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## Heating, Ventilation & AC

**52.0501**

**Career Cluster: Architecture & Construction**

**Pathway: Construction**

**Last Update: Unknown**

**Title: Heating, Ventilation, Air Conditioning and Refrigeration Engineering  
Technology/Technician**

### Definition:

A program that prepares individuals to apply basic engineering principles and technical skills in support of engineers and other professionals engaged in developing and using air conditioning, refrigeration, ventilation, and heating systems. Includes instruction in principles of heating and cooling technology, design and operational testing, inspection and maintenance procedures, installation and operation procedures, and report preparation.

### DIRECTIONS

Evaluate the student by checking the appropriate box to indicate the degree of Competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

### Rating Scale:

**0 No exposure**

**1 Introduced-** the student has been exposed through non participatory instruction (e.g. lecture, demonstration, field trip, and video).

**2 Practiced-** the student can perform the task with direct supervision.

**3 Entry-Level Competency-** the student can perform the task with limited supervision and/or does not perform the task to standard (a typical entry-level performance expectation).

**4 Competency-** the student consistently performs task to standard with no supervision (on at least two occasions or at instructor's option).

## Basic Construction Skills

- 0 1 2 3 4     A.    Orientation to the Trade
- 0 1 2 3 4     B.    Safety
- 0 1 2 3 4     C.    Math
- 0 1 2 3 4     D.    Hand Tools
- 0 1 2 3 4     E.    Power Tools
- 0 1 2 3 4     F.    Blueprints
- 0 1 2 3 4     G.    Wood Materials and Fastening

## HAVC

- 0 1 2 3        4A.   Trade Mathematics
- 0 1 2 3        4B.   Tools of the Trade
- 0 1 2 3        4C.   Copper and Plastic Piping Practices
- 0 1 2 3        4D.   Soldering and Brazing
- 0 1 2 3        4E.   Ferrous Metal Piping Practices
- 0 1 2 3        4F.   Basic Electricity
- 0 1 2 3        4G.   Introduction to Cooling
- 0 1 2 3        4H.   Introduction to Heating

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## Core Instruction

### BASIC CONSTRUCTION SKILLS

- 0 1 2 3 4      A.      Orientation to the Trade
- A.001 Describe the history of the carpentry trade.
  - A.002 Identify the stages of progress within the carpentry trade.
  - A.003 Identify the responsibilities of a person working in the construction industry.
  - A.004 State the personal characteristics of a professional.
  - A.005 Explain the importance of safety in the construction industry.
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- 0 1 2 3 4      B.      Safety
- B.001 Describe how to avoid job-site accidents.
  - B.002 Explain the relationship between housekeeping and safety.
  - B.003 Appreciate the importance of following all safety rules and company safety policies.
  - B.004 Explain the importance of reporting all on-the-job injuries, accidents, and near misses.
  - B.005 Explain the need for evacuation procedures and the importance of following them.
  - B.006 Explain their employer's substance abuse policy and how it relates to their safety.
  - B.007 Use proper safety practices when welding or working around welding operations.
  - B.008 Use proper safety practices when working in or near trenches and excavations.
  - B.009 Explain the term Proximity Work.
  - B.010 Follow safe practices when working near pressurized or high-temperature systems.
  - B.011 Know and follow the safety requirements for working in confined spaces.
  - B.012 Explain and practice safe lockout-tagout procedures.
  - B.013 Know the different types of barriers and barricades, and where they should be used.
  - B.014 Recognize and explain personal protective equipment uses.
  - B.015 Inspect and care for various types of personal protective equipment.
  - B.016 Follow safe procedures for lifting heavy objects.

- B.017 Inspect and safely work with various types of ladders and scaffolds.
- B.018 Demonstrate an understanding of the OSHA Hazard Communication Standard.
- B.019 Explain the function of Material Safety Data Sheets.
- B.020 Explain the process by which fires start.
- B.021 Practice fire prevention in dealing with various flammable materials.
- B.022 Explain the classes of fires, and the type(s) of extinguishers to use for each.
- B.023 Explain why injuries result when electrical contact occurs.
- B.024 Practice safe work procedures around electrical hazards.
- B.025 Take action if present when an electrical shock occurs.

0 1 2 3 4      C.      Math

- C.001 Add, subtract, multiply, and divide whole numbers, with and without a calculator.
- C.002 Use a standards and metric ruler to measure.
- C.003 Add, subtract, multiply, and divide fractions.
- C.004 Add, subtract, multiply, and divide decimals, with and without a calculator.
- C.005 Convert decimals to percents and percents to decimals.
- C.006 Convert fractions to decimals and decimals to fractions.
- C.007 Explain what the Metric System is and its importance in the construction trade.
- C.008 Recognize and use metric units of length, weight, volume, and temperature.

0 1 2 3 4      D.      Hand Tools

- D.001 Recognize basic hand tools used in the construction trade.
- D.002 Safely use these basic hand tools.
- D.003 Have an awareness of basic maintenance procedures on these hand tools.

0 1 2 3 4      E.      Power Tools

- E.001 Identify commonly used power tools of the construction trade.
- E.002 Recognize safe use of power tools.

- E.003 Explain the procedures to properly maintain these power tools.

0 1 2 3 4 F. Blueprints

- F.001 Identify and recognize basic blueprint terms and symbols.
- F.002 Relate information on prints to real parts and locations.

