

2013 – 2014

**Florida Department of Education  
Curriculum Framework**

**Program Title:** Air-Conditioning, Refrigeration and Heating Technology 2  
**Program Type:** Career Preparatory  
**Career Cluster:** Architecture and Construction

PSAV	
Program Number	C400200
CIP Number	0647020108
Grade Level	30, 31
Standard Length	600 Hours
Teacher Certification	AC HEAT ME @7 G REFRG MECH @7 G
CTSO	SkillsUSA
SOC Codes (all applicable)	49-9021 - Heating, Air Conditioning, and Refrigeration Mechanics and Installers
Facility Code	245 - <a href="http://www.fldoe.org/edfacil/sref.asp">http://www.fldoe.org/edfacil/sref.asp</a> (State Requirements for Educational Facilities)
Targeted Occupation List	<a href="http://www.labormarketinfo.com/wec/TargetOccupationList.htm">http://www.labormarketinfo.com/wec/TargetOccupationList.htm</a>
Perkins Technical Skill Attainment Inventory	<a href="http://www.fldoe.org/workforce/perkins/perkins_resources.asp">http://www.fldoe.org/workforce/perkins/perkins_resources.asp</a>
Industry Certifications	<a href="http://www.fldoe.org/workforce/fcpea/default.asp">http://www.fldoe.org/workforce/fcpea/default.asp</a>
Statewide Articulation	<a href="http://www.fldoe.org/workforce/dwdframe/artic_frame.asp">http://www.fldoe.org/workforce/dwdframe/artic_frame.asp</a>
Basic Skills Level	Mathematics: 10 Language: 9 Reading: 9

### **Purpose**

The purpose of this program is to prepare students for employment or advanced training in the heating, air-conditioning (A/C), and refrigeration and ventilation industry. This program prepares students for employment as A/C, Refrigeration and Heating Helper, A/C, Refrigeration and Heating Mechanic Assistant, A/C, Refrigeration and Heating Mechanic, A/C, Refrigeration and Heating Technician, and Refrigeration Technician (SOC 49-9021).

The student should obtain EPA certification prior to leaving school in order to be employed in any job that requires work with refrigerants.

This program focuses on broad, transferable skills, stresses the understanding of the heating, air-conditioning, refrigeration and ventilation industry, and demonstrates elements of the industry such as planning, management, finance, technical and production skills, the underlying principles of technology, and health, safety, and environmental issues.

This program offers a sequence of courses that provides coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in the Architecture and Construction career cluster; provides technical skill proficiency, and includes competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of the Architecture and Construction career cluster.

### **Program Structure**

This is a planned sequence of instruction consisting two occupational completion points. The recommended sequence allows students to complete specified portions of the program for employment or to remain for advanced training. A student who completes the applicable competencies at any occupational completion point may either continue with the training program or terminate as an occupational completer

**Air-Conditioning, Refrigeration and Heating Technology 1** is a core program. It is recommended students complete **Air-Conditioning, Refrigeration and Heating Technology 1**, or demonstrate mastery of the outcomes in that program, prior to enrollment in **Air-Conditioning, Refrigeration and Heating Technology 2**.

When offered at the postsecondary adult career and technical level, this program is comprised of courses which have been assigned course numbers in the SCNS (Statewide Course Numbering System) in accordance with Section 1007.24 (1), F.S. Career and Technical credit shall be awarded to the student on a transcript in accordance with Section 1001.44(3)(b), F.S.

The following table illustrates the program structure:

OCP	Course Number	Course Title	Course Length	SOC Code
A	ACR0049	Air Conditioning, Refrigeration and Heating Mechanic 2	250 Hours	49-9021
B	ACR0044	Air Conditioning, Refrigeration and Heating Technician	350 Hours	49-9021

### **Laboratory Activities**

Laboratory activities are an integral part of this program. These activities include instruction in the use of safety procedures, tools, equipment, materials, and processes related to these occupations. Equipment and supplies should be provided to enhance hands-on experiences for students.

### **Special Notes**

#### **Career and Technical Student Organization (CTSO)**

SkillsUSA, Inc. is the appropriate career and technical student organization for providing leadership training and reinforcing specific career and technical skills. Career and Technical Student Organizations provide activities for students as an integral part of the instruction offered. The activities of such organizations are defined as part of the curriculum in accordance with Rule 6A-6.065, F.A.C.

### **Cooperative Training – OJT**

On-the-job training is appropriate but not required for this program. Whenever offered, the rules, guidelines, and requirements specified in the OJT framework apply.

