# Learning Objectives / Competencies

**Craft:**

## HVAC Level One

| Module Number | Obj # | Objectives |
|---|---|---|
| 03101 V5 | 01 | Explain the basic principles of heating, ventilation, air conditioning, and refrigeration. |
| 03101 V5 | 1a | Explain the principles of heating. |
| 03101 V5 | 1b | Explain the principles of ventilation. |
| 03101 V5 | 1c | Explain the principles of air conditioning. |
| 03101 V5 | 1d | Explain the principles of refrigeration. |
| 03101 V5 | 02 | Describe the principles that guide HVACR installation and service techniques. |
| 03101 V5 | 2a | Identify common safety principles and organizations. |
| 03101 V5 | 2b | Describe the importance of LEED construction and energy management. |
| 03101 V5 | 2c | Describe trade licensing and certification requirements. |
| 03101 V5 | 2d | Identify important codes and permits. |
| 03101 V5 | 03 | Identify career paths available in the HVACR trade. |
| 03101 V5 | 3a | Identify the responsibilities and characteristics needed to be a successful HVACR technician. |
| 03101 V5 | 3b | Identify residential, commercial, and industrial career opportunities. |
| 03101 V5 | 3c | Describe opportunities provided by equipment manufacturers. |
| 03102 V5 | 01 | Convert units of measurement from the inch-pound system to the metric system, and vice-versa. |
| 03102 V5 | 1a | Identify units of measure in the inch-pound and metric systems. |
| 03102 V5 | 1b | Convert length, area, and volume values. |
| 03102 V5 | 1c | Convert weight values. |
| 03102 V5 | 1d | Convert pressure and temperature values. |
| 03102 V5 | 02 | Solve basic algebra equations. |
| 03102 V5 | 2a | Define algebraic terms. |
| 03102 V5 | 2b | Demonstrate an understanding of the sequence of operations. |
| 03102 V5 | 2c | Solve basic algebraic equations. |
| 03102 V5 | 03 | Identify and describe geometric figures. |
| 03102 V5 | 3a | Describe the characteristics of a circle. |
| 03102 V5 | 3b | Identify and describe types of angles. |
| 03102 V5 | 3c | Identify and describe types of polygons. |
| 03102 V5 | 3d | Calculate various values associated with triangles. |
| 03106 V5 | 01 | Describe the fundamentals of electricity. |
| 03106 V5 | 1a | State how electrical power is created and distributed. |
| 03106 V5 | 1b | Describe the difference between alternating current and direct current. |
| 03106 V5 | 1c | Identify general electrical safety practices. |
| 03106 V5 | 1d | Describe the OSHA requirements and procedures related to electrical lockout/tagout. |
| 03106 V5 | 02 | Explain basic electrical theory. |
| 03106 V5 | 2a | Define *voltage* , *current* , *resistance* , and *power* and describe how they are related. |
| 03106 V5 | 2b | Use Ohm's law to calculate the current, voltage, and resistance in a circuit. |
| 03106 V5 | 2c | Use the power formula to calculate how much power is consumed by a circuit. |
| 03106 V5 | 2d | Describe the differences between series and parallel circuits and calculate circuit loads for each type. |

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| 03106 V5 | 03 | Identify the electrical measuring instruments used in HVACR work and describe their uses. |
| 03106 V5 | 3a | Describe how voltage is measured. |
| 03106 V5 | 3b | Describe how current is measured. |
| 03106 V5 | 3c | Describe how resistance is measured. |
| 03106 V5 | 04 | Identify electrical components used in HVACR systems and describe their functions. |
| 03106 V5 | 4a | Identify and describe various load devices and explain how they are represented on circuit diagrams. |
| 03106 V5 | 4b | Identify and describe various control devices and explain how they are represented on circuit diagrams. |
| 03106 V5 | 4c | Identify and describe the types of electrical diagrams used in HVACR work. |
| 03108 V5 | 01 | Explain the fundamental concepts of heating and combustion. |
| 03108 V5 | 1a | Describe the heat transfer process. |
| 03108 V5 | 1b | Identify gas fuels and their combustion characteristics. |
| 03108 V5 | 02 | Describe the role of forced-air gas furnaces in residential heating. |
| 03108 V5 | 2a | Describe the types of gas furnaces and how they operate. |
| 03108 V5 | 2b | Identify and describe the equipment and controls used in gas furnaces. |
| 03108 V5 | 2c | Describe the basic installation and maintenance requirements for gas furnaces. |
| 03108 V5 | 03 | Describe hydronic and electric heating systems. |
| 03108 V5 | 3a | Describe the operation of hydronic heating systems. |
| 03108 V5 | 3b | Describe the operation of electric heating equipment. |
| 03107 V5 | 01 | Explain the fundamental concepts of the refrigeration cycle. |
| 03107 V5 | 1a | Describe how heat affects the state of substances. |
| 03107 V5 | 1b | Explain how heat is transferred from one substance to another. |
| 03107 V5 | 1c | Describe pressure-temperature relationships. |
| 03107 V5 | 1d | Describe basic refrigerant flow and the changes of state occurring in the refrigeration cycle. |
| 03107 V5 | 1e | Identify common instruments used to measure pressure and temperature. |
| 03107 V5 | 02 | Identify common refrigerants and their identifying characteristics. |
| 03107 V5 | 2a | Identify fluorocarbon refrigerants. |
| 03107 V5 | 2b | Describe the use of ammonia as a refrigerant. |
| 03107 V5 | 2c | Identify various refrigerant containers and their safe handling requirements. |
| 03107 V5 | 03 | Identify the major components of cooling systems and how they function. |
| 03107 V5 | 3a | Identify various types of compressors. |
| 03107 V5 | 3b | Identify different types of condensers. |
| 03107 V5 | 3c | Identify different types of evaporators. |
| 03107 V5 | 3d | Describe the devices used to meter refrigerant flow. |
| 03107 V5 | 3e | Discuss basic refrigerant piping concepts. |
| 03107 V5 | 3f | Identify various accessories used in refrigerant circuits. |
| 03107 V5 | 04 | Identify the common controls used in cooling systems and how they function. |
| 03107 V5 | 4a | Identify common primary controls. |

