HVAC Apprenticeship Evaluation Tool

2020 Curricular Materials Review

Idaho CTE Trades and Industry (T&I) Electrical Apprenticeship Program Standards[[1]](#footnote-1)[[2]](#footnote-2)[[3]](#footnote-3)[[4]](#footnote-4)

**Publisher information**

* Publisher Name:
* Title:
* Grade Level:
* ISBN #:
* Author:
* Copyright:

# Instructions:

Complete the Publisher Standards Alignment Report below. Please provide written justification as to how the material meets the standard along with location references. If a justification requires additional space, please submit response on an additional document.

# Publisher STANDARDS ALIGNMENT Report:

## YEAR ONE Standard HVAC.1.0: Trade Math

### YEAR ONE Performance Standard HVAC.1.1 Basic Math

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.1.1.1 Perform addition, subtraction, multiplication, and division calculations of whole numbers. |  |
| CTE HVAC.1.1.2 Perform addition and subtraction calculations of common fractions. |  |
| CTE HVAC.1.1.3 Perform multiplication and division calculations of common fractions. |  |
| CTE HVAC.1.1.4 Perform addition, subtraction, multiplication, and division calculations of decimal fractions. |  |
| CTE HVAC.1.1.5 Perform ratio and proportion calculations. |  |
| CTE HVAC.1.1.6 Perform percent, percentage, and discount calculations. |  |
| CTE HVAC.1.1.7 Perform angular, length, and converted temperature measure calculations. |  |
| CTE HVAC.1.1.8 Perform area calculations. |  |
| CTE HVAC.1.1.9 Perform volume calculations. |  |
| CTE HVAC.1.1.10 Solve basic equations. |  |
| CTE HVAC.1.1.11 Demonstrate the use of order of operations. |  |

## YEAR ONE Standard HVAC.2.0: General Safety

### YEAR ONE Performance Standard HVAC.2.1 Workplace Safety

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.2.1.1 Describe potential excavation site hazards. |  |
| CTE HVAC.2.1.2 Explain proper personal protective equipment (PPE) use. |  |
| CTE HVAC.2.1.3 Describe proper material handling, storage, use, and disposal. |  |
| CTE HVAC.2.1.4 Describe ladder, stairway, and scaffold hazards and proper use. |  |
| CTE HVAC.2.1.5 Describe jobsite electrical hazards and proper lockout/tagout use. |  |
| CTE HVAC.2.1.6 Describe proper refrigerant and pressure vessel use and storage. |  |
| CTE HVAC.2.1.7 Identify safety data sheets (SDS) properties of chemicals specific to HVAC. |  |
| CTE HVAC.2.1.8 Identify and describe environmental hazards (e.g., lead, silica, asbestos, carbon monoxide). |  |
| CTE HVAC.2.1.9 Identify the hazards associated with confined spaces. |  |
| CTE HVAC.2.1.10 Use appropriate fire extinguishers and other safety devices. |  |
| CTE HVAC.2.1.11 Identify the importance of safety procedures for brazing and soldering. |  |

## YEAR ONE Standard HVAC.3.0: Tools and Materials

### YEAR ONE Performance Standard HVAC.3.1 Power and Hand Tool Use

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.3.1.1 Describe proper use of hand tools used in the HVAC industry. |  |
| CTE HVAC.3.1.2 Describe proper use of power tools used in the HVAC industry |  |
| CTE HVAC.3.1.3 Describe proper use of various types of torches. |  |
| CTE HVAC.3.1.4 Describe proper use of piping and tubing fabrication tools. |  |

### YEAR ONE Performance Standard HVAC.3.2 Tubing and Piping

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.3.2.1 Identify the purpose of the piping, tubing, and fittings used in the heating, air-conditioning, and refrigeration industry. |  |
| CTE HVAC.3.2.2 Identify appropriate brazing and soldering alloys and materials. |  |
| CTE HVAC.3.2.3 Explain the purposes and procedures for protecting piping materials and fabrication, such as valves, fittings, and products from heat. |  |

## YEAR ONE Standard HVAC.4.0: Energy Sources

### YEAR ONE Performance Standard HVAC.4.1 Energy Sources

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.4.1.1 Explain natural, LP gas, and fuel oil combustion characteristics. |  |
| CTE HVAC.4.1.2 Describe the application of geothermal systems. |  |
| CTE HVAC.4.1.3 Describe the application of renewable energy systems. |  |
| CTE HVAC.4.1.4 Describe the application of electric production systems. |  |

