



Western Technical College

## 10601101 HVACR Refrigeration

### Course Outcome Summary

#### Course Information

<b>Description</b>	This course is an introduction to basic refrigeration systems. Topics include terminology, the refrigeration cycle, safety, refrigerants, lubricants, and environmental issues. The learner will assemble copper tubing, use hand tools, and use test instruments. The learner will operate, evacuate, charge and repair basic refrigeration units. HVACR is a common reference to Heating, Ventilation, Air Conditioning and Refrigeration.
<b>Career Cluster</b>	Architecture and Construction
<b>Instructional Level</b>	Associate Degree Courses
<b>Total Credits</b>	4
<b>Total Hours</b>	108

#### Textbooks

*Refrigeration and Air Conditioning Technology*. 9th Edition. Copyright 2021. Whitman, Bill, Bill Johnson, John Timczyk, and Eugene Silberstein. Publisher: Cengage Learning. **ISBN-13:**978-0-357-12227-3. Required.

#### Learner Supplies

Safety glasses with side eye protection that meet Z87 OSHA guidelines. **Vendor:** Campus Shop. Required.

#### Experiential Learning

1. Community Based Learning Project: a key learning outcome of this course is to connect academic learning and civic development while simultaneously addressing a community partner's needs, interests, or problems.

## Program Outcomes

1. Install HVACR systems
2. Service HVACR systems
3. Troubleshoot HVACR systems
4. Evaluate HVACR system designs
5. Repair HVACR equipment
6. Analyze HVACR systems

## Course Competencies

### 1. Practice shop safety

#### Assessment Strategies

- 1.1. Skill Demonstration

#### Criteria

*You will know you are successful when*

- 1.1. you wear proper lab clothes.
- 1.2. you practice eye protection safety.
- 1.3. you respect other student's space and projects.
- 1.4. you handle chemicals and tools with appropriate caution.

#### Learning Objectives

- 1.a. Analyze the operation, rules, and safety requirements of the school and the class.
- 1.b. Articulate and practice personal safety and work habits.
- 1.c. Apply safety practices handling hazardous substances including, gas, oxygen, acetylene, nitrogen, oil, refrigerant, cleaning fluids, acids and sanitizing fluids.
- 1.d. Use safe practices when working with pressurized vessels.

### 2. Draw the basic refrigeration cycle

#### Assessment Strategies

- 2.1. Drawing/Illustration
- 2.2. Written Product

#### Criteria

*You will know you are successful when*

- 2.1. you show the basic refrigeration components in their proper place in the system in a drawing.
- 2.2. you label the refrigerant lines (discharge, liquid, and suction) and direction of flow.
- 2.3. you propose reasonable discharge and suction pressures for an application and a specific refrigerant.
- 2.4. you show superheat and subcooling representations in their proper place.

#### Learning Objectives

- 2.a. Be introduced to the theory of refrigeration.
- 2.b. Be introduced to the theory of fluids and pressures related to refrigeration.
- 2.c. Discriminate between the relationship of the system components as compared to the refrigeration cycle.
- 2.d. Diagram a basic refrigeration system.
- 2.e. Describe the basic refrigeration system.

### 3. Diagram the function of the main components of a refrigeration system

#### Assessment Strategies

- 3.1. Drawing/Illustration
- 3.2. Written Product
- 3.3. Written Objective Test

#### Criteria

*You will know you are successful when*

- 3.1. you diagram the basic refrigeration system.
- 3.2. you list the main components of a basic refrigeration system.
- 3.3. you explain the function of the basic refrigeration system components.
- 3.4. you identify the inter-connecting piping between the basic refrigeration system components.

#### **Learning Objectives**

- 3.a. Classify the various types of metering devices and know their operation.
- 3.b. Classify the various types of evaporators and know their operation.
- 3.c. Classify the various types of compressors and know their operation.
- 3.d. Classify the various types of condensers and know their operation.

### **4. Use HVACR related tools and instruments**

#### **Assessment Strategies**

- 4.1. Demonstration
- 4.2. Project

#### **Criteria**

*You will know you are successful when*

- 4.1. you cut and ream copper tubes for projects.
- 4.2. you use a swagging tool for connecting two tubes.
- 4.3. You flare copper tubing for projects
- 4.4. you complete a bending project using a tube bender.
- 4.5. you complete a flaring project
- 4.6. you complete a soldering, brazing, flaring, and bending project.
- 4.7. You leak test fittings with R-22 trace gas and nitrogen
- 4.8. You identify leaks with various electronic leak detectors and pinpoint leaks with soap suds.