### **Basic Skills**

In PSAV programs offered for 450 hours or more, in accordance with Rule 6A-10.040, F.A.C., the minimum basic skills grade levels required for postsecondary adult career and technical students to complete this program are: Mathematics 10, Language 9, and Reading 9. These grade level numbers correspond to a grade equivalent score obtained on a state designated basic skills examination.

Adult students with disabilities, as defined in Section 1004.02(7), Florida Statutes, may be exempted from meeting the Basic Skills requirements (Rule 6A-10.040). Students served in exceptional student education (except gifted) as defined in s. 1003.01(3)(a), F.S., may also be exempted from meeting the Basic Skills requirement. Each school district and Florida College must adopt a policy addressing procedures for exempting eligible students with disabilities from the Basic Skills requirement as permitted in Section 1004.91(3), F.S.

Students who possess a college degree at the Associate of Applied Science level or higher; who have completed or are exempt from the college entry-level examination; or who have passed a state, national, or industry licensure exam are exempt from meeting the Basic Skills requirement (Rule 6A-10.040, F.A.C.) Exemptions from state, national or industry licensure are limited to the certifications listed at <http://www.fl DOE.org/workforce/dwdframe/rtf/basicskills-License-exempt.rtf>.

### **Accommodations**

Federal and state legislation requires the provision of accommodations for students with disabilities as identified on the secondary student's IEP or 504 plan or postsecondary student's accommodations' plan to meet individual needs and ensure equal access. Postsecondary students with disabilities must self-identify, present documentation, request accommodations if needed, and develop a plan with their counselor and/or instructors. Accommodations received in postsecondary education may differ from those received in secondary education. Accommodations change the way the student is instructed. Students with disabilities may need accommodations in such areas as instructional methods and materials, assignments and assessments, time demands and schedules, learning environment, assistive technology and special communication systems. Documentation of the accommodations requested and provided should be maintained in a confidential file.

In addition to accommodations, some secondary students with disabilities (students with an Individual Educational Plan (IEP) served in Exceptional Student Education or ESE) will need modifications to meet their needs. Modifications change the outcomes or what the student is

expected to learn, e.g., modifying the curriculum of a secondary career and technical education course. Note postsecondary curriculum cannot be modified.

Some secondary students with disabilities (ESE) may need additional time (i.e., longer than the regular school year), to master the student performance standards associated with a regular Occupational Completion Point (OCP) or a Modified Occupational Completion Point (MOCP). If needed, a student may enroll in the same career and technical course more than once. Documentation should be included in the IEP that clearly indicates that it is anticipated that the student may need an additional year to complete an OCP/MOCP. The student should work on different competencies and new applications of competencies each year toward completion of the OCP/MOCP. After achieving the competencies identified for the year, the student earns credit for the course. It is important to ensure that credits earned by students are reported accurately. The district's information system must be designed to accept multiple credits for the same course number (for eligible students with disabilities).

### **Articulation**

This program has no statewide articulation agreement approved by the Florida State Board of Education. However, this does not preclude the awarding of credits by any college through local agreements.

For details on statewide articulation agreements which correlate to programs and industry certifications, refer to [http://www.fldoe.org/workforce/dwdframe/artic\\_frame.asp](http://www.fldoe.org/workforce/dwdframe/artic_frame.asp).

### **Standards**

After successfully completing this program, the student will be able to perform the following:

- 01.0 Troubleshoot combustion gas valves and regulators as used in heating, air-conditioning, refrigeration and ventilation systems.
- 02.0 Maintain, test, and adjust commercial heating and air-conditioning accessories.
- 03.0 Maintain, troubleshoot, and repair commercial heating systems.
- 04.0 Install, maintain and repair heating, air-conditioning, and refrigeration systems.
- 05.0 Demonstrate knowledge of retail refrigeration systems.
- 06.0 Demonstrate knowledge of commercial and industrial refrigeration systems.
- 07.0 Develop an understanding of hydronic systems.
- 08.0 Develop an understanding of steam systems.
- 09.0 Determine the properties of air.
- 10.0 Use a pressure enthalpy chart to diagram refrigerant cycles.
- 11.0 Explain the standards for and ways to measure indoor-air quality.
- 12.0 Operate environmental control systems as used in commercial heating and air-conditioning systems.
- 13.0 Maintain and troubleshoot pneumatic control systems for commercial heating and air-conditioning applications.
- 14.0 Maintain and repair thermal storage systems.
- 15.0 Maintain, troubleshoot, and repair commercial heating and air-conditioning systems.
- 16.0 Calculate commercial heating and air-conditioning loads.
- 17.0 Install air distribution systems.
- 18.0 Evaluate commercial airside systems.
- 19.0 Balance an air distribution system.
- 20.0 Select energy conservation equipment.