## YEAR ONE Standard HVAC.5.0: Basic Systems Overview

### YEAR ONE Performance Standard HVAC.5.1 Basic Systems Overview

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.5.1.1 Describe fossil-fuel and electrical furnace operations. |  |
| CTE HVAC.5.1.2 Describe the typical configuration of residential split air conditioning systems. |  |
| CTE HVAC.5.1.3 List various types of commercial air conditioning systems and their application. |  |
| CTE HVAC.5.1.4 Describe the configuration of common duct systems. |  |

## YEAR ONE Standard HVAC.6.0: Intro to Applied Science

### YEAR ONE Performance Standard HVAC.6.1 Intro to Applied Science

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.6.1.1. Perform energy conversion calculations. |  |
| CTE HVAC.6.1.2 Perform sensible, latent, and total heat calculations. |  |
| CTE HVAC.6.1.3 Differentiate between saturated, superheated, and subcooled refrigerant. |  |
| CTE HVAC.6.1.4 Explain atmospheric, absolute, and gauge pressure relationship. |  |
| CTE HVAC.6.1.5 Convert gauge pressure, absolute pressure, and vacuum. |  |
| CTE HVAC.6.1.6 Diagram a basic refrigeration cycle identifying pressure, temperature, and state of refrigerant. |  |
| CTE HVAC.6.1.7 List the type and function of the four major refrigeration components. |  |
| CTE HVAC.6.1.8 Describe the methods of heat transfer. |  |

## YEAR TWO Standard HVAC.1.0: Trade Math

### YEAR TWO Performance Standard HVAC.1.1 Basic Math

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.1.1.1 Perform addition, subtraction, multiplication, and division calculations of whole numbers. |  |
| CTE HVAC.1.1.2 Perform addition and subtraction calculations of common fractions. |  |
| CTE HVAC.1.1.3 Perform multiplication and division calculations of common fractions. |  |
| CTE HVAC.1.1.4 Perform addition, subtraction, multiplication, and division calculations of decimal fractions. |  |
| CTE HVAC.1.1.5 Perform ratio and proportion calculations. |  |
| CTE HVAC.1.1.6 Perform percent, percentage, and discount calculations. |  |
| CTE HVAC.1.1.7 Perform angular, length, and converted temperature measure calculations. |  |
| CTE HVAC.1.1.8 Perform area calculations. |  |
| CTE HVAC.1.1.9 Perform volume calculations. |  |
| CTE HVAC.1.1.10 Solve basic equations. |  |
| CTE HVAC.1.1.11 Demonstrate the use of order of operations. |  |

## YEAR TWO Standard HVAC.2.0: General Safety

### YEAR TWO Performance Standard HVAC.2.1 Workplace Safety

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.2.1.1 Describe potential excavation site hazards. |  |
| CTE HVAC.2.1.2 Explain proper personal protective equipment (PPE) use. |  |
| CTE HVAC.2.1.3 Describe proper material handling, storage, use, and disposal. |  |
| CTE HVAC.2.1.4 Describe ladder, stairway, and scaffold hazards and proper use. |  |
| CTE HVAC.2.1.5 Describe jobsite electrical hazards and proper lockout/tagout use. |  |
| CTE HVAC.2.1.6 Describe proper refrigerant and pressure vessel use and storage. |  |
| CTE HVAC.2.1.7 Identify safety data sheets (SDS) properties of chemicals specific to HVAC. |  |
| CTE HVAC.2.1.8 Identify and describe environmental hazards (e.g., lead, silica, asbestos, carbon monoxide). |  |
| CTE HVAC.2.1.9 Identify the hazards associated with confined spaces. |  |
| CTE HVAC.2.1.10 Use appropriate fire extinguishers and other safety devices. |  |
| CTE HVAC.2.1.11 Identify the importance of safety procedures for brazing and soldering. |  |

## YEAR TWO Standard HVAC.3.0: Tools and Materials

### YEAR TWO Performance Standard HVAC.3.1 Power and Hand Tool Use

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.3.1.1 Describe proper use of hand tools used in the HVAC industry. |  |
| CTE HVAC.3.1.2 Describe proper use of power tools used in the HVAC industry |  |
| CTE HVAC.3.1.3 Describe proper use of various types of torches. |  |
| CTE HVAC.3.1.4 Describe proper use of piping and tubing fabrication tools. |  |