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| 03107 V5 | 4b | Identify common secondary controls. |
| 03109 V5 | 01 | Describe the factors related to air movement and its measurement in air distribution systems. |
| 03109 V5 | 1a | Describe how pressure, velocity, and volume are interrelated in air flow. |
| 03109 V5 | 1b | Describe air distribution in a typical residential system. |
| 03109 V5 | 1c | Identify common air measurement instruments. |
| 03109 V5 | 02 | Describe the mechanical equipment and materials used to create air distribution systems. |
| 03109 V5 | 2a | Describe various blower types and applications. |
| 03109 V5 | 2b | Describe various fan designs and applications. |
| 03109 V5 | 2c | Demonstrate an understanding of the fan laws. |
| 03109 V5 | 2d | Describe common duct materials and fittings. |
| 03109 V5 | 2e | Identify the characteristics of common grilles, registers, and dampers. |
| 03109 V5 | 03 | Identify the different approaches to air distribution system design and energy conservation. |
| 03109 V5 | 3a | Identify various air distribution system layouts. |
| 03109 V5 | 3b | Describe heating and cooling air movement resulting from various air distribution system designs. |
| 03109 V5 | 3c | Explain how to maximize energy efficiency through the proper sealing and testing of air distribution systems. |
| 03103 V5 | 01 | Recognize and identify different types of copper tubing and their related fittings. |
| 03103 V5 | 1a | Describe and identify copper tubing characteristics. |
| 03103 V5 | 1b | Identify various copper fittings. |
| 03103 V5 | 02 | Describe and demonstrate how to join copper tubing mechanically. |
| 03103 V5 | 2a | Measure, cut, and bend copper tubing to prepare it for joining. |
| 03103 V5 | 2b | Describe and demonstrate the methods and tools used to join copper tubing. |
| 03103 V5 | 2c | Describe common hangers and supports associated with copper tubing installations. |
| 03103 V5 | 03 | Recognize different types of plastic piping and show how it can be joined. |
| 03103 V5 | 3a | Identify different types of plastic piping. |
| 03103 V5 | 3b | Identify the tools and products needed and demonstrate how to join plastic piping. |
| 03104 V5 | 01 | Describe and demonstrate the safe process of soldering copper tubing. |
| 03104 V5 | 1a | Describe and demonstrate the use of the PPE, tools, and materials needed to solder copper tubing. |
| 03104 V5 | 1b | Describe and demonstrate the preparation required for soldering. |
| 03104 V5 | 1c | Describe and demonstrate the soldering process. |
| 03104 V5 | 02 | Describe and demonstrate the safe process of brazing copper tubing. |
| 03104 V5 | 2a | Describe and demonstrate the use of the PPE, tools, and materials needed to braze copper tubing. |
| 03104 V5 | 2b | Describe and demonstrate the preparation used for brazing. |
| 03104 V5 | 2c | Describe and demonstrate the brazing process. |

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|---|---|---|
| 03104 V5 | 2d | Describe and demonstrate the process of brazing copper tubing to dissimilar metals. |
| 03105 V5 | 01 | Describe and identify the various types of steel pipe and fittings. |
| 03105 V5 | 1a | Identify the characteristics and uses of steel pipe. |
| 03105 V5 | 1b | Describe how pipe threads are classified and measured. |
| 03105 V5 | 1c | Identify the various types of fittings used on steel pipe and describe how they are used. |
| 03105 V5 | 1d | Describe how to properly measure lengths of steel pipe. |
| 03105 V5 | 02 | Describe the tools and methods used to cut and thread steel pipe. |
| 03105 V5 | 2a | Identify pipe cutting and reaming tools and describe how they are used. |
| 03105 V5 | 2b | Identify threading tools and describe how they are used. |
| 03105 V5 | 03 | Explain and demonstrate the methods of installing and mechanically joining steel pipe. |
| 03105 V5 | 3a | Explain and demonstrate the methods and use of the tools to connect threaded pipe. |
| 03105 V5 | 3b | Explain and demonstrate an understanding of pipe grooving methods. |
| 03105 V5 | 3c | Describe how to assemble flanged steel pipe. |
| 03105 V5 | 3d | Describe how to correctly install steel pipe. |

