

NATIONAL METAL AND ENGINEERING CURRICULUM

<u>MODULE:</u>	INSTALLATION (NR11)
<u>PURPOSE:</u>	This module aims to provide the student with the knowledge and skills to install refrigeration piping and equipment.
<u>NOMINAL DURATION:</u>	One Module

*This module is designed on the assumption that most of the students will achieve the competencies specified in 35 to 40 hours.
The length of time taken to complete a module will vary depending on factors such as teaching method used, knowledge and skills at entry and individual students ability.*

<u>PREREQUISITES:</u>	Refrigeration System Operation (NR09) Refrigeration Control (NR10)
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<u>LEARNING OUTCOMES:</u>	On completion of this module, the student will be able to:
	<ol style="list-style-type: none">1. Identify dangers and observe safe working practices in an installation environment.2. Read and interpret engineering site drawings, layouts and specifications with reference to SAA Codes and local building regulations.3. Describe common practices and principles involved in installing refrigerant piping.4. Describe refrigerant pipe sizing methods and demonstrate selection techniques.5. Install refrigeration piping and accessories.6. Identify and describe refrigerant piping accessories.

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.

<u>OUTLINE OF CONTENT:</u>	This module contains:
	<ol style="list-style-type: none">1. Dangers and safe working practices<ul style="list-style-type: none">- industrial accidents- burns - welding- lifting- site maintenance- safe working practices

2. **Site drawings and specifications**
 - equipment layout drawings
 - piping diagrams
 - wiring diagrams
 - manufacturers equipment specifications
 - standard symbols
 - SAA Codes
3. **Piping installation**
 - planning piping and equipment layout/liaison
 - mounting methods
 - piping arrangements
 - pipe fittings
 - insulation
4. **Pipe sizing**
 - oversized and undersized pipe
 - oil return
 - refrigerant velocity
 - pressure drop
 - equivalent lengths
 - sizing charts
 - correction factors
5. **Pressure testing**
 - maximum pressures
 - methods of pressurizing
 - methods of leak testing
 - evacuation
 - code of practice
6. **Refrigerant piping accessories**
 - liquid receivers
 - pressure vessels
 - oil separators
 - suction line accumulators
 - sight glass/moisture indicator
 - filter/driers-suction and liquid line
 - surge drum/tank
 - hand valves
 - vibration eliminators
 - discharge mufflers
 - heat exchangers - suction/liquid line

* Details of above Outline topics are available in APPENDIX 1.

ON-THE-JOB TRAINING:

For consolidation, the material in this module should be linked with and complemented by relevant on.job skill practice or other equivalent experience.

PERFORMANCE CRITERIA:

The criteria for each learning outcome should be:

Learning Outcome 1

Assessment: Short answer tests.
Practical exercises.

- Performance:**
- a. Identify possible causes of Industrial accidents.
 - b. Identify burn types and describe their treatment.
 - c. Describe and demonstrate safe lifting procedures.
 - d. Identify safety apparel required on.site.
 - e. Outline site maintenance procedures.
 - f. Apply general safe working practices.

Learning Outcome 2

Assessment: Short answer tests.
Practical exercises/project.

- Performance:**
- a. Read and interpret equipment layout diagrams.
 - b. Read and interpret piping diagrams.
 - c. Read and interpret wiring diagrams.
 - d. Determine manufacturers specifications.
 - e. Determine piping and electrical symbols in accordance with SAA Standards.

Learning Outcome 3

Assessment: Short answer tests.
Practical exercises/project.

- Performance:**
- a. Determine planning considerations for refrigerant piping and equipment layout including service aspects/liaise with other tradesmen.
 - b. Identify the correct methods to mount and attach refrigerant piping and equipment, including the use of pipe hangers, vibration control devices and expansion/contraction joints.
 - c. Describe piping arrangements for piping of discharge lines, liquid lines and suction lines.
 - d. Identify pipe fittings including tees, elbows, P.traps and saddles.
 - e. Identify insulation requirements for refrigerant piping and equipment and describe the correct installation techniques.

Learning Outcome 4

- Assessment:** Practical tests.
Project.
- Performance:**
- a. Establish the effects of oversizing and undersizing refrigerant piping.
 - b. Describe the effect of pipe sizing on compressor oil return.
 - c. State the maximum and minimum velocities for both horizontal and vertical lines.
 - d. Identify the maximum acceptable pressure drop in refrigerant lines for various lines.
 - e. Establish equivalent lengths for valves, fittings and pipe lengths using appropriate charts.
 - f. Identify and interpret pipe sizing data from graphs or charts, and demonstrate the selection of pipe for specified applications.
 - g. Apply correction factors based on varying condenser and evaporator conditions.

Learning Outcome 5

- Assessment:** Short answer tests.
Practical tests.
- Performance:**
- a. Identify the maximum pressure allowances of refrigerant piping and equipment.
 - b. Install and pressurize refrigerant system piping and equipment.
 - c. Demonstrate refrigerant leak testing.
 - d. Evacuate and charge the installation.

Learning Outcome 6

- Assessment:** Practical test/project.
- Performance:**
- a. Locate, identify and describe the use, principle of operation, installation and maintenance of selected accessories.
 - . liquid receivers
 - . pressure vessels
 - . oil separators
 - . suction line accumulators
 - . sight glass/moisture indicator
 - . filter/driers - suction/liquid line
 - . surge drum/tank
 - . hand valves
 - . vibration eliminators
 - . discharge mufflers
 - . heat exchangers - suction/liquid line

APPENDIX 1

Suggested module content

For Learning Outcome 3 and 4

The student should determine the correct methods to:

- . install or replace piping along walls or ceilings
- . provide adequate protection for piping which is run through floors or walls
- . install the suction lines so that piping will drain towards the compressor
- . replace insulation and fittings for lagged piping
- . install vibration control devices in the refrigerant lines
- . install pressure control lines

The student should be able to determine the correct methods to:

- . describe piping arrangements for piping as follows

Discharge Line Piping

- . condenser above compressor
- . condenser on the same level or lower level than the compressor
- . compressors with capacity reduction or multiple compressors
- . recommended velocity for oil entrainment

Liquid Line Piping

- . acceptable maximum pressure drop
- . recommended velocities
- . effect of "flash gas" in the liquid line
- . multiple evaporator installation

Suction Line Piping

- . evaporator and compressor on the same level
- . evaporator above compressor
- . evaporator below compressor
- . acceptable maximum pressure drop
- . recommended velocity for oil entrainment
- . multiple compressor installations

ADDITIONAL INFORMATION: MODULE (NR11)

1. SUGGESTED TEACHING/LEARNING STRATEGIES

1. A number of the learning outcomes in this module could be assessed through practical exercises, projects or assignments.

An example could be the planning, equipment sizing, pipe sizing and pipe installation which would envelop most of the learning outcomes.

2. An important part of this module should involve the student in practically sizing and then installing refrigerant piping on a commercial system.
3. Students could be asked to complete piping diagrams of various layouts using correct refrigerant piping practice.

2. SUGGESTED MINIMUM RESOURCES

3. SUGGESTED ON-JOB TRAINING - FOR MAXIMUM SKILL ACQUISITION