### YEAR TWO Performance Standard HVAC.3.2 Tubing and Piping

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.3.2.1 Identify the purpose of the piping, tubing, and fittings used in the heating, air-conditioning, and refrigeration industry. |  |
| CTE HVAC.3.2.2 Identify appropriate brazing and soldering alloys and materials. |  |
| CTE HVAC.3.2.3 Explain the purposes and procedures for protecting piping materials and fabrication, such as valves, fittings, and products from heat. |  |

## YEAR TWO Standard HVAC.4.0: Energy Sources

### YEAR TWO Performance Standard HVAC.4.1 Energy Sources

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.4.1.1 Explain natural, LP gas, and fuel oil combustion characteristics. |  |
| CTE HVAC.4.1.2 Describe the application of geothermal systems. |  |
| CTE HVAC.4.1.3 Describe the application of renewable energy systems. |  |
| CTE HVAC.4.1.4 Describe the application of electric production systems. |  |

## YEAR TWO Standard HVAC.5.0: Basic Systems Overview

### YEAR TWO Performance Standard HVAC.5.1 Basic Systems Overview

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.5.1.1 Describe fossil-fuel and electrical furnace operations. |  |
| CTE HVAC.5.1.2 Describe the typical configuration of residential split air conditioning systems. |  |
| CTE HVAC.5.1.3 List various types of commercial air conditioning systems and their application. |  |
| CTE HVAC.5.1.4 Describe the configuration of common duct systems. |  |

## YEAR TWO Standard HVAC.6.0: Intro to Applied Science

### YEAR TWO Performance Standard HVAC.6.1 Intro to Applied Science

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.6.1.1. Perform energy conversion calculations. |  |
| CTE HVAC.6.1.2 Perform sensible, latent, and total heat calculations. |  |
| CTE HVAC.6.1.3 Differentiate between saturated, superheated, and subcooled refrigerant. |  |
| CTE HVAC.6.1.4 Explain atmospheric, absolute, and gauge pressure relationship. |  |
| CTE HVAC.6.1.5 Convert gauge pressure, absolute pressure, and vacuum. |  |
| CTE HVAC.6.1.6 Diagram a basic refrigeration cycle identifying pressure, temperature, and state of refrigerant. |  |
| CTE HVAC.6.1.7 List the type and function of the four major refrigeration components. |  |
| CTE HVAC.6.1.8 Describe the methods of heat transfer. |  |

## YEAR TWO Standard HVAC.7.0: Appliance Installation

### YEAR TWO Performance Standard HVAC.7.1 Appliance Installation

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.7.1.1 Apply National Electric Code (NEC) standards to HVAC electrical circuit installations. |  |
| CTE HVAC.7.1.2 Interpret HVAC manufacturer electrical name plate data. |  |
| CTE HVAC.7.1.3 Apply appropriate code standards to appliance installation. |  |
| CTE HVAC.7.1.4 Describe gas, oil, and electrical appliance installation, start-up, and checkout procedures. |  |
| CTE HVAC.7.1.5 Describe sheet metal, fiberglass, and flex duct installation procedures. |  |
| CTE HVAC.7.1.6 Describe split and packaged air conditioning system installation, start-up, and checkout procedures. |  |

## YEAR TWO Standard HVAC.8.0: Introduction to Construction Drawings and Specifications

### YEAR TWO Performance Standard HVAC.8.1 Introduction to Construction Drawings and Specifications

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.8.1.1 Describe the application of architectural plans and specifications. |  |
| CTE HVAC.8.1.2 Interpret mechanical, plumbing, and electrical drawing symbols. |  |
| CTE HVAC.8.1.3 Interpret specification documents and apply to plans. |  |
| CTE HVAC.8.1.4 Interpret shop drawings and apply to plans and specifications. |  |
| CTE HVAC.8.1.5 Describe a submittal and its derivation, routing, and makeup. |  |
| CTE HVAC.8.1.6 Develop cut lists for duct runs from shop drawings. |  |
| CTE HVAC.8.1.7 Interpret as-built modifications on HVAC mechanical plans. |  |
| CTE HVAC.8.1.8 Perform HVAC equipment and material takeoff. |  |

