantage
- efficiency
- pressure/stress

### T6 Molecular theory

- changes of state
- sublimation
- expansion and contraction
- electron flow
- state of aggregation
- internal potential energy
- phase change diagrams

### T7 Thermodynamics

- temperature scales
- conservation of energy
- specific heat
- sensible, latent and super heat
- properties of steam
- enthalpy
- heat energy/temperature relationship
- heat balance on a body

## REQUIRED SKILLS AND KNOWLEDGE

- heat transfer
- conductivity
- calorimetry
- Peltier effect
- 1st and 2nd law of thermodynamics

### T8 Gas laws and liquids

- pressure
- Boyles law
- Charles law
- Volumetric relationship
- psychrometrics
- latent heat of vaporisation
- relative humidity
- air conditioning processes
- dynamic pressure loss
- velocity and static pressure
- bourdon tubes
- density and relative density
- Archimedes principle
- Bernoulli's Equation
- manometers
- absorption refrigeration
- centrifugal compression
- external work of a liquid
- pressure volume diagrams
- isothermal and adiabatic processes
- polytropic processes
- Dalton's law of partial pressure

### T9 Vapour compression

- pressure/enthalpy relationship
- entropy
- characteristics of the evaporation, condensation,
- compression and pressure drop phases
- co-efficient of performance
- theoretical/practical cycles
- characteristics of refrigerants
- theoretical power input
- pressure losses
- heat exchange

## REQUIRED SKILLS AND KNOWLEDGE

- effects of condensing condition changes
- sub-cooling and super-heating

## 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 nature of working with electricity, electrical equipment, gas or any other hazardous substance/material carries risk in deeming a person competent. Sources of evidence need to be 'rich' in nature to minimise error in judgment.

Activities associated with normal everyday work influence decisions about how/how much 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

## EVIDENCE GUIDE

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 evidence required to demonstrate competency in this unit**

#### **9.2)**

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

Evidence for competence in this unit shall be considered holistically. Each Element and associated performance criteria shall be demonstrated on at least two occasions in accordance with the 'Assessment Guidelines - UEE07'. Evidence shall 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 shall 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:
  - Determine thermodynamic parameters of refrigeration and air conditioning systems as described in 8) and including:
    - A Selecting and using appropriate measuring devices correctly

## EVIDENCE GUIDE

- B Interpreting measurements
- C Using calculation methods accurately
- D Identifying parameters not within the specified range
- E Documenting thermodynamic parameters correctly
- F Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in the holistic assessment with the above listed items

### Note:

Successful completion of relevant vendor training may be used to contribute to evidence on which competency is deemed. In these cases the alignment of outcomes of vendor training with performance criteria and critical aspects of evidence shall be clearly identified

### 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.

Evidence should show demonstrated competency in determining thermodynamic parameters of refrigeration and air conditioning systems.

## EVIDENCE GUIDE

|                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Method of assessment</b>                                    | <b>9.4)</b><br><br>This unit shall be assessed by methods given in Volume 1, Part 3 'Assessment Guidelines'.<br><br>Note:<br>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. |
| <b>Concurrent assessment and relationship with other units</b> | <b>9.5)</b><br><br>There are no concurrent assessment recommendations for 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 thermodynamic parameters using measurement and calculation methods of a refrigeration or air conditioning system, including temperature, pressure, relative humidity and enthalpy.

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

### 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 | 4 | Writing | 4 | Numeracy | 4 |
|---------|---|---------|---|----------|---|

### 2.2) Literacy and numeracy skills

Competency Field 5)

Refrigeration and Air Conditioning