



Australian Government

UEENEEJ143A Design complex air conditioning systems and select equipment

Release: 3

UEENEEJ143A Design complex air conditioning systems and select equipment

Modification History

Not Applicable

Unit Descriptor

Unit Descriptor

1)

1.1) Descriptor

This unit covers the design of complex air conditioning systems. It encompasses applying knowledge of complex air conditioning systems, safety and regulatory requirements, developing alternative design schemes based on a design brief and customer requirements and documenting system designs.

Application of the Unit

Application of the Unit 4)

This unit is intended to augment formally acquired competencies. It is suitable for employment-based programs under an approved contract of training or institutional based delivery. It applies to any formal recognition for this standard at the aligned AQF 6 level.

Licensing/Regulatory Information

1.2) License to practice

The skills and knowledge described in this unit do not require a license to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

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.

UEENEEJ134A Design heating, ventilation and air conditioning (HVAC) systems and select components

UEENEEJ138A Analyse vibration and noise in refrigeration and air conditioning systems

UEENEEJ165A Evaluate thermodynamic and fluid parameters of refrigeration systems

UEENEEJ164A Analyse the operation of HVAC air and hydronic systems

UEENEEJ192A Analyse the psychrometric performance of HVAC/R systems

and

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

UEENEEE102A Fabricate, assemble and dismantle

Prerequisite Unit(s)**2)**

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 composite appliances using set procedures

Prerequisite Unit(s)

2)

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**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 is to be consistent with the evidence guide.

Elements and Performance Criteria**ELEMENT****PERFORMANCE CRITERIA**

1	Prepare to design complex commercial refrigeration system	1.1	OHS processes and procedures for a given work area are identified, obtained and understood
		1.2	Established OHS risk control measures and procedures are followed in preparation for the work.
		1.3	The extent of the proposed refrigeration system is determined from the design brief or in consultations with appropriate person(s).

ELEMENT	PERFORMANCE CRITERIA
2 Design complex commercial refrigeration system	1.4 Design development work is planned to meet scheduled timelines in consultation with others involved on the work site.
	2.1 Knowledge of complex air conditioning processes and methods are applied to the design.
	2.2 Alternative concepts for the design are evaluated based on the requirements outlined in the design brief. (See Note)
	2.3 Safety, functional and budget considerations are incorporated in the design.
	2.4 System design draft is checked for compliance with the design brief and regulatory requirements.
	2.5 System design is documented for submission to appropriate person(s) for approval.
3 Obtain approval for complex commercial refrigeration system design	2.6 Solutions to unplanned situation are provided consistent with organisation's policy.
	3.1 System design is presented and explained to client representative and/or other relevant person(s).
	3.2 Requests for alterations to the design are negotiated with relevant person(s) within the constraints of organisation's policy.
	3.3 Final design is documented and approval obtained from appropriate person(s).
	3.4 Quality of work is monitored against personal performance agreement and/or established organizational or professional standards.

Note.

Design concepts should be evaluated by real or virtual prototyping where it cannot be shown easily by other means that particular aspects of the design met specified requirements.

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

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

Evidence shall show that knowledge has been acquired of safe working practices and designing complex air conditioning systems.

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

KS01-EJ143A

Complex HVAC system design

Evidence shall show an understanding of complex air conditioning system design, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

T1 HVAC load estimating of multiple zone and multi-storey buildings

- System design parameters
 - human comfort
 - system requirements in accordance with AS1668
 - heat transfer calculations for complex structures and building components
 - heat and radiation transfer calculations through complex glass structures including various internal and external shading devices
 - indoor air quality
 - olfs and decipols
- Complex shading
 - solar data, azimuth and altitude angles
 - shading from adjacent structures
- Computer software
 - heat load estimating
 - building thermal performance analysis and simulation software

T2 Advanced Psychrometrics

- Complex psychrometric processes
 - revise sensible cooling and heating and evaporative (adiabatic) cooling
 - cooling and dehumidification
 - cooling and dehumidification with high latent load
 - cooling and dehumidification all out door air
 - cooling and dehumidification all out door air with dehumidified air requirements less than supply air
 - cooling with evaporative humidification
 - cooling with near isothermal humidification
 - spray process to include cooling and dehumidification, cooling and humidification with heated spray water, heating and humidification.
 - partial load processes

REQUIRED SKILLS AND KNOWLEDGE

- reheat
- bypass of, RA only and mix of RA & OA
- variable air volume
- variable coil effective surface temperature
- split coil, horizontal, vertical and intertwined.
- System performance
 - saturation efficiency of sprayers
 - system capacity calculated from air quantity and enthalpy change
- Required plant capacity and airflow rates
 - effects of coil bypass factor and ADP
 - calculation of dehumidified air quantity, using both TSH and ERSH methods.
- Recap on psychrometrics formulae and charts
 - properties of air
 - gas constants
 - derivation of air constants
 - combined gas laws
 - Dalton's law of partial pressures
 - Carrier's equation
 - psychrometric property tables
 - psychrometric charts
 - air mixing equations
 - air quantity equations
 - indirect evaporative coolers
 - analysis of cooling coil selection and performance
 - psychrometric analysis of:
 - air conditioning in tropics
 - all outdoor air
 - LCV/HWF systems
 - psychrometric analysis using equations and tables

T3 Air conditioning system design

- Design parameters for multi-storey building
 - customer and objective
 - customer concept of environment desired
 - economic
 - client brief
- Relevant design criteria
 - building purpose, location, orientation and shape
 - external environment ambient conditions

REQUIRED SKILLS AND KNOWLEDGE

- internal load diversity
- thermal capacity behaviour
- thermal load (full and partial)
- Zoning and building usage
 - space and building
 - occupancies, single purpose, multi-purpose
- System selection criteria
 - economics
 - environment
 - control requirements
 - existing structures
 - new structures
 - system components
 - space for equipment and system
 - selection of appropriate system
- System and applications
 - design features, engineering procedures and controls for:
 - direct expansion - self contained room/zone, heat pump, multi-zone fan-coils, central station
 - all water - room fan-coil
 - all-air - constant volume variable temperature, face and bypass, reheat, constant temp variable volume, constant volume induction, dual-duct, dual-conduit
 - air water - induction unit, primary air fan- coil
- HVAC energy conservation techniques
 - heat recovery systems
 - night cycle
 - optimum stop/start
 - purge cycles
 - chiller/boiler/cooling tower sequencing
 - economy cycles (based on temperature or enthalpy)
 - supply air reset
 - supply water reset
 - condenser water temperature reset
 - power demand control
 - load limiting
 - load shedding
 - set point relaxation
 - ventilation cycles

REQUIRED SKILLS AND KNOWLEDGE

- plant - fixed OA to economy, boiler to electric reheat, constant volume to VAV etc.
- cost-benefit (payback)

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

EVIDENCE GUIDE

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 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:
 - Design complex air conditioning systems as described in 8) and including:
 - A Developing outlines of alternative designs
 - B Developing the design within the safety, regulatory, functional requirements and budget limitations

EVIDENCE GUIDE

- C Documenting and presenting design effectively
- D Successfully negotiating design alteration requests
- E Obtaining approval for final design
- 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 designing complex air conditioning systems.

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.

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 designing a complex air conditioning system incorporating multiple major components (i.e. air handling plant, compressors, condenser or evaporators) circuits or systems and associated components and controls.

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	5	Writing	5	Numeracy	5
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Custom Content Section

Competency Field 5)

Refrigeration and Air Conditioning