## YEAR TWO Standard HVAC.9.0: Basic Electricity

### YEAR TWO Performance Standard HVAC.9.1 Basic Electricity

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.9.1.1 Describe basic electrical theory. |  |
| CTE HVAC.9.1.2 Describe series, parallel, and combination circuit characteristics. |  |
| CTE HVAC.9.1.3 Calculate electrical circuit values. |  |
| CTE HVAC.9.1.4 Describe electrical meter functions. |  |
| CTE HVAC.9.1.5 Measure electrical circuit values. |  |
| CTE HVAC.9.1.6 Identify electrical symbols. |  |
| CTE HVAC.9.1.7 Draw basic HVAC electrical circuit diagrams. |  |
| CTE HVAC.9.1.8 Interpret basic residential HVAC schematic diagrams. |  |
| CTE HVAC.9.1.9 Interpret basic commercial HVAC schematic diagrams. |  |
| CTE HVAC.9.1.10 Explain AC circuit characteristics. |  |
| CTE HVAC.9.1.11 Describe power distribution transformer systems. |  |
| CTE HVAC.9.1.12 Calculate HVAC branch circuit conductor, breaker, and disconnect sizes. |  |
| CTE HVAC.9.1.13 Describe basic motor theory. |  |
| CTE HVAC.9.1.14 Describe the five single-phase motor types. |  |
| CTE HVAC.9.1.15 Identify single-phase motor diagrams. |  |
| CTE HVAC.9.1.16 Explain single-phase motor starting relay operation. |  |
| CTE HVAC.9.1.17 Calculate motor capacitor replacement values. |  |
| CTE HVAC.9.1.18 Explain three-phase motor operation. |  |
| CTE HVAC.9.1.19 Explain ECM motor operation. |  |
| CTE HVAC.9.1.20 Perform Ohm’s law calculations to series, parallel, and combination circuits. |  |

## YEAR THREE Standard HVAC.1.0: Trade Math

### YEAR THREE Performance Standard HVAC.1.1 Basic Math

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.1.1.1 Perform addition, subtraction, multiplication, and division calculations of whole numbers. |  |
| CTE HVAC.1.1.2 Perform addition and subtraction calculations of common fractions. |  |
| CTE HVAC.1.1.3 Perform multiplication and division calculations of common fractions. |  |
| CTE HVAC.1.1.4 Perform addition, subtraction, multiplication, and division calculations of decimal fractions. |  |
| CTE HVAC.1.1.5 Perform ratio and proportion calculations. |  |
| CTE HVAC.1.1.6 Perform percent, percentage, and discount calculations. |  |
| CTE HVAC.1.1.7 Perform angular, length, and converted temperature measure calculations. |  |
| CTE HVAC.1.1.8 Perform area calculations. |  |
| CTE HVAC.1.1.9 Perform volume calculations. |  |
| CTE HVAC.1.1.10 Solve basic equations. |  |
| CTE HVAC.1.1.11 Demonstrate the use of order of operations. |  |

## YEAR THREE Standard HVAC.2.0: General Safety

### YEAR THREE Performance Standard HVAC.2.1 Workplace Safety

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.2.1.1 Describe potential excavation site hazards. |  |
| CTE HVAC.2.1.2 Explain proper personal protective equipment (PPE) use. |  |
| CTE HVAC.2.1.3 Describe proper material handling, storage, use, and disposal. |  |
| CTE HVAC.2.1.4 Describe ladder, stairway, and scaffold hazards and proper use. |  |
| CTE HVAC.2.1.5 Describe jobsite electrical hazards and proper lockout/tagout use. |  |
| CTE HVAC.2.1.6 Describe proper refrigerant and pressure vessel use and storage. |  |
| CTE HVAC.2.1.7 Identify safety data sheets (SDS) properties of chemicals specific to HVAC. |  |
| CTE HVAC.2.1.8 Identify and describe environmental hazards (e.g., lead, silica, asbestos, carbon monoxide). |  |
| CTE HVAC.2.1.9 Identify the hazards associated with confined spaces. |  |
| CTE HVAC.2.1.10 Use appropriate fire extinguishers and other safety devices. |  |
| CTE HVAC.2.1.11 Identify the importance of safety procedures for brazing and soldering. |  |

## YEAR THREE Standard HVAC.3.0: Tools and Materials

### YEAR THREE Performance Standard HVAC.3.1 Power and Hand Tool Use

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.3.1.1 Describe proper use of hand tools used in the HVAC industry. |  |
| CTE HVAC.3.1.2 Describe proper use of power tools used in the HVAC industry |  |
| CTE HVAC.3.1.3 Describe proper use of various types of torches. |  |
| CTE HVAC.3.1.4 Describe proper use of piping and tubing fabrication tools. |  |