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| Module Number | Obj # | Objective |
|---|---|---|
| 03206 V5 | 01 | Explain how AC power is generated and how it is used. |
| 03206 V5 | 1a | Explain the basic concepts of power generation. |
| 03206 V5 | 1b | Describe a sine wave and how it is created. |
| 03206 V5 | 1c | Explain the concept of AC power frequency. |
| 03206 V5 | 1d | Explain how single- and three-phase power is provided for practical use. |
| 03206 V5 | 1e | Identify resistive and inductive circuits. |
| 03206 V5 | 02 | Explain how transformers operate and identify various types of transformers used in HVAC systems. |
| 03206 V5 | 2a | Explain how transformers operate. |
| 03206 V5 | 2b | Identify various forms of single-phase and three-phase transformers. |
| 03206 V5 | 03 | Explain the various types of induction motors and explain how they operate. |
| 03206 V5 | 3a | Describe how single-phase motors operate. |
| 03206 V5 | 3b | Describe single-phase motor starting circuits. |
| 03206 V5 | 3c | Identify the physical and operating characteristics of three-phase motors. |
| 03206 V5 | 04 | Explain how to safely test various AC-powered devices. |
| 03206 V5 | 4a | Identify electrical test instruments and methods used to test motors. |
| 03206 V5 | 4b | Explain how to use a capacitor tester. |
| 03206 V5 | 4c | Identify basic electrical safety rules and guidelines for safely testing AC components. |
| 03302 V5 | 01 | Identify and describe the operation of various compressor types. |
| 03302 V5 | 1a | Identify and describe the operation of various hermetic and semi-hermetic compressors. |
| 03302 V5 | 1b | Identify and describe the operation of reciprocating compressors. |
| 03302 V5 | 1c | Identify and describe the operation of rotary compressors. |
| 03302 V5 | 1d | Identify and describe the operation of scroll compressors. |
| 03302 V5 | 1e | Identify and describe the operation of screw compressors. |
| 03302 V5 | 1f | Identify and describe the operation of centrifugal compressors. |
| 03302 V5 | 02 | Identify and describe various approaches to compressor capacity control. |
| 03302 V5 | 2a | Identify and describe capacity control methods for reciprocating and scroll compressors. |
| 03302 V5 | 2b | Identify and describe capacity control methods for screw and centrifugal compressors. |
| 03302 V5 | 03 | Describe the common causes of compressor failures. |
| 03302 V5 | 3a | Describe compressor failures related to the refrigerant circuit. |
| 03302 V5 | 3b | Describe compressor failures related to electrical issues. |
| 03302 V5 | 04 | Identify and explain the operation of various compressor protection devices. |
| 03302 V5 | 4a | Identify and explain the operation of various overload devices. |
| 03302 V5 | 4b | Identify and explain the operation of other compressor protection devices. |
| 03302 V5 | 05 | Explain how to analyze the operation of a hermetic compressor. |
| 03302 V5 | 5a | Explain how to evaluate the mechanical operation of an operable compressor. |
| 03302 V5 | 5b | Explain how to evaluate the electrical operation of an operable compressor. |
| 03301 V5 | 01 | Describe the desirable characteristics of refrigerants and the various applications that require these chara |
| 03301 V5 | 1a | Describe the desirable characteristics of refrigerants. |
| 03301 V5 | 1b | Identify various applications that require specific refrigerant characteristics. |
| 03301 V5 | 02 | Identify various refrigerant classifications and describe their environmental impact. |
| 03301 V5 | 2a | Identify the primary chemical classifications of common characteristics. |
| 03301 V5 | 2b | Describe the environmental concerns associated with refrigerants. |
| 03301 V5 | 2c | Identify and describe compounded and blended azeotropic, near-azeotropic, and zeotropic refrigerants. |
| 03301 V5 | 2d | Identify various refrigerant classifications and cylinder colors. |
| 03301 V5 | 03 | Explain how to use pressure-temperature (PT) charts to calculate superheat and subcooling. |
| 03301 V5 | 3a | Explain how to use PT charts for compound, azeotropic, and near-azeotropic refrigerants. |
| 03301 V5 | 3b | Explain how to use PT charts for zeotropic refrigerants. |