0 1 2 3 4 G. Wood Materials and Fastening

- G.001 Explain the terms commonly used in discussing wood and lumber.
- G.002 State the uses of various types of hardwoods and softwoods.
- G.003 Identify various types of imperfections that are found in lumber.
- G.004 Explain how lumber is graded.
- G.005 Interpret grade markings on lumber and plywood.
- G.006 Explain how plywood is manufactured, graded, and used.
- G.007 Identify various types of building boards and identify their uses.
- G.008 Identify the uses of and safety precautions associated with pressure-treated lumber.
- G.009 Describe the proper method of caring for lumber and wood building materials at the job site.
- G.010 State the uses of various types of engineered lumber.
- G.011 Calculate the quantities of lumber and wood products using industry-standards methods.
- G.012 List the basic nail and staple types and their uses.
- G.013 List the basic types of screws and their uses.
- G.014 Identify the different types of anchors and their uses.
- G.015 Describe the common types of adhesives used in construction work and explain their uses.

## HVAC

0 1 2 3 4 A. Trade Mathematics

- A. 001 Solve algebraic equations that relate to the HVAC trade.
- A. 002 Calculate volume, weight, pressure, vacuum, and temperature.

- A. 003 Construct simple geometric figures and solve basic geometry problems that relate to the HVAC trade.

0 1 2 3 4      B.      Tools of the Trade

- B. 001 Identify and demonstrate the ability to use the following tools:
  - Pipe wrenches
  - Torque wrenches
  - Tinner's and soft face hammers
  - Hand cutting snips
  - Hand and power hacksaws
  - Drill press
  - Measuring Tools

0 1 2 3 4      C.      Copper and Plastic Piping Practices

- C. 001 State the precautions that must be taken when installing refrigerant piping.
- C. 002 Select the right tubing for a job.
- C. 003 Cut and bend tubing.
- C. 004 Join tubing by using flare and compression fittings.
- C. 005 Determine the kinds of hangers and support needed for refrigerant piping.
- C. 006 Insulate refrigerant piping.
- C. 007 State the basic requirements for pressure-testing a system once it has been installed.
- C. 008 Follow basic safety precautions for the installation, operating and maintenance of refrigerating and air conditioning equipment.

0 1 2 3 4      D.      Soldering and Brazing

- D. 001 Assemble and operate the tools used for soldering.
- D. 002 Prepare tubing and fittings for soldering.
- D. 003 Identify the purposes and use of solder and solder fluxes.
- D. 004 Solder copper tubing and fittings.
- D. 005 Assemble and operate the tools used for brazing.
- D. 006 Prepare tubing and fittings for brazing.
- D. 007 Identify the purposes and use of filler metals and fluxes used for brazing.
- D. 008 Braze copper tubing and fittings.

- D. 009 Identify the inert gases that can safely be used to purge tubing when brazing.

0 1 2 3 4 E. Ferrous Metal Piping Practices

- E. 001 Identify the types of ferrous metal pipes.
- E. 002 Measure the sizes of ferrous metal pipes.
- E. 003 Identify the common malleable iron fittings.
- E. 004 Cut, ream and thread ferrous metal pipe.
- E. 005 Join lengths of threaded pipe together and install fittings.
- E. 006 Describe the main points to consider when installing pipe runs.
- E. 007 Describe the method used to join grooved piping.

0 1 2 3 4 F. Basic Electricity

- F. 001 State how electrical power is generated and distributed.
- F. 002 Describe how voltage, current, resistance, and power are related.
- F. 003 Use Ohm's Law to calculate the current, voltage, and resistance in a circuit.
- F. 004 Use the power formula to calculate how much power is consumed by a circuit.
- F. 005 Describe the differences between series and parallel circuits.
- F. 006 Recognize and describe the purpose and operation of the various electrical components used in HVAC equipment.
- F. 007 State and demonstrate the safety precaution that must be followed when working on electrical equipment.
- F. 008 Make voltage, current, and resistance measurements using electrical test equipment.

0 1 2 3 4 G. Introduction to Cooling

- G. 001 Explain how heat transfer occurs in a cooling system, demonstrating an understanding of the terms and concepts used in the refrigeration cycle.
- G. 002 Calculate the temperature and pressure relationships at key points in the refrigeration cycle.
- G. 003 Under supervision, use temperature and pressure measuring instruments to make readings at key points in the refrigeration cycle.

- G. 004 Identify commonly used refrigerants and demonstrate the procedures for handling these refrigerants.
- G. 005 Recognize the major components of a cooling system and explain how each type works.
- G. 006 Recognize the major accessories available with cooling systems and explain how each type works.
- G. 007 Recognize the control devices used in cooling systems and explain how each type works.
- G. 008 Under supervision, perform basic power-off maintenance procedures applicable to cooling systems.
- G. 009 State the correct methods to be used when piping a refrigeration or cooling system.

0 1 2 3 4

H. Introduction to Heating

- H. 001 Explain the three methods by which heat is transferred and give an example of each.
- H. 002 Describe how combustion occurs and identify the by-products of combustion.
- H. 003 Identify the various types of fuels used in heating.
- H. 004 Recognize the major components and accessories of a forced-air furnace and explain the function of each component.
- H. 005 State the factors that must be considered when installing a furnace.
- H. 006 Identify the major components of a gas furnace and describe how each works.
- H. 007 With supervision, use a manometer to measure and adjust manifold pressure on a gas furnace.
- H. 008 Identify the major components of an oil furnace and describe how each works.
- H. 009 Describe how an electric furnace works.
- H. 010 With supervision, perform basic furnace preventive maintenance procedures such as cleaning and filter replacement.