

## 1. Module details

**Module name**

**INDUSTRIAL REFRIGERATION SYSTEM  
DESIGN 2**

**Nominal duration**

One module  
It is anticipated that students will achieve the competencies specified in 35 to 40 hours.

**Module codes**

**EB145**

**Discipline code**

## 2. Module purpose

To provide the student with the knowledge and skills necessary to design and select equipment for moderate and low temperature industrial refrigeration systems. Students will be able to determine the performance aspects of multiple evaporators and multiple compressors, select major system components for indirect refrigeration systems, and select and design the major system components for flooded systems. This module will build on the skills and knowledge acquired in the module 'Industrial Refrigeration Systems Design 1'.

## 3. Prerequisites

EA148 - Industrial Refrigeration Systems Design 1

## 4. Relationship to competency standards

TBA

## 5. Content

1. Standards:
  - AS1677
  - ANSI/IIAR Standards
  - ANSI/ASHRAE Standards
  - IIAR Bulletins
2. Moderate and low temperature industrial refrigeration systems
  - revise direct, flooded and pumped liquid recirculation systems
  - evaporators
  - multi-staged compression
  - direct staging
  - cascade staging
  - compound compressors
  - desuperheaters, liquid injection
  - direct expansion intercoolers
  - open and closed intercoolers
  - basic designs of accumulators/intercooler vessels
  - oil cooling methods
  - oil stabilisation, return and oil recovery in flooded systems

3. Multiple evaporators and multiple compressors
  - parallel evaporators
  - multiple temperature systems
  - evaporator pressure regulators
  - temperature control methods
  - parallel compressors
  - pipework layout
  - methods of establishing pressure drop in dry and wet suction lines
4. Indirect refrigeration systems
  - classification according to AS1677
  - applications
  - evaporators
  - heat exchangers, types, construction, selection
  - secondary refrigerants
  - brines
  - antifreeze solutions
5. Flooded systems
  - applications
  - equipment
  - accumulators
  - level controls
  - liquid recirculation pumps
  - liquid pressure relief valve
6. Cryogenic systems
  - applications and equipment
  - system components
  - refrigerants
  - design safety
  - economics
  - cascade systems
7. Basic control sequences
  - maintaining evaporator conditions
  - staging and suction pressure control
  - maintaining condenser conditions
  - control of intermediate pressure, methods of industrial refrigeration compressor capacity control

## 6. Learning outcome details

### Learning outcome 1

#### Assessment criteria

On the completion of this module, the learner will be able to:

Design and select equipment for moderate and low temperature industrial refrigeration systems.

Short answer test.  
Project/assignments.

1.1 Describe the scope of industrial refrigeration applications, plant and equipment defined as moderate and low temperature

	<p>systems.</p> <p>1.2 List components which are found in a variety of moderate and low temperature industrial refrigeration systems.</p> <p>1.3 With the aid of manufacturer's data and catalogues, select equipment for specific moderate and low temperature industrial refrigeration systems.</p> <p>1.4 Design specific items of plant item and equipment for given moderate and low temperature industrial refrigeration systems.</p> <p>1.5 Prepare statements detailing the operational costs associated with plant equipment selected and pay back periods as appropriate.</p>
<b>Learning outcome 2</b>	Determine the performance aspects of multiple evaporators and multiple compressors.
<b>Assessment criteria</b>	<p>Short answer test.</p> <p>Project/assignments.</p> <p>2.1 Accurately calculate the capacity of evaporators when clear and when subject to partial frosting.</p> <p>2.2 Determine required capacity at full and part load conditions, and select evaporators to match load requirements.</p> <p>2.3 For refrigerated spaces served by a multiple evaporator system establish the effects on space conditions at full and partial loads.</p> <p>2.4 Carry out a selection of compressors to operate in parallel to provide the optimum range of refrigeration capacity to match given load profile requirements.</p>
<b>Learning outcome 3</b>	Select major system components for indirect refrigeration systems.
<b>Assessment criteria</b>	<p>Short answer test.</p> <p>Project assignments.</p> <p>3.1 Describe indirect refrigeration systems and their components, in accordance with the application classification found in Australian Standards.</p> <p>3.2 List the types, properties and applications of secondary refrigerants used in indirect industrial refrigeration systems.</p> <p>3.3 List the types and applications of heat exchangers used in indirect industrial refrigeration systems.</p> <p>3.4 Given specific information, successfully carry out the</p>

	<p>selection major system components for indirect refrigeration systems.</p>
<b>Learning outcome 4</b>	Select and design the major system components for flooded systems.
<b>Assessment criteria</b>	<p>Short answer test. Project/assignments.</p> <p>4.1 Describe the range of flooded industrial refrigeration systems, their applications and components.</p> <p>4.2 Given specific information, successfully carry out the selection major system components for flooded industrial refrigeration systems.</p>
<b>7. Assessment Strategies</b>	See Assessment Criteria.
<b>8. Module Delivery Strategies</b>	<p>This module contains learning outcomes that will require both theory and practical instruction. As such, it will require resources to facilitate both on and off-the-job delivery strategies.</p> <p>These strategies may involve:</p> <ul style="list-style-type: none"> <li>- co-operative registered off-the-job provider/employer delivery sharing available resources.</li> <li>- delivery by an employer who is subregistered as an off-the-job provider, with qualified trainers in-house using resources to facilitate on and off-the-job delivery.</li> <li>- off-the-job objectives should focus on the industry context while on-the-job objectives should reflect application within enterprise operations.</li> </ul> <p>Assessment instruments will need to be developed by the module provider. These instruments will need to reflect consistency with stated module learning outcomes and related assessment criteria.</p> <p>Student records will be the responsibility of the off-the-job provider and where more than one off-the-job provider is involved, formal processes for transfer of student information must be established.</p>
<b>9. Resource Requirements</b>	<p>Actrol Parts Catalogue &amp; Technical Manual</p> <p>ASHRAE. ASHRAE Handbook, Fundamentals. Atlanta</p> <p>ASHRAE. ASHRAE Handbook, Refrigeration Systems and Applications SI Version. Atlanta</p> <p>Australian Pump Manufacturer's Association. Australian Pump Technical Handbook</p>

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Australian Pump Manufacturer's Association. Pipe Friction Handbook

Boyle. Australian Refrigeration and Air Conditioning. Trust Publications

Dossat R.J. Principles of Refrigeration. SI Edition. McGraw - Hill

Lovelock Luke Refrigeration Catalogue

NATSPEC (latest edition) NATSPEC Volume 6 - Services Control Monitoring Security Refrigeration, Heating, Air handling.

Standards Australia - Latest Editions to be used:

ANSI/ARI410 Forced Circulation Air Cooling and Air Heating Coils.

AS1432 Copper Tube for Water Gas and Sanitation.

AS1571 Copper Seamless Tubes for Air Conditioning and Refrigeration.

AS1677 Refrigeration Systems.

AS3666. Air Handling and Water Systems of Buildings - Microbial Control.

ASHB40. The Australian Refrigeration and Air Conditioning Code of Good Practice

Stoecker W.F., Jones J.W., 1982. Refrigeration and Air Conditioning McGraw - Hill.

Additionally, further information may be sourced from:

- journal articles
- literature from water treatment companies
- literature form hydronic system specialist companies
- extracts from manufacturer's catalogues and manuals