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| Module Number | Obj # | Objective |
|---|---|---|
| 03301 V5 | 04 | Identify and describe lubricating oils and issues related to their function. |
| 03301 V5 | 4a | Identify the important characteristics of refrigerant oils. |
| 03301 V5 | 4b | Compare mineral-based and synthetic oils. |
| 03301 V5 | 4c | Describe the movement of oil through the refrigerant circuit. |
| 03301 V5 | 4d | Describe oil contamination and its sources. |
| 03301 V5 | 4e | Describe common practices associated with handling, charging, and removing oils. |
| 03301 V5 | 05 | Describe considerations related to refrigerant conversions. |
| 03301 V5 | 5a | Identify issues of concern in all refrigerant conversions. |
| 03301 V5 | 5b | Describe common practices related to refrigerant conversions. |
| 03205 V5 | 01 | Describe the equipment and approaches used to leak-test refrigerant circuits. |
| 03205 V5 | 1a | Describe the various methods used to detect refrigerant leaks. |
| 03205 V5 | 1b | Describe how leak detection is approached based on the current refrigerant charge in the system. |
| 03205 V5 | 02 | Describe refrigerant containment and management requirements and the equipment used to recover refri |
| 03205 V5 | 2a | Identify the basic refrigerant containment requirements of Section 608 of the Clean Air Act. |
| 03205 V5 | 2b | Identify and explain how to operate refrigerant recovery and recycling equipment. |
| 03205 V5 | 03 | Explain the related principles and identify the equipment used to evacuate refrigerant circuits. |
| 03205 V5 | 3a | Explain the basic principles of refrigerant-circuit evacuation. |
| 03205 V5 | 3b | Identify and explain how to operate vacuum pumps to evacuate a system. |
| 03205 V5 | 04 | Describe the procedures for charging refrigerant circuits. |
| 03205 V5 | 4a | Identify and describe the equipment and components related to refrigerant charging. |
| 03205 V5 | 4b | Explain how to properly charge various types of refrigerants using the appropriate method. |
| 03303 V5 | 01 | Explain the function of refrigerant metering devices and their effect on refrigerants. |
| 03303 V5 | 1a | Explain the function of metering devices. |
| 03303 V5 | 1b | Describe how refrigerants react as they pass through a metering device. |
| 03303 V5 | 1c | Identify distributors and explain their relationship to metering device performance and operation. |
| 03303 V5 | 02 | Identify fixed metering devices and explain how they function. |
| 03303 V5 | 2a | Identify and explain how fixed-orifice metering devices function. |
| 03303 V5 | 2b | Identify and explain how capillary tubes function. |
| 03303 V5 | 2c | Describe common problems associated with fixed metering devices. |
| 03303 V5 | 03 | Identify types of expansion valves and explain how they operate. |
| 03303 V5 | 3a | Identify and explain the operation of manual expansion valves. |
| 03303 V5 | 3b | Identify and explain the operation of automatic expansion valves. |
| 03303 V5 | 3c | Identify and explain the operation of thermal expansion valves. |
| 03303 V5 | 3d | Identify and explain the operation of electric and electronically controlled expansion valves. |
| 03303 V5 | 3e | Describe common problems associated with all types of expansion valves. |
| 03303 V5 | 04 | Explain how thermal expansion valves are selected and installed. |
| 03303 V5 | 4a | Explain how thermal expansion valves are selected for a given application. |
| 03303 V5 | 4b | Describe the installation practices and considerations related to thermal expansion valves. |
| 03211 V5 | 01 | Explain heat pump operating principles and their related performance ratings. |
| 03211 V5 | 1a | Explain how heat pumps can extract heat from air and water. |
| 03211 V5 | 1b | Describe the Coefficient of Performance (COP) and how it is determined. |
| 03211 V5 | 1c | Describe the Heating Seasonal Performance Factor (HSPF) and how it is determined. |
| 03211 V5 | 1d | Describe the Seasonal Energy Efficiency Ratio (SEER) and how it is determined. |
| 03211 V5 | 02 | Describe the operation of heat pump systems. |
| 03211 V5 | 2a | Describe the refrigeration cycle of heat pumps. |
| 03211 V5 | 2b | Identify the various types of heat pump systems. |
| 03211 V5 | 2c | Describe the basic control strategies for heat pumps and defrost cycles. |

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|---|---|---|
| 03211 V5 | 2d | Identify unit components that are important to heat pump operation. |
| 03211 V5 | 2e | Describe sources of supplemental and/or emergency heat used in heat pump systems. |
| 03211 V5 | 03 | Identify common installation practices associated with heat pumps. |
| 03211 V5 | 3a | Identify installation practices associated with split systems. |
| 03211 V5 | 3b | Identify installation practices associated with packaged systems. |
| 03211 V5 | 04 | Describe the operation of electric heating equipment commonly used with heat pumps. |
| 03211 V5 | 4a | Explain how electric heating equipment operates. |
| 03211 V5 | 4b | Identify the major components of an electric heater. |
| 03215 V5 | 01 | Identify and describe common gaskets, packing materials, seals, and bearings. |
| 03215 V5 | 1a | Identify and describe common gasket and packing materials. |
| 03215 V5 | 1b | Identify and describe common types of seals. |
| 03215 V5 | 1c | Identify and describe common types of bearings. |
| 03215 V5 | 02 | Describe the properties of common lubricants and how they are applied. |
| 03215 V5 | 2a | Describe the properties of common lubricants. |
| 03215 V5 | 2b | Explain the importance of selecting the proper lubricants and how to apply them. |
| 03215 V5 | 03 | Identify different types of drive belts and describe how they are installed and adjusted. |
| 03215 V5 | 3a | Identify various types of drive belts. |
| 03215 V5 | 3b | Explain how to install and adjust drive belts. |
| 03215 V5 | 04 | Describe the inspection and/or maintenance requirements for selected equipment. |
| 03215 V5 | 4a | Identify common environmental health hazards associated with HVACR maintenance activities. |
| 03215 V5 | 4b | Describe common inspection and maintenance procedures for gas heating equipment. |
| 03215 V5 | 4c | Describe common inspection and maintenance procedures for DX cooling and heat pump systems. |
| 03215 V5 | 4d | Describe common inspection and maintenance procedures for various system accessories. |
| 03215 V5 | 4e | Describe how to complete common HVACR service reports. |
| 03202 V5 | 01 | Describe the principles of combustion. |
| 03202 V5 | 1a | Describe the requirements for combustion and flame characteristics. |
| 03202 V5 | 1b | Distinguish between complete and incomplete combustion. |
| 03202 V5 | 1c | Describe the contents of flue gases and related concerns. |
| 03202 V5 | 02 | Identify the basic requirements and components of a furnace venting system. |
| 03202 V5 | 2a | Explain the basic principles of combustion ventilation. |
| 03202 V5 | 2b | Identify vented appliance categories. |
| 03202 V5 | 2c | Describe the construction of various venting systems. |
| 03202 V5 | 03 | Describe the basic venting considerations for various gas-fired heating units. |
| 03202 V5 | 3a | Describe the venting considerations for natural-draft furnaces. |
| 03202 V5 | 3b | Describe the venting considerations for induced-draft furnaces. |
| 03202 V5 | 3c | Describe the venting considerations for condensing furnaces. |
| 03213 V5 | 01 | Identify and describe the common types of sheet metal. |
| 03213 V5 | 1a | Identify various types of steel sheet metals. |
| 03213 V5 | 1b | Identify various types of alloy sheet metals. |
| 03213 V5 | 02 | Identify various methods of joining sheet metal. |
| 03213 V5 | 2a | Identify various types of duct seams. |
| 03213 V5 | 2b | Identify various methods of duct component connection. |
| 03213 V5 | 03 | Describe the methods used to suspend and support sheet metal duct. |
| 03213 V5 | 3a | Describe methods used to suspend sheet metal duct. |
| 03213 V5 | 3b | Describe methods used to support sheet metal duct. |
| 03213 V5 | 04 | Describe methods used to insulate and attenuate sheet metal duct. |
| 03213 V5 | 4a | Describe the selection and installation of duct lining products. |