- 21.0 Analyze building management systems.
- 22.0 Recommend alternative heating and cooling systems for various case studies.

2013 – 2014

**Florida Department of Education  
Student Performance Standards**

**Program Title: Air-Conditioning, Refrigeration and Heating Technology 2**  
**PSAV Number: C400200**

**Course Number: ACR0049**  
**Occupational Completion Point: A**  
**A/C, Refrigeration and Heating Mechanic 2 – 250 Hours – SOC Code 49-9021**

- 01.0 Use combustion-type heating servicing and testing equipment--The student will be able to:
- 01.01 Explain combustion theory and the safety precautions for using combustion-type-heating servicing and testing equipment.
  - 01.02 Identify and explain the various types of combustion-type heating servicing and testing equipment (such as draft gauge, U-tube manometer, sling psychrometer, millivolt meter, and oil-furnace testing equipment).
  - 01.03 Use the servicing and testing equipment.
  - 01.04 Test, analyze, and troubleshoot combustion-type-heating systems.
- 02.0 Troubleshoot combustion gas valves and regulators as used in heating, air-conditioning, refrigeration and ventilation systems--The student will be able to:
- 02.01 Identify and discuss the safety and regulation issues and concerns.
  - 02.02 Explain the operations of various types of gas valves and regulators (such as low-voltage, line-voltage, pneumatic, solenoid, and gas and pressure regulators).
  - 02.03 Identify and size various types of gas valves and regulators.
  - 02.04 Determine the application of gas valves and regulators.
  - 02.05 Troubleshoot gas valves and regulators.
- 03.0 Maintain, test, and adjust commercial heating and air-conditioning accessories--The student will be able to
- 03.01 Compare commercial accessories with residential and light- commercial-heating and air-conditioning accessories.
  - 03.02 Select the heating and air-conditioning accessories appropriate for various commercial applications.
  - 03.03 Maintain, test, and adjust commercial heating and air-conditioning accessories.
- 04.0 Maintain, troubleshoot, and repair commercial heating systems--The student will be able to:
- 04.01 Identify the components of various commercial heating systems.
  - 04.02 Explain the operational principles of various commercial heating systems.
  - 04.03 Test and analyze heating air-distribution systems.
  - 04.04 Maintain, troubleshoot, and repair various commercial heating systems, such as:
    - a. A gas furnace and boiler
    - b. An oil furnace and boiler
    - c. An electric furnace

- d. Electric heaters
- e. A heat pump
- f. Solar-heating systems

05.0 Install, maintain and repair heating, air-conditioning, and refrigeration systems--The student will be able to:

- 05.01 Follow safety precautions.
- 05.02 Describe new technologies in heating, air-conditioning, and refrigeration installation, including
  - a. Variable-speed motors
  - b. Heat-pipe systems
  - c. Desiccant systems
  - d. Gas-driven heating systems
- 05.03 Lay out, construct, and troubleshoot comfort systems.
- 05.04 Test and analyze systems.
- 05.05 Test and analyze heat-recovery systems.

06.0 Demonstrate knowledge of retail refrigeration systems--The student will be able to:

- 06.01 Describe the mechanical refrigeration cycle as it applies to retail refrigeration systems.
- 06.02 Explain the differences in refrigerants and applications in low-, medium-, and high-temperature refrigeration systems.
- 06.03 Identify and describe the primary refrigeration cycle components used in retail refrigeration systems.
- 06.04 Identify and describe the supporting components and accessories used in retail refrigeration systems.
- 06.05 Describe the various methods of defrost used in retail refrigeration systems.
- 06.06 Identify and describe the applications for the various types of retail refrigeration systems.
- 06.07 Describe the control system components used in retail refrigeration systems.
- 06.08 Explain the operating sequence of a retail refrigeration system.
- 06.09 Interpret wiring diagrams and troubleshooting charts to isolate malfunctions in retail refrigeration systems.

