



Australian Government

UEERA0014 Design ammonia refrigerated systems

Release: 1

UEERA0014 Design ammonia refrigerated systems

Modification History

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

Application

This unit involves the skills and knowledge required to design ammonia refrigerated systems.

It includes designing ammonia refrigerated systems based on a design brief and customer requirements, applying relevant industry standards, selecting components and documenting system design.

The skills and knowledge described in this unit may, in some jurisdictions, require a licence or permit to practice in the workplace subject to regulations for undertaking refrigeration and air conditioning work. Practice in the workplace and during training is also subject to work health and safety (WHS)/occupational health and safety (OHS) regulations.

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

Pre-requisite Unit

UEERA0005 Apply safety awareness and legal requirements for ammonia refrigerant

UEERA0016 Design commercial refrigeration systems and select components

UEERA0034 Establish heat loads for commercial refrigeration and/or air conditioning applications

UEERA0042 Evaluate thermodynamic and fluid parameters of refrigeration systems

UEERA0038 Establish the thermodynamic parameters of refrigeration and air conditioning systems

UEERA0001 Analyse the operation of HVAC air and hydronic systems

UEERA0002 Analyse the psychrometric performance of HVAC/R systems
and

UEERA0003 Analyse the thermodynamic performance of HVAC/R systems
or

UEERA0094 Verify functionality and compliance of refrigeration and air conditioning installations

UEECD0007 Apply work health and safety regulations, codes and practices in the workplace

UEECD0019 Fabricate, assemble and dismantle utilities industry components

UEECD0042 Solve problems in ELV single path circuits

UEECD0020 Fix and secure electrotechnology equipment

UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications

UEECD0016 Document and apply measures to control WHS risks associated with electrotechnology work

UEERA0059 Prepare and connect refrigerant tubing and fittings

UEERA0036 Establish the basic operating conditions of vapour compression systems

UEERA0035 Establish the basic operating conditions of air conditioning systems

UEERA0050 Install refrigerant pipe work, flow controls and accessories

UEERA0081 Select refrigerant piping, accessories and associated controls

UEERA0031 Diagnose and rectify faults in air conditioning and refrigeration control systems

UEERA0092 Solve problems in low voltage refrigeration and air conditioning circuits

UEERL0005 Locate and rectify faults in low voltage (LV) electrical equipment using set procedures

UEERL0004 Disconnect - reconnect electrical equipment connected to low voltage (LV) installation wiring

UEERL0001 Attach cords and plugs to electrical equipment for connection to a single phase 230 Volt supply

UEERL0002 Attach cords, cables and plugs to electrical equipment for connection to 1000 V a.c. or 1500 V d.c.

Competency Field

Refrigeration and air-conditioning

Unit Sector

Electrotechnology

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1 Prepare to design ammonia refrigeration systems

PERFORMANCE CRITERIA

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

1.1 WHS/OHS requirements and workplace procedures for a given work area are identified, obtained and applied

- 1.2 Scope of the refrigeration system is determined from design specifications and/or in consultation with relevant person/s
 - 1.3 Safety systems are identified, obtained and applied in accordance with relevant industry standard
 - 1.4 Work supervisor and/or customer/s are consulted to determine functions and parameters of the system required in accordance with design specifications and workplace documentation
 - 1.5 Design development work is planned in accordance with workplace procedures for timelines in consultation with others involved
- 2 **Design ammonia refrigeration systems**
 - 2.1 WHS/OHS risk control measures and workplace procedures for carrying out the work are followed
 - 2.2 Relevant ammonia refrigeration system analysis, components and piping are applied to developing the system design in accordance with workplace procedures and relevant industry standards
 - 2.3 Safety, functionality and budgetary considerations are incorporated in the design specifications
 - 2.4 Equipment required is selected in accordance with the design specifications and workplace procedures
 - 2.5 Location of components is documented in accordance with workplace procedures and operation of system functions
 - 2.6 System design draft is checked for compliance with the design brief and regulatory requirements
 - 2.7 System design is documented for submission to relevant person/s for approval
 - 2.8 Unplanned events are dealt with in accordance with problem-solving techniques and workplace procedures
- 3 **Obtain approval for engineering computer applications design**
 - 3.1 System design is presented to customer and/or relevant person/s in accordance with workplace procedures
 - 3.2 Requests for alterations to the design are negotiated with relevant person/s in accordance with workplace

procedures

- 3.3 Final design is documented and approval obtained from relevant person/s in accordance with workplace procedures
- 3.4 Quality of work is monitored in accordance with workplace procedures and relevant industry standards