#### **Learning Objectives**

- 4.a. Use hand tools common to the HVACR trade.
- 4.b. Use field approved pipe cleaning methods.
- 4.c. Use a Nitrogen cylinder and adjust the regulator.
- 4.d. Use leak detectors.
- 4.e. Use assorted micron gauges

### **5. Operate torches safely per manufactures recommendations.**

#### **Assessment Strategies**

- 5.1. Skill Demonstration

#### **Criteria**

*You will know you are successful when*

- 5.1. Show proper set up and shutdown procedures.
- 5.2. Demonstrate regulator replacement and leak checking of tank and hose fittings.
- 5.3. Demonstrate proper pressure regulator adjustments to manufactures recommendations.
- 5.4. Adjust flame to neutral flame.
- 5.5. Demonstrate proper torch, regulator and tank shutdown procedures

#### **Learning Objectives**

- 5.a. Operate hand held propane torches.
- 5.b. Operate air acetylene torches.
- 5.c. Operate oxygen acetylene torches.
- 5.d. Demonstrate safe use of torches.
- 5.e. Identify regulator, on/off procedures, and adjust flame.

### **6. Assemble copper piping.**

#### **Assessment Strategies**

- 6.1. Skill Demonstration

#### **Criteria**

*You will know you are successful when*

- 6.1. you use oxygen / acetylene equipment to solder and braze.
- 6.2. you use air acetylene equipment to solder and braze.
- 6.3. you use propane-air equipment to solder and braze.
- 6.4. you use silfos, soft solder, and silver solder to connect tubing.

**Learning Objectives**

- 6.a. Use various torches.
- 6.b. Distinguish between soldering and brazing.
- 6.c. Use various hand tools.
- 6.d. Construct copper tubing tasks.

**7. Adhere to federal and local codes and standards.**

**Assessment Strategies**

- 7.1. Written Objective Test

**Criteria**

*You will know you are successful when*

- 7.1. you explain and observe federal, state, and local refrigerant rules.
- 7.2. you explain and observe federal, state, and local electrical rules.
- 7.3. you explain and observe federal, state, and local mechanical rules.
- 7.4. you explain and observe federal, state, and local safety rules.

**Learning Objectives**

- 7.a. Analyze regulations affecting ozone depletion.
- 7.b. Analyze regulations affecting global warming.

**8. Practice safe refrigerant handling.**

**Assessment Strategies**

- 8.1. Demonstration
- 8.2. Written Product

**Criteria**

*Your performance will be successful when:*

- 8.1. you identify refrigerants by ARI color code and ASHRAE refrigerant number.
- 8.2. you classify refrigerants into their ASHRAE designated safety group.
- 8.3. you use refrigeration equipment without venting excess refrigerant.
- 8.4. you select proper replacement refrigerants.

**Learning Objectives**

- 8.a. Follow proper refrigerant handling procedures.
- 8.b. Analyze regulations affecting ozone depletion.

**9. Install a refrigeration gauge manifold set on to a fully operational refrigeration system.**

**Assessment Strategies**

- 9.1. Skill Demonstration

**Criteria**

*You will know you are successful when*

- 9.1. You will identify high and low side hoses on the manifold set.
- 9.2. You will identify the service hose of the manifold set.
- 9.3. You will install gauges on systems with service valves and schraeder valves.
- 9.4. you will purge the gauge hoses.
- 9.5. You will remove the gauges with minimal refrigerant loss.

**10. Practice a complete start-up, checkout , and test operation of a refrigeration system**

**Assessment Strategies**

10.1. Skill Demonstration

**Criteria**

*You will know you are successful when*

- 10.1. you monitor pull down to the prescribed operating conditions.
- 10.2. you compare compressor full load current with actual measurements.
- 10.3. you measure and record low and high side pressures.
- 10.4. you measure, calculate and record system superheat and subcooling.
- 10.5. you accurately measure and record temperature drop across both the evaporator and condenser coils

**Learning Objectives**

- 10.a. Know the function and operation of various access fittings.
- 10.b. Determine the temperature of a refrigerant given its corresponding pressure.
- 10.c. Calculate the typical operating conditions of a refrigeration and / or air conditioning system.
- 10.d. Calculate superheat.
- 10.e. Calculate subcooling.
- 10.f. Evaluate amp draws of system loads.