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| 03213 V5 | 4b | Describe the selection and installation of external duct wraps. |
| 03213 V5 | 05 | Identify various sheet metal duct accessories and describe their installation. |
| 03213 V5 | 5a | Identify and describe the installation of various types of dampers. |
| 03213 V5 | 5b | Identify and describe the installation of duct takeoffs and access doors. |
| 03213 V5 | 06 | Identify different types of flexible duct and explain how it is installed. |
| 03213 V5 | 6a | Identify different types of flexible duct. |
| 03213 V5 | 6b | Explain how flexible duct is connected and supported. |
| 03214 V5 | 01 | Describe the standards and application considerations related to fiberglass duct. |
| 03214 V5 | 1a | Identify the standards related to fiberglass duct. |
| 03214 V5 | 1b | Identify application considerations related to fiberglass duct. |
| 03214 V5 | 02 | Describe the methods used to fabricate and repair fiberglass duct. |
| 03214 V5 | 2a | Describe how to close and join fiberglass duct using various methods. |
| 03214 V5 | 2b | Describe how to repair both minor and major fiberglass duct damage. |
| 03214 V5 | 03 | Describe the methods used to suspend and support fiberglass duct systems. |
| 03214 V5 | 3a | Describe methods used to suspend and support fiberglass duct. |
| 03214 V5 | 3b | Describe methods used to suspend and support fiberglass duct fittings and risers. |
| 03214 V5 | 04 | Describe fabric-based air distribution products and their installation methods. |
| 03214 V5 | 4a | Identify various types and designs of fabric-based air distribution products. |
| 03214 V5 | 4b | Describe the various methods of installing and suspending fabric-based air distribution products. |
| 03201 V5 | 01 | Describe basic commercial airside systems and their operating characteristics. |
| 03201 V5 | 1a | Describe the typical operating characteristics of a commercial airside system. |
| 03201 V5 | 1b | Describe the purpose and function of ventilation and exhaust systems. |
| 03201 V5 | 02 | Describe various approaches used in commercial air distribution. |
| 03201 V5 | 2a | Describe single-zone constant volume system operation. |
| 03201 V5 | 2b | Describe multi-zone constant volume system operation. |
| 03201 V5 | 2c | Describe variable volume, variable temperature (VVT) system operation. |
| 03201 V5 | 2d | Describe variable air volume (VAV) system operation. |
| 03201 V5 | 03 | Describe common air terminal operation and related air delivery devices. |
| 03201 V5 | 3a | Explain the basic operation of VVT and single-duct VAV terminal devices. |
| 03201 V5 | 3b | Explain the basic operation of fan-powered VAV terminals. |
| 03201 V5 | 3c | Identify various styles of commercial grilles and registers. |
| 03201 V5 | 04 | Identify the characteristics and components of various airflow sources. |
| 03201 V5 | 4a | Describe the various forms and components of packaged systems. |
| 03201 V5 | 4b | Describe the various forms and components of air handling units. |
| 03201 V5 | 4c | Describe the purpose and function of economizers. |
| 03201 V5 | 4d | Describe common accessories used with commercial airside systems. |
| 03204 V5 | 01 | Explain the importance of indoor air quality and the factors to be controlled. |
| 03204 V5 | 1a | Identify the factors related to the quality of indoor air. |
| 03204 V5 | 1b | Describe the elements of human comfort and their relationship to air properties. |
| 03204 V5 | 02 | Describe the processes and equipment used to control humidity levels. |
| 03204 V5 | 2a | Explain the relationship between air and moisture content. |
| 03204 V5 | 2b | Describe the processes and equipment used to humidify and dehumidify air. |
| 03204 V5 | 03 | Describe the equipment and devices used to control air cleanliness. |
| 03204 V5 | 3a | Identify the various types of media-based air filters. |
| 03204 V5 | 3b | Describe the operation of non-media based air filtration and purification equipment. |
| 03204 V5 | 04 | Identify the equipment used to provide and control the introduction of fresh air into buildings. |
| 03204 V5 | 4a | Explain how dampers and economizers are used to control the introduction of fresh air. |