Foundation Skills

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

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the UEE Electrotechnology Training Package Companion Volume Implementation Guide.

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| Designing ammonia refrigeration systems must include at least two different systems of the following: | <ul style="list-style-type: none">• two single-stage, or• two multi-stage, or• one single-stage and one multi-stage |
| Designing ammonia refrigeration systems must include at least the following: | <ul style="list-style-type: none">• one major component, including:<ul style="list-style-type: none">• condenser• compressors• evaporator• flash chamber/flash intercooler• associated components and controls |

Unit Mapping Information

This unit replaces and is equivalent to UEENEEJ181A Design ammonia refrigerated systems.

Links

Companion Volume implementation guides are found in VETNet - - <https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6>

Assessment Requirements for UEERA0014 Design ammonia refrigerated systems

Modification History

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least one occasion and include:

- understanding required operating functions and parameters from the design specification
- developing the design within the safety, regulatory and functional requirements and budget limitations
- documenting and presenting design effectively
- negotiating design alteration requests successfully
- obtaining approval for final design
- dealing with unplanned events
- applying relevant work health and safety (WHS)/occupational health and safety (WHS/OHS) requirements, including using risk control measures
- designing ammonia refrigeration systems
- preparing to design ammonia refrigeration systems.

Knowledge Evidence

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

- ammonia refrigeration system design, components and piping design requirements, safe working practices and relevant standards, codes and regulations, including:
 - technical standards, codes and regulations:
 - environmental and safety considerations in the use and disposal of ammonia refrigerant:
 - toxicity of ammonia, the effects on human health and the legislative limitations imposed on ammonia refrigerant as a result
 - flammability of ammonia, concentration and lower explosive limit (LEL)
 - environmental effects
 - safe disposal
 - safety data sheets (SDS)/material safety data sheets (MSDS) samples

- registration requirements for transport and on-site use
- relationship between ammonia system refrigerant charge and dangerous goods storage regulations
- engine ventilation requirements and determination of ventilation rates
- scrubbers for elimination of the harmful effects of ammonia
- ammonia refrigeration system design requirements:
 - applications of ammonia refrigerant (NH₃) in industrial refrigeration:
 - introduction to industrial ammonia refrigeration applications and systems
 - applications in industrial refrigeration: cool and cold storage, food processing, beverage manufacturing plants, fertilizer plants and second compression stage of CO₂ systems
 - application in environment control and air conditioning: large scale reticulated water/secondary refrigerant systems
 - advantages and disadvantages of ammonia refrigerant compared with other natural and synthetic refrigerants
 - properties, application and limitations of ammonia refrigerant:
 - general classification of ammonia refrigerant according to AS/NZS 1677 Refrigerating systems SAA refrigeration code refrigerating systems
 - common contaminants in ammonia refrigeration systems, water, oil, non-condensable and the effects of same on cycle efficiency and system wear
 - refrigeration machine oils soluble in ammonia, oil type, applications and reactions with water
 - thermal and transport properties of ammonia in comparison with other natural and synthetic refrigerants, including the behaviour in a vapour compression cycle
 - application concepts and principles:
 - single stage vapour compression cycles with dry expansion refrigerant feed
 - single and dual stage vapour compression cycles with liquid overfeed
 - single stage vapour compression cycles with screw compressors and liquid overfeed
 - cascade ammonia/CO₂ systems with dry expansion and liquid overfeed
 - single and dual stage vapour compression cycles with gravity flooded refrigerant feed
 - single and dual stage vapour compression cycles with ammonia used as a volatile secondary refrigerant
 - dual stage vapour compression cycles with multiple (>2) saturation temperature levels
 - automatic defrost principles, including off-cycle air defrost, ambient air defrost, hot gas defrost, electric defrost and water defrost
 - selection and sizing of ammonia pumps for liquid overfeed systems
 - selection and sizing of high pressure and low-pressure vessels
 - refrigerant pipe sizing using ammonia refrigerant
 - selection of suitable refrigerant oil