## YEAR THREE Standard HVAC.4.0: Energy Sources

### YEAR THREE Performance Standard HVAC.4.1 Energy Sources

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.4.1.1 Explain natural, LP gas, and fuel oil combustion characteristics. |  |
| CTE HVAC.4.1.2 Describe the application of geothermal systems. |  |
| CTE HVAC.4.1.3 Describe the application of renewable energy systems. |  |
| CTE HVAC.4.1.4 Describe the application of electric production systems. |  |

## YEAR THREE Standard HVAC.5.0: Basic Systems Overview

### YEAR THREE Performance Standard HVAC.5.1 Basic Systems Overview

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.5.1.1 Describe fossil-fuel and electrical furnace operations. |  |
| CTE HVAC.5.1.2 Describe the typical configuration of residential split air conditioning systems. |  |
| CTE HVAC.5.1.3 List various types of commercial air conditioning systems and their application. |  |
| CTE HVAC.5.1.4 Describe the configuration of common duct systems. |  |

## YEAR THREE Standard HVAC.6.0: Intro to Applied Science

### YEAR THREE Performance Standard HVAC.6.1 Intro to Applied Science

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.6.1.1. Perform energy conversion calculations. |  |
| CTE HVAC.6.1.2 Perform sensible, latent, and total heat calculations. |  |
| CTE HVAC.6.1.3 Differentiate between saturated, superheated, and subcooled refrigerant. |  |
| CTE HVAC.6.1.4 Explain atmospheric, absolute, and gauge pressure relationship. |  |
| CTE HVAC.6.1.5 Convert gauge pressure, absolute pressure, and vacuum. |  |
| CTE HVAC.6.1.6 Diagram a basic refrigeration cycle identifying pressure, temperature, and state of refrigerant. |  |
| CTE HVAC.6.1.7 List the type and function of the four major refrigeration components. |  |
| CTE HVAC.6.1.8 Describe the methods of heat transfer. |  |

## YEAR THREE Standard HVAC.7.0: Appliance Installation

### YEAR THREE Performance Standard HVAC.7.1 Appliance Installation

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.7.1.1 Apply National Electric Code (NEC) standards to HVAC electrical circuit installations. |  |
| CTE HVAC.7.1.2 Interpret HVAC manufacturer electrical name plate data. |  |
| CTE HVAC.7.1.3 Apply appropriate code standards to appliance installation. |  |
| CTE HVAC.7.1.4 Describe gas, oil, and electrical appliance installation, start-up, and checkout procedures. |  |
| CTE HVAC.7.1.5 Describe sheet metal, fiberglass, and flex duct installation procedures. |  |
| CTE HVAC.7.1.6 Describe split and packaged air conditioning system installation, start-up, and checkout procedures. |  |

## YEAR THREE Standard HVAC.8.0: Introduction to Construction Drawings and Specifications

### YEAR THREE Performance Standard HVAC.8.1 Introduction to Construction Drawings and Specifications

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.8.1.1 Describe the application of architectural plans and specifications. |  |
| CTE HVAC.8.1.2 Interpret mechanical, plumbing, and electrical drawing symbols. |  |
| CTE HVAC.8.1.3 Interpret specification documents and apply to plans. |  |
| CTE HVAC.8.1.4 Interpret shop drawings and apply to plans and specifications. |  |
| CTE HVAC.8.1.5 Describe a submittal and its derivation, routing, and makeup. |  |
| CTE HVAC.8.1.6 Develop cut lists for duct runs from shop drawings. |  |
| CTE HVAC.8.1.7 Interpret as-built modifications on HVAC mechanical plans. |  |
| CTE HVAC.8.1.8 Perform HVAC equipment and material takeoff. |  |