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|---|---|---|
| 03204 V5 | 4b | Describe the function and operation of energy and heat recovery ventilation systems. |
| 03203 V5 | 01 | Describe hydronic systems and the principles of closed-system water flow. |
| 03203 V5 | 1a | Describe the basic properties of water and the significance of its contents. |
| 03203 V5 | 1b | Describe the relationship between water flow and system pressures. |
| 03203 V5 | 02 | Describe the primary types of hot-water heating systems and their components. |
| 03203 V5 | 2a | Identify gravity and forced hydronic systems. |
| 03203 V5 | 2b | Describe the different types of boilers used. |
| 03203 V5 | 2c | Identify primary boiler components. |
| 03203 V5 | 2d | Identify common components related to air and water control. |
| 03203 V5 | 03 | Identify various hot-water heating piping systems and the terminal devices used. |
| 03203 V5 | 3a | Describe the characteristics of one- and two-pipe systems. |
| 03203 V5 | 3b | Describe the function of hot-water zoning systems. |
| 03203 V5 | 3c | Identify various hot-water heating system terminal devices. |
| 03203 V5 | 04 | Describe the methods and devices used to select pumps and balance water flow in hydronic systems. |
| 03203 V5 | 4a | Identify the devices used to measure and control water flow in hydronic systems. |
| 03203 V5 | 4b | Describe how circulating pumps are selected based on required flow rates. |
| 03203 V5 | 4c | Explain how to measure pump pressures and system flow rates in an operating system. |

# Learning Objectives / Competencies

**Craft:**

## HVAC Level Three

| Module Number | Obj # | Objective |
|---|---|---|
| 03313 V5 | 01 | Identify the types, uses, and installation methods of fasteners. |
| 03313 V5 | 1a | Identify various types and the uses of threaded fasteners. |
| 03313 V5 | 1b | Identify and explain how to use taps, dies, and screw extractors. |
| 03313 V5 | 1c | Explain how to install and torque fasteners to a specific value. |
| 03313 V5 | 1d | Identify and explain how to install various types of toggle and anchor bolts. |
| 03313 V5 | 1e | Identify various types of non-threaded fasteners. |
| 03313 V5 | 02 | Identify and describe the installation of various types of vibration isolators. |
| 03313 V5 | 2a | Identify and describe vibration isolators used to support and suspend equipment and piping. |
| 03313 V5 | 2b | Identify and describe methods used to restrain equipment during seismic events. |
| 03313 V5 | 2c | Explain how to select and install various vibration isolators. |
| 03313 V5 | 03 | Identify common low- and line-voltage electrical termination hardware and explain how to properly terminate wiring connections. |
| 03313 V5 | 3a | Identify common low- and line-voltage electrical terminating hardware. |
| 03313 V5 | 3b | Explain how to properly terminate low- and line-voltage wiring connections. |
| 03314 V5 | 01 | Identify and describe the operation of common HVACR control circuit devices. |
| 03314 V5 | 1a | Identify and describe the operation of relays, contactors, and motor starters. |
| 03314 V5 | 1b | Identify and describe the operation of other common safety and control circuit devices. |
| 03314 V5 | 02 | Describe the operation, installation, and testing of various thermostats and temperature controls. |
| 03314 V5 | 2a | Describe the operation of various thermostats and temperature controls. |
| 03314 V5 | 2b | Identify and describe how to troubleshoot thermistors. |
| 03314 V5 | 2c | Explain how to install and wire thermostats. |
| 03314 V5 | 2d | Explain how to troubleshoot the functions of a thermostat. |
| 03314 V5 | 03 | Explain how to troubleshoot common control circuits and load components. |
| 03314 V5 | 3a | Identify basic safety practices related to troubleshooting HVACR power and control circuits. |
| 03314 V5 | 3b | Describe the operating sequence of simple heating and cooling systems. |
| 03314 V5 | 3c | Explain how to approach HVACR problems and prepare for troubleshooting. |
| 03314 V5 | 3d | Explain how to test line-voltage power sources. |
| 03314 V5 | 3e | Explain how to troubleshoot control circuits and low-voltage power sources. |
| 03314 V5 | 3f | Explain how to troubleshoot both resistive and inductive loads. |
| 03314 V5 | 3g | Explain how to troubleshoot various hydronic control-system components. |
| 03314 V5 | 04 | Describe the operation of variable frequency drives (VFD) and their selection considerations. |
| 03314 V5 | 4a | Describe the operation of a VFD. |
| 03314 V5 | 4b | Identify VFD parameters that can be programmed. |
| 03314 V5 | 4c | Describe the important considerations for the selection of a VFD. |
| 03314 V5 | 4d | Explain dynamic motor braking processes. |
| 03314 V5 | 05 | Identify and describe how to service electronically commutated motors (ECMs). |
| 03314 V5 | 5a | Identify and describe the operation of ECMs. |