- ammonia refrigeration system components and piping:
 - corrosion and material selection:
 - materials compatibility table
 - thermal and other properties of materials in use
 - pipe material and jointing methods/materials
 - compressors
 - pumps, impellers and seals
 - isolation and control valves
 - heat exchangers
 - pipe and insulation materials, pipe stresses and pipe suspension methods:
 - mild steel pipe
 - stainless steel pipe
 - sharp tested pipe
 - post-installation insulation (in situ foaming, formed insulation and closed cell flexible insulation)
 - pre-insulated pipe material
 - vapour barrier – importance and maintenance
 - heat exchangers:
 - finned air coolers or evaporators - induced draught; forced draught; stainless steel/aluminium; mild steel galvanized; all aluminium; stainless steel/AlMg3; all stainless steel; description of what materials are used where and for what reason; various refrigerant feed methods including advantages/disadvantages i.e. top feed, bottom feed, vertical up flow/down flow of air; fin spacing; fin thickness and impact of geometry on fluid pressure drops
 - condensers – evaporative, air cooled, air cooled adiabatically assisted, water cooled shell and tube, water cooled plate/plate, water cooled plate and shell, cascade shell and tube, cascade plate/plate, cascade plate and shell, material selection for condensers, and importance of discharge temperature for condenser design
 - cooling towers
 - intercoolers and economisers of the closed type, sizing of liquid sub-cooling coils and tube bundles
 - liquid coolers or evaporators – plate/plate, plate/shell, shell and tube, material selections, refrigerant feed methods and oil management
 - screw compressor oil coolers – plate/plate type, shell and tube type, water cooled, refrigerant cooled and surface enhancement options
 - heat recovery – shell and tube de-superheaters, plate/plate de-superheaters and heat recovery condensers of various types
 - system control and monitoring:
 - compressor capacity control – pressure and temperature signals
 - room temperature and humidity control – understanding the principle of cooling and re-heating air streams to control absolute moisture contents

- control of condensers – optimisation of overall plant C.O.P
- floating condensing pressures
- control of fluid temperatures within the system – oil, secondary refrigerants and sub-cooling
- control of flows – thermostatic expansion valves, low pressure floats, high pressure floats, motorised valves, electronic expansion valves, hand regulating valves, and oil return systems between compressor oil separators and compressors
- pressure controllers - evaporating pressure controllers, thermostatic controllers, hot gas bypass valves, crankcase pressure regulators, overflow valves, ammonia pump pressure control, flow controllers and defrost pressure controllers
- defrost control
- programmable logic controller (PLC) control systems
- supervisory control and data acquisition (SCADA) systems
- water treatment and desiccant dehumidifiers:
 - condenser water treatment – purpose and legislative requirement
 - treatment of secondary refrigerant loops including monitoring
 - desiccant dehumidifiers and their role in infiltration minimisation, defrost control and energy savings
- equipment selection:
 - use computer software and manufacturers' data to select major components of an ammonia refrigeration plant
- problem-solving techniques
- relevant job safety assessments or risk mitigation processes
- relevant manufacturer specifications
- relevant WHS/OHS legislated requirements
- relevant workplace budget, quality, policies and procedures
- relevant workplace documentation.

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must occur in suitable workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated suitable workplace operational situations that replicate workplace conditions.

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.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or simulations
- relevant and appropriate materials, tools, facilities and equipment currently used in industry
- applicable documentation, including workplace procedures, equipment specifications, regulations, codes of practice and operation manuals.

Links

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