**11. Complete refrigerant recovery, system evacuation, system charging, and operational checks of a basic refrigeration system.**

**Assessment Strategies**

- 11.1. Skill Demonstration

**Criteria**

*You will know you are successful when*

- 11.1. you select proper recovery machine and recovery tank according to the refrigerant type.
- 11.2. you connect equipment, gauges, recovery machine, and recovery tank for liquid recovery and/or for vapor recovery.
- 11.3. you recover the refrigerant to the required degree according to the EPA and Wisconsin codes.
- 11.4. you terminate the recovery process with minimum losses and store or dispense with refrigerant as needed.

**Learning Objectives**

- 11.a. Identify regulations affecting ozone depletion.
- 11.b. Differentiate between various refrigerant recovery, recycling, and reclamation methods.
- 11.c. Plan refrigerant recovery safety.
- 11.d. Use refrigerant recovery equipment.
- 11.e. Describe alternative refrigerant retrofits.

**12. Determine different types of lubricants with specific refrigerant types.**

**Assessment Strategies**

- 12.1. Skill Demonstration

**Criteria**

*Your performance will be successful when:*

- 12.1. you characterize mineral, alkylbenzene, and polyolester oils.
- 12.2. you remove and replace the proper amount of the indicated oil in a system.
- 12.3. you use a refractory meter to identify types of oil.
- 12.4. you replace mineral oil with a suitable substitute according to the refrigerant type.
- 12.5. you replace alkylbenzene oil with polyolester measuring percentages according to manufacturers conditions.
- 12.6. you pump down a basic refrigeration unit.

**Learning Objectives**

- 12.a. Change compressor oil using proper replacement procedures.
- 12.b. Select lubricants for refrigerant retrofits.
- 12.c. Analyze oil condition and type.

**13. Differentiate between refrigerants and understand refrigerant retrofit options.**

### **Assessment Strategies**

- 13.1. Written Product

### **Criteria**

*You will know you are successful when*

- 13.1. you select refrigerant cylinders according to their color codes.
- 13.2. you replace a refrigerant with a suitable substitute.
- 13.3. you identify refrigerants according to their pressure range.
- 13.4. you associate temperature ranges with refrigerants that are appropriate.

### **Learning Objectives**

- 13.a. Differentiate between CFC's, HCFC's, HFC's, and HC's.
- 13.b. Discuss popular refrigerants .
- 13.c. Discuss refrigerant blends.
- 13.d. Discuss refrigerant applications.

## **14. Troubleshoot a complete refrigeration system and perform problem analysis**

### **Assessment Strategies**

- 14.1. Skill Demonstration
- 14.2. Written Product

### **Criteria**

*Your performance will be successful when:*

- 14.1. you diagnose a basic refrigeration system using a logical step procedure.
- 14.2. you analyze electrical conditions and compare to normal or expected results.
- 14.3. you analyze refrigerant pressures and temperatures and compare to normal or expected results.
- 14.4. you properly use diagnostic tools to collect data.

### **Learning Objectives**

- 14.a. Solve mechanical system problems.
- 14.b. Understand basic refrigeration maintenance programs.
- 14.c. Recover refrigerant from a basic refrigeration unit.
- 14.d. Charge a basic refrigeration unit by the sight glass method.
- 14.e. Charge a basic refrigeration unit by the weight method.
- 14.f. Monitor compressor amp draw and compare to nameplate data.

## **15. Examine components of window air conditioners.**

### **Assessment Strategies**

- 15.1. Critique

### **Criteria**

*You will know you are successful when*

- 15.1. you will analyze unit construction
- 15.2. you will determine motor type, amperage and voltage.
- 15.3. you will recover refrigerant from the unit and weigh in the correct charge.
  
- 15.4. you will monitor pressures, temperatures and amps to determine if the unit is operating as designed.

### **Learning Objectives**

- 15.a. demonstrate understanding of unit construction.
- 15.b. recover refrigerant to proper EPA required vacuum level.
- 15.c. charge unit to nameplate requirement.
- 15.d. evaluate unit performance as compared to manufactures specifications.

## **16. Replace a hermetic compressor.**

### **Assessment Strategies**

- 16.1. Skill Demonstration

### **Criteria**

*Performance will be satisfactory when:*

- 16.1. you will recover refrigerant from a window air conditioner.
- 16.2. you will remove the compressor from the system.
- 16.3. you will replace the filter drier.
- 16.4. you will leak test the system.
- 16.5. you will evacuate the system to 500 microns.
- 16.6. you will charge the unit to nameplate data.
- 16.7. you will evaluate system performance as compared to manufactures specifications.

**Learning Objectives**

- 16.a. recover refrigerant to EPA required vacuum level.
- 16.b. remove and replace compressor according to manufactures specifications.
- 16.c. leak test the system.
- 16.d. evacuate the system to 500 microns.
- 16.e. evaluate the system