# Learning Objectives / Competencies

**Craft:**

## HVAC Level Three

| Module Number | Obj # | Objective |
|---|---|---|
| 03314 V5 | 5b | Describe how to install and set-up an ECM. |
| 03314 V5 | 5c | Describe how to troubleshoot an ECM. |
| 03210 V5 | 01 | Describe the operation of the refrigeration cycle and identify problems that can occur. |
| 03210 V5 | 1a | Identify the primary components of the refrigeration circuit and explain their individual function. |
| 03210 V5 | 1b | Describe the typical refrigeration cycle. |
| 03210 V5 | 1c | Explain how to analyze refrigeration-circuit operating conditions. |
| 03210 V5 | 1d | Identify possible causes for specific abnormal pressures and temperatures. |
| 03210 V5 | 1e | Explain how condenser and evaporator airflow affects the refrigeration cycle. |
| 03210 V5 | 1f | Identify and describe problems related to fixed metering devices. |
| 03210 V5 | 1g | Identify and describe problems related to TXVs and distributors. |
| 03210 V5 | 1h | Identify and describe other problems related to the refrigerant circuit. |
| 03210 V5 | 02 | Explain how to troubleshoot and replace a compressor. |
| 03210 V5 | 2a | Identify common problems that can lead to compressor failure. |
| 03210 V5 | 2b | Explain how to troubleshoot compressor mechanical problems. |
| 03210 V5 | 2c | Explain how to replace a hermetic compressor. |
| 03210 V5 | 2d | Describe the additional steps that may be required to replace a compressor following an electrical failure. |
| 03311 V5 | 01 | Compare heat pumps to standard cooling systems and describe their operating cycles. |
| 03311 V5 | 1a | Compare heat pump systems to standard cooling systems and identify the different types. |
| 03311 V5 | 1b | Describe the three operating cycles of common heat pumps. |
| 03311 V5 | 02 | Describe the sequence of operation for the common operating modes. |
| 03311 V5 | 2a | Describe the sequence of operation for the cooling mode. |
| 03311 V5 | 2b | Describe the sequence of operation for the three heating modes. |
| 03311 V5 | 2c | Describe the sequence of operation for the defrost mode. |
| 03311 V5 | 2d | Describe the sequence of operation of dual-fuel systems. |
| 03311 V5 | 2e | Describe the use of microprocessor controls in heat pump systems. |
| 03311 V5 | 03 | Explain how to check and/or troubleshoot various functions and components of heat pump systems. |
| 03311 V5 | 3a | Explain how to check field and factory wiring. |
| 03311 V5 | 3b | Explain how to check and troubleshoot heat pump thermostats. |
| 03311 V5 | 3c | Explain how to test thermistors. |
| 03311 V5 | 3d | Explain how to check the various valves found in heat pumps. |
| 03311 V5 | 3e | Explain how to check defrost control circuits. |
| 03209 V5 | 01 | Describe how to troubleshoot the components related to gas heating. |
| 03209 V5 | 1a | Describe the control circuits and typical sequence of operation of various gas heating units. |
| 03209 V5 | 1b | Describe the operation and troubleshooting process for ignition devices. |
| 03209 V5 | 1c | Describe the operation and troubleshooting process for flame sensors. |

# Learning Objectives / Competencies

**Craft:**

## HVAC Level Three

| Module Number | Obj # | Objective |
|---|---|---|
| 03209 V5 | 1d | Identify common problems associated with system airflow. |
| 03209 V5 | 02 | Identify infrared gas heaters and describe how they operate. |
| 03209 V5 | 2a | Identify various types of infrared gas heaters. |
| 03209 V5 | 2b | Describe the operating characteristics of infrared gas heaters. |
| 03209 V5 | 03 | Explain how to conduct a combustion analysis on a gas furnace. |
| 03209 V5 | 3a | Identify combustion analysis equipment and the combustion byproducts that are of importance to the analysis. |
| 03209 V5 | 3b | Describe the combustion analysis process and how to interpret basic results. |
| 03310 V5 | 01 | Identify the primary components of an oil-fired furnace and explain its operation. |
| 03310 V5 | 1a | Describe a basic oil-fired heating system. |
| 03310 V5 | 1b | Describe the primary components and operation of a pressure-type oil burner. |
| 03310 V5 | 1c | Describe the safety controls used on oil furnaces. |
| 03310 V5 | 1d | Describe the fuel supply system used with oil furnaces. |
| 03310 V5 | 02 | Describe how to perform periodic servicing of a typical oil-fired heating system. |
| 03310 V5 | 2a | Describe the basic servicing procedures performed on an oil-fired system. |
| 03310 V5 | 2b | Describe how to perform a combustion efficiency test. |
| 03310 V5 | 03 | Describe how to troubleshoot a typical oil-fired heating system. |
| 03310 V5 | 3a | Describe troubleshooting procedures for typical oil furnace controls. |
| 03310 V5 | 3b | Describe troubleshooting procedures for common oil heating problems. |
| 03312 V5 | 01 | Describe how to troubleshoot various HVAC system accessories. |
| 03312 V5 | 1a | Describe how to approach the troubleshooting process. |
| 03312 V5 | 1b | Describe how to troubleshoot humidifiers. |
| 03312 V5 | 1c | Describe how to troubleshoot electronic air cleaners. |
| 03312 V5 | 1d | Describe how to troubleshoot UV lighting devices. |
| 03312 V5 | 02 | Describe how to troubleshoot accessories related to the introduction of outside air. |
| 03312 V5 | 2a | Describe how to troubleshoot economizers. |
| 03312 V5 | 2b | Describe how to troubleshoot recovery ventilators. |
| 03315 V5 | 01 | Identify common zoning systems and describe the basic approach to troubleshooting. |
| 03315 V5 | 1a | Describe common zoning system components. |
| 03315 V5 | 1b | Describe the sequence of operation for common zoning systems. |
| 03315 V5 | 1c | Describe the basic approach to troubleshooting zoning systems. |
| 03315 V5 | 1d | Describe common VVT-system zoning components. |
| 03315 V5 | 1e | Describe the operating characteristics of VVT control systems. |
| 03315 V5 | 02 | Identify ductless and variable refrigerant flow systems and describe the basic approach to troubleshooting. |
| 03315 V5 | 2a | Identify and describe the operation of ductless split-system equipment. |
| 03315 V5 | 2b | Describe the installation and troubleshooting of typical ductless systems. |
| 03315 V5 | 2c | Identify and describe the operation of variable refrigerant flow systems. |
| 03315 V5 | 2d | Describe the installation and troubleshooting of variable refrigerant flow systems. |
| 03305 V5 | 01 | Describe basic concepts related to water as a substance and its movement. |