07.0 Demonstrate knowledge of commercial and industrial refrigeration systems--The student will be able to:

- 07.01 Identify different types of refrigerated coolers and display cases and describe each one's common application.
- 07.02 Compare the basic components used in commercial/industrial refrigeration systems with those used in retail refrigeration systems.
- 07.03 Identify single, multiple, and satellite compressor systems. Describe the applications, installation considerations, and advantages and disadvantages of each type.
- 07.04 Identify packaged condensing units and unit coolers. Describe their applications, operation, and installation considerations.
- 07.05 Identify two-stage compressors and explain their operation and applications.
- 07.06 Identify the various accessories used in commercial refrigeration systems. Explain why each is used and where it should be installed in the system.

- 07.07 Identify the various refrigeration control devices. Explain the purpose of each type and how it works.
- 07.08 Compare the components used in ammonia systems with those used in halocarbon-based refrigerant systems.

08.0 Develop an understanding of hydronic systems--The student will be able to:

- 08.01 Explain the terms and concepts used when working with hot-water heating and chilled-water cooling systems.
- 08.02 Identify the major components of hot-water heating, chilled-water cooling, and dual-temperature water systems.
- 08.03 Explain the purpose of each component of hot-water heating, chilled-water cooling, and dual-temperature water systems.
- 08.04 Describe the safety precautions used when working with hot-water/chilled-water systems.
- 08.05 Explain the differences between reciprocating, rotary screw, scroll, and centrifugal chillers.
- 08.06 Identify the common piping configurations used with hot-water heating and chilled-water cooling systems.
- 08.07 Explain the principles involved, and describe the procedures used, in balancing hydronic systems.
- 08.08 Select, calibrate, and properly use the tools and instruments needed to balance hydronic systems.
- 08.09 Read the pressure across a water system circulating pump.

09.0 Develop an understanding of steam systems--The student will be able to:

- 09.01 Explain the terms and concepts used when working with steam-heating systems.
- 09.02 Identify major components of steam heating systems and explain the purpose of each.
- 09.03 Describe the basic steam-heating cycle.
- 09.04 Safely perform selected operating procedures on low-pressure steam boilers and systems.
- 09.05 Install and maintain selected steam traps.
- 09.06 Identify the common piping configurations used with steam-heating systems.

**Course Number: ACR0044**

**Occupational Completion Point: B**

**A/C, Refrigeration and Heating Technician – 350 Hours – SOC Code 49-9021**

10.0 Determine the properties of air--The student will be able to:

- 10.01 Explain the principles of psychrometrics.
- 10.02 Identify and explain the components and uses of a psychrometric meter.
- 10.03 Identify indoor-air-quality concerns as related to psychrometrics.
- 10.04 Determine the properties of air, using a psychrometric chart.
- 10.05 Follow safety precautions.
- 10.06 Identify and explain the different types and benefits of
  - a. Air-filtration systems
  - b. Air-handling systems
  - c. Ventilation systems

- 10.07 Fabricate, operate, maintain, and troubleshoot
  - a. Air-filtration systems
  - b. Air-handling systems
  - c. Ventilation systems
  
- 11.0 Use a pressure enthalpy chart to diagram refrigerant cycles--The student will be able to:
  - 11.01 Identify all components of the pressure enthalpy chart.
  - 11.02 Define "enthalpy" and "entropy."
  - 11.03 Diagram several refrigerant cycles, using the pressure enthalpy chart.
  
- 12.0 Explain the standards for and ways to measure indoor-air quality--The student will be able to:
  - 12.01 Define indoor-air quality.
  - 12.02 Identify and explain the codes and standards regarding indoor-air quality.
  - 12.03 Select and use indoor-air-quality measuring devices.
  - 12.04 Explain the standards for and ways to measure indoor-air quality, using various methods.
  
- 13.0 Operate environmental control systems as used in commercial heating and air-conditioning systems--The student will be able to:
  - 13.01 Identify and explain the various types of environmental control systems and their sequences of operation as used in commercial heating and air-conditioning systems.
  - 13.02 Maintain, test, and troubleshoot various types of environmental control systems as used in commercial heating and air-conditioning systems.
  
- 14.0 Maintain and troubleshoot pneumatic control systems for commercial heating and air-conditioning applications--The student will be able to:
  - 14.01 Identify pneumatic control systems.
  - 14.02 Demonstrate the ability to maintain and troubleshoot pneumatic control systems.
  
- 15.0 Maintain and repair thermal storage systems--The student will be able to:
  - 15.01 Apply appropriate codes, standards, and safety practices.
  - 15.02 Describe the benefits and limitations of each type.
  - 15.03 Explain the operational principles of a thermal storage system.
  - 15.04 Identify and explain various types of thermal storage systems.
  - 15.05 Maintain, troubleshoot, and test various types of thermal storage systems.
  