## YEAR THREE Standard HVAC.9.0: Basic Electricity

### YEAR THREE Performance Standard HVAC.9.1 Basic Electricity

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.9.1.1 Describe basic electrical theory. |  |
| CTE HVAC.9.1.2 Describe series, parallel, and combination circuit characteristics. |  |
| CTE HVAC.9.1.3 Calculate electrical circuit values. |  |
| CTE HVAC.9.1.4 Describe electrical meter functions. |  |
| CTE HVAC.9.1.5 Measure electrical circuit values. |  |
| CTE HVAC.9.1.6 Identify electrical symbols. |  |
| CTE HVAC.9.1.7 Draw basic HVAC electrical circuit diagrams. |  |
| CTE HVAC.9.1.8 Interpret basic residential HVAC schematic diagrams. |  |
| CTE HVAC.9.1.9 Interpret basic commercial HVAC schematic diagrams. |  |
| CTE HVAC.9.1.10 Explain AC circuit characteristics. |  |
| CTE HVAC.9.1.11 Describe power distribution transformer systems. |  |
| CTE HVAC.9.1.12 Calculate HVAC branch circuit conductor, breaker, and disconnect sizes. |  |
| CTE HVAC.9.1.13 Describe basic motor theory. |  |
| CTE HVAC.9.1.14 Describe the five single-phase motor types. |  |
| CTE HVAC.9.1.15 Identify single-phase motor diagrams. |  |
| CTE HVAC.9.1.16 Explain single-phase motor starting relay operation. |  |
| CTE HVAC.9.1.17 Calculate motor capacitor replacement values. |  |
| CTE HVAC.9.1.18 Explain three-phase motor operation. |  |
| CTE HVAC.9.1.19 Explain ECM motor operation. |  |
| CTE HVAC.9.1.20 Perform Ohm’s law calculations to series, parallel, and combination circuits. |  |

## YEAR THREE Standard HVAC.10.0: Indoor Air Quality

### YEAR THREE Performance Standard HVAC.10.1 Indoor Air Quality

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.10.1.1 Describe indoor air quality (IAQ) factors as related to HVAC. |  |
| CTE HVAC.10.1.2 Identify various indoor air quality pollutant and pollutant pathways. |  |
| CTE HVAC.10.1.3 Describe indoor air quality evaluation and measurement tools. |  |
| CTE HVAC.10.1.4 Explain appropriate prevention, control, and resolution strategies for IAQ issues. |  |
| CTE HVAC.10.1.5 Identify when to involve IAQ professionals as necessary. |  |

## YEAR THREE Standard HVAC.11.0: Residential Load Calculations

### YEAR THREE Performance Standard HVAC.11.1 Residential Load Calculations

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.11.1.1 Identify the importance of heat load calculation in building design. |  |
| CTE HVAC.11.1.2 Differentiate sensible, latent, and total heat gain/loss. |  |
| CTE HVAC.11.1.3 Determine U values and R values for various building construction components. |  |
| CTE HVAC.11.1.4 Calculate Btu gain/loss values using HTM and temperature difference factors. |  |
| CTE HVAC.11.1.5 Determine heating and cooling load temperature difference and daily range values. |  |
| CTE HVAC.11.1.6 Explain the relationship between house orientation and solar heat gain. |  |
| CTE HVAC.11.1.7 Perform building component area and volume calculations from construction drawings. |  |
| CTE HVAC.11.1.8 Perform winter/summer infiltration calculations using Manual J procedures. |  |
| CTE HVAC.11.1.9 Perform heat gain calculations using Manual J procedures. |  |
| CTE HVAC.11.1.10 Perform heat loss calculations using Manual J procedures. |  |
| CTE HVAC.11.1.11 Determine sensible, latent, and total heat for house block and room values. |  |

## YEAR THREE Standard HVAC.12.0: Basic Controls

### YEAR THREE Performance Standard HVAC.12.1 Basic Controls

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.12.1.1 Differentiate between operating and safety controls. |  |
| CTE HVAC.12.1.2 Describe the sequence of operation of standing pilot, intermittent, and direct ignition control systems. |  |
| CTE HVAC.12.1.3 Interpret basic gas furnace wiring diagrams. |  |
| CTE HVAC.12.1.4 Explain oil furnace primary control operation. |  |
| CTE HVAC.12.1.5 Describe electric furnace operating sequence. |  |
| CTE HVAC.12.1.6 Describe hydronic heating system controls. |  |
| CTE HVAC.12.1.7 Describe basic motor circuit troubleshooting procedures. |  |
| CTE HVAC.12.1.8 Interpret packaged and split air conditioning systems and wiring diagrams. |  |
| CTE HVAC.12.1.9 Identify commercial and industrial air conditioning system control methods. |  |
| CTE HVAC.12.1.10 Describe basic electronic control system troubleshooting procedures. |  |