# Learning Objectives / Competencies

**Craft:**

## HVAC Level Three

| Module Number | Obj # | Objective |
|---|---|---|
| 03305 V5 | 1a | Describe the basic properties of water and water pressure. |
| 03305 V5 | 1b | Explain how pressure drop, head pressure, and static pressure are related to hydronics. |
| 03305 V5 | 02 | Describe various commercial hot-water heating system components and subsystems. |
| 03305 V5 | 2a | Identify various types of hot-water boilers and their common controls. |
| 03305 V5 | 2b | Describe the construction of common centrifugal pumps. |
| 03305 V5 | 2c | Identify various types of valves and other commercial hydronic system components. |
| 03305 V5 | 2d | Identify common commercial piping systems and their characteristics. |
| 03305 V5 | 2e | Describe how a typical hydronic piping system is balanced. |
| 03305 V5 | 03 | Explain the basic concepts of chilled-water systems and the related components. |
| 03305 V5 | 3a | Explain the basic concepts of chilled-water cooling systems. |
| 03305 V5 | 3b | Identify various types of chillers and their common controls. |
| 03305 V5 | 3c | Identify various types of cooling towers and evaporative condensers. |
| 03306 V5 | 01 | Describe the properties of water as they are related to steam systems. |
| 03306 V5 | 1a | Describe the basic properties of water. |
| 03306 V5 | 1b | Describe the pressure-temperature relationship of water. |
| 03306 V5 | 02 | Describe the basic steam cycle and the primary components related to its operation. |
| 03306 V5 | 2a | Describe the steam cycle principles of operation. |
| 03306 V5 | 2b | Identify steam boilers and their common accessories. |
| 03306 V5 | 2c | Identify common steam heat exchangers and terminal devices. |
| 03306 V5 | 03 | Identify common steam system piping arrangements and valves. |
| 03306 V5 | 3a | Identify common steam system piping arrangements. |
| 03306 V5 | 3b | Identify common condensate return systems and describe waterside care. |
| 03306 V5 | 3c | Explain how steam and condensate system piping is sized. |
| 03306 V5 | 3d | Identify steam-based pressure-reducing and thermostatic control valves. |
| 03306 V5 | 04 | Identify, install, and maintain various types of steam traps. |
| 03306 V5 | 4a | Identify various types of steam traps. |
| 03306 V5 | 4b | Explain the basic concepts of installing steam traps. |
| 03306 V5 | 4c | Explain how to maintain various steam traps. |
| 03306 V5 | 4d | Explain how to troubleshoot various steam traps. |
| 03304 V5 | 01 | Describe retail refrigeration applications and the related refrigeration cycle. |
| 03304 V5 | 1a | Describe the refrigeration cycle for medium-temperature systems. |
| 03304 V5 | 1b | Describe the refrigeration cycle for low-temperature systems. |
| 03304 V5 | 1c | Describe various approaches to defrosting. |
| 03304 V5 | 02 | Identify various types of refrigeration equipment and their application in retail refrigeration. |
| 03304 V5 | 2a | Identify and describe reach-in coolers and freezers. |
| 03304 V5 | 2b | Identify and describe various walk-ins and merchandisers. |

# Learning Objectives / Competencies

**Craft:**

## HVAC Level Three

| Module Number | Obj # | Objective |
|---|---|---|
| 03304 V5 | 2c | Identify various types of commercial ice machines and their applications. |
| 03304 V5 | 03 | Identify and describe components related to the operation of retail refrigeration systems. |
| 03304 V5 | 3a | Identify and describe the primary components used in retail refrigeration applications. |
| 03304 V5 | 3b | Identify and describe secondary components and accessories used in retail refrigeration applications. |
| 03304 V5 | 3c | Identify and describe common refrigeration system controls. |
| 03304 V5 | 04 | Explain the basic principles of maintaining and troubleshooting various retail refrigeration systems. |
| 03304 V5 | 4a | Explain how to maintain and troubleshoot a typical reach-in freezer. |
| 03304 V5 | 4b | Explain how to maintain and troubleshoot a typical cubed-ice machine. |
| 03316 V5 | 01 | Explain the service technician’s role in customer relations. |
| 03316 V5 | 1a | Explain how personal habits, behaviors, and attitudes affect customer relations. |
| 03316 V5 | 1b | Explain how to properly communicate with customers. |
| 03316 V5 | 02 | Describe basic conduct required for a service call. |
| 03316 V5 | 2a | Describe how to conduct the three phases of a service call. |
| 03316 V5 | 2b | Describe ways to handle challenging customer situations. |