- 16.0 Maintain, troubleshoot, and repair commercial heating and air-conditioning systems--The student will be able to:
  - 16.01 Keep a record of the installation, maintenance, and repair of commercial heating and air-conditioning systems.
  - 16.02 Apply local and national codes and safety practices.
  - 16.03 Lay out a commercial heating and air-conditioning system.
  - 16.04 Lay out a typical split commercial air-conditioning system.

- 16.05 Lay out a typical split commercial heating system.
  - 16.06 Maintain, test, analyze, and repair various types of commercial heating and air-conditioning systems.
  - 16.07 Maintain, troubleshoot, and repair water-cooled condensers
- 17.0 Calculate commercial heating and air-conditioning loads--The student will be able to:
- 17.01 Explain conduction as a heat-load source.
  - 17.02 Describe the implications of conducting and the resistance values for different types of construction materials.
  - 17.03 Define "U" value (BTU/hr/ft<sup>2</sup>F).
  - 17.04 Define "K" value (°Fft<sup>2</sup>hr/BTU).
  - 17.05 Define "C" value (°Fft<sup>2</sup>hr/BTU).
  - 17.06 Define "R" value (°Fft<sup>2</sup>hr/BTU).
  - 17.07 Interpret heat-transfer tables ("U," "K," "C," and "R").
  - 17.08 Locate the total heat-transfer value of any surface (R) - (U).
  - 17.09 Explain infiltration and exfiltration/ventilation as a heat-load source.
  - 17.10 Explain a product heat-load source.
  - 17.11 Explain miscellaneous loads (people, motors, and equipment) as heat-load sources.
  - 17.12 Explain the purpose of vapor barriers.
  - 17.13 Interpret tables of specific heat values as applied to commercial heating and air-conditioning systems.
  - 17.14 Calculate and design systems.
  - 17.15 Calculate cooling and heating equipment sizes.
  - 17.16 Design and identify methods of installing air-movement systems.
- 18.0 Install air distribution systems--The student will be able to:
- 18.01 Describe airflow and pressures in a basic forced-air distribution system.
  - 18.02 Explain the differences between propeller and centrifugal fans and blowers.
  - 18.03 Identify the various types of duct systems and explain why and where each type is used.
  - 18.04 Demonstrate or explain the installation of metal, fiberboard, and flexible duct.
  - 18.05 Demonstrate or explain the installation of fittings and transitions used in duct systems.
  - 18.06 Demonstrate or explain the use and installation of diffusers, registers, and grilles used in duct systems.
  - 18.07 Demonstrate or explain the use and installation of dampers used in duct systems.
  - 18.08 Demonstrate or explain the use and installation of insulation and vapor barriers used in duct systems.
  - 18.09 Identify instruments used to make measurements in air systems and explain the use of each instrument.
  - 18.10 Make basic temperature, air pressure, and velocity measurements in an air distribution system.
- 19.0 Evaluate commercial airside systems--The student will be able to:
- 19.01 Identify the differences in various types of commercial all-air systems.

- 19.02 Identify the type of building in which a particular type of system is used.
- 19.03 Explain the typical range of capacities for a commercial air system.
- 20.0 Balance an air distribution system--The student will be able to:
  - 20.01 Explain the gas laws (Dalton, Boyle, and Charles) used when dealing with air and its properties.
  - 20.02 Explain the fan and pump laws.
  - 20.03 Use a psychrometric chart to evaluate air properties and changes in air properties.
  - 20.04 Explain the principles involved in the balancing of air and water distribution systems.
  - 20.05 Define common terms used by manufacturers when describing grilles, registers, and diffusers.
  - 20.06 Identify and use the tools and instruments needed to balance air distribution systems.
  - 20.07 Change the speed of an air distribution system supply fan.
- 21.0 Select energy conservation equipment--The student will be able to:
  - 21.01 Identify and explain the operation of energy conservation equipment.
  - 21.02 Operate selected energy conservation equipment.
- 22.0 Analyze building management systems--The student will be able to:
  - 22.01 Identify the major components of a building management system and describe how they fit together.
  - 22.02 Operate a basic direct digital controller.
- 23.0 Recommend alternative heating and cooling systems for various case studies--The student will be able to:
  - 23.01 Describe alternative technologies for heating such as in-floor, direct-fired makeup unit (DFMU), solar, air turnover, corn or wood pellet burners, waste oil/multi-fuel and fireplace inserts.
  - 23.02 Describe alternative technologies for heating such as ductless systems, computer rooms, chilled beams and multi-zone.