

1. Module details

Module name	Refrigeration System Components & Piping
Module duration	One module (36-40hrs)
Module code	EA149.1
Discipline code	TBA

2. Module purpose

This module provides the student with the knowledge and skills necessary to select the major refrigeration components in a specified commercial refrigeration and air conditioning system and to correctly determine the refrigeration pipe sizes. Students will also be able to describe various piping design procedures necessary to ensure proper oil return and refrigerant flows in a commercial refrigeration system.

3. Prerequisites

EA142 Refrigeration System Analysis

4. Relationship to competency standards

NES404e, NES503e

5. Content**1. Standards and Codes:**

- AS1677, detailed understanding
- AS 3666, overview
- ozone protection regulations
- IIR Ammonia Data Book
- ANSI/IIR standards
- ANSI/ASHRAE Mechanical Refrigeration & IIR bulletins and standards

2. Calculation of capacity in heat exchangers:

$$Q = UA (LMTD)$$

$$Q = mc \Delta t$$

$$Q = m \Delta h$$

3. Evaporators

- commercial types and applications
- coil bypass factor
- effects of evaporator TD on space humidity
- effects of air circulation on product conditions
- selection criteria and selection tables

4. Condensers

- commercial types and applications

- effects of ambient conditions
- condenser control
- heat rejection factor
- condenser TD
- selection criteria and selection tables

5. Compressors

- types and applications
- capacity
 - displacement
 - volume flow rate
 - theoretical capacity
 - total volumetric efficiency
 - effect of operating conditions, including suction pressure drop and superheating
 - actual capacity
- power
 - theoretical requirement
 - effects of operating conditions
 - actual requirements
 - post defrost loads
 - pull down torque requirements, high, medium and low back pressure compressors
- selection tables, motor selection

6. Liquid expansion devices

- types, operation and applications
- effects from sub-cooling
- distributor types, operation and applications
- selection tables

7. System load balance point

- graphical representation

8. Line sizing an design

- velocity tables
- pressure drop in lines and fittings
- oil migration stabilisation
- refrigerant velocity
- effect of varying system capacity
- oil traps
- risers
- double risers
- liquid migration
- design for parallel components and multiplex systems

9. Automatic controls

- fin spacing, suction temp to evaporator suction
- hot-gas bypass valves
- electronic control of valves PLC control

- refrigerant regulating valves
- solenoid valves
- condenser pressure regulating valves
- evaporator pressure regulating valves
- crankcase pressure regulating valves
- cycling controls
- pressure-stats
- thermostats,
- defrost controls
- monitoring and alarm controls
- refrigeration automation systems
- control strategies
- control modes

6. Assessment strategy

Assessment methods

Supervised open book, short answer test, practical on the job exercises

Conditions of assessment

7. Learning outcome details

Learning outcome 1

Select evaporators for specific applications.

Assessment criteria

1.1 Correctly select evaporators to match refrigeration load, room/product storage conditions for a variety of applications and refrigeration capacities to represent those likely to be encounter in the commercial refrigeration industry.

Learning outcome 2

Select compressors for specific applications.

Assessment criteria

2.1 Correctly select compressors and/or condensing units to match the evaporators, refrigeration load, desired saturated suction temperature and conditions as detailed in Learning Outcome 1.

Learning outcome 3

Select condensers for specific applications.

Assessment criteria	3.1 Correctly select a variety of condensers to match compressor refrigeration capacity, with due regard to cooling medium, ambient conditions and, heat rejection factors.
Learning outcome 4	Determine System Load Balance Points.
Assessment criteria	4.1 Determine System Load Balance Points.
Learning outcome 5	Select liquid expansion devices.
Assessment criteria	5.1 Correctly select liquid expansion devices from given and established operating conditions, representative of a variety of applications and refrigeration capacities to represent those likely to be encountered in the commercial refrigeration industry.
Learning outcome 6	Determine Refrigeration Line Sizes.
Assessment criteria	6.1 Correctly establish appropriate line sizes to maintain adequate oil return with acceptable refrigerant velocity and pressure drop.
Learning outcome 7	Describe Various Piping Design Procedures.
Assessment criteria	7.1 Produce refrigeration line designs to ensure efficient, safe operation under varying operating conditions and capacities for a variety of applications and refrigeration capacities to represent those likely to be encountered in the commercial refrigeration industry.
Learning outcome 8	Select appropriate automatic controls system.
Assessment criteria	8.1 List elements of typical commercial refrigeration control systems and state the purpose of each element. 8.2 List and give examples of use of control modes used in commercial refrigeration systems. 8.3 For given commercial refrigeration systems select appropriate automatic controls system.
8. Delivery of the module	
Delivery strategy	Normally learning will take place in the design office, classroom or other suitable study environment. During learning, access to manufacturer's data, selection

Resource requirements

tables, catalogues, relevant texts, as well as examples of similar projects and /or selections.

Actrol Parts Catalogue & Technical Manual.

AIRAH 1989. AIRAH Handbook.

ASHRAE. ASHRAE Handbook, Fundamentals. Atlanta

ASHRAE. ASHRAE Handbook, Refrigeration Systems and Applications SI Version. Atlanta

Boyle. Australian Refrigeration and Air Conditioning. Trust publications.

Copeland Refrigeration. Copeland Refrigeration Manual - Part 1 Fundamentals of refrigeration, Part 2 Refrigeration System Components, Part 4 System Design. USA.

Dossat RJ. Principles of Refrigeration. SI Edition., McGraw-Hill.

Du Pont. Pipe Size Data: Pressure Drop and Velocity Tables. Du Pont Freon Products Division.

Lovelock Luke Refrigeration Catalogue

Standards Australia-Latest Editions to be used:

AS1571 Copper-Seamless tubes for Air Conditioning and Refrigeration.

AS1677 Refrigeration Systems.

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

Additionally further information may be sourced from;

Journal Articles.

Occupational health and safety requirements

Students should be made aware of occupational health and safety issues in all situations and be expected to demonstrate safe working practices at all times.