## YEAR THREE Standard HVAC.13.0: System Air Flow and Duct Sizing

### YEAR THREE Performance Standard HVAC.13.1 System Air Flow and Duct Sizing

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.13.1.1 Describe basic air flow characteristics. |  |
| CTE HVAC.13.1.2 Explain duct system pressures. |  |
| CTE HVAC.13.1.3 Calculate duct system air flow. |  |
| CTE HVAC.13.1.4 Determine proper air flow requirements. |  |
| CTE HVAC.13.1.5 Describe air distribution system configurations. |  |
| CTE HVAC.13.1.6 Select primary heating/cooling equipment using nationally recognized standards. |  |
| CTE HVAC.13.1.7 Determine air-side component pressure drops from manufacturer tables. |  |
| CTE HVAC.13.1.8 Sketch a residential duct system layout using nationally recognized standards. |  |
| CTE HVAC.13.1.9 Determine duct size based on nationally recognized standards. |  |

## YEAR THREE Standard HVAC.14.0: Basic Air Conditioning and Refrigeration

### YEAR THREE Performance Standard HVAC.14.1 Basic Air Conditioning and Refrigeration

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.14.1.1 Explain latent, sensible, and total heat differences. |  |
| CTE HVAC.14.1.2 Diagram refrigeration cycle conditions and components. |  |
| CTE HVAC.14.1.3 Explain pressure-enthalpy diagrams. |  |
| CTE HVAC.14.1.4 Describe compressor design differences, efficiencies, and applications. |  |
| CTE HVAC.14.1.5 Explain water/air-cooled condenser operation and performance. |  |
| CTE HVAC.14.1.6 Describe metering device design and operation. |  |
| CTE HVAC.14.1.7 Describe refrigeration accessory components and operation. |  |
| CTE HVAC.14.1.8 Describe evaporator types. |  |
| CTE HVAC.14.1.9 Identify proper refrigerant line sizing and installation practices. |  |
| CTE HVAC.14.1.10 Explain various refrigerant physical and chemical properties. |  |
| CTE HVAC.14.1.11 Explain refrigerant oil properties and application. |  |
| CTE HVAC.14.1.12 Describe proper refrigeration system access procedures. |  |
| CTE HVAC.14.1.13 Differentiate between recovered, recycled, and reclaimed refrigerant. |  |
| CTE HVAC.14.1.14 Describe proper refrigerant recovery, evacuation, and charging procedures. |  |
| CTE HVAC.14.1.15 Describe the operation of a variable refrigerant flow system. |  |

## YEAR THREE Standard HVAC.15.0: Introduction to Hydronic Systems

### YEAR THREE Performance Standard HVAC.15.1 Introduction to Hydronic Systems

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.15.1.1 Identify hydronic piping system configurations. |  |
| CTE HVAC.15.1.2 Describe hydronic system components. |  |
| CTE HVAC.15.1.3 Explain hydronic systems drain and fill procedures. |  |
| CTE HVAC.15.1.4 Diagram basic hydronic system control circuits. |  |

## YEAR THREE Standard HVAC.16.0: Basic Sheet Metal

### YEAR THREE Performance Standard HVAC.16.1 Basic Sheet Metal

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.16.1.1 Define sheet metal layout terms. |  |
| CTE HVAC.16.1.2 Explain parallel line development procedures. |  |
| CTE HVAC.16.1.3 Layout and fabricate the following sheet metal fitting: Pittsburgh seam and square elbow. |  |
| CTE HVAC.16.1.4 Layout and fabricate the following sheet metal fitting: 90 degree elbow and transition. |  |
| CTE HVAC.16.1.5 Explain radial line development procedures. |  |
| CTE HVAC.16.1.6 Layout and fabricate the following sheet metal fitting: symmetrical tapered duct. |  |
| CTE HVAC.16.1.7 Layout and fabricate the following sheet metal fitting: square to square tapered duct. |  |
| CTE HVAC.16.1.8 Explain triangulation development procedures. |  |
| CTE HVAC.16.1.9 Layout and fabricate the following sheet metal fitting: two-way offset transition. |  |
| CTE HVAC.16.1.10 Layout and fabricate the following sheet metal fitting: tapered duct section. |  |

## YEAR THREE Standard HVAC.17.0: Introduction to Service

### YEAR THREE Performance Standard HVAC.17.1 Introduction to Service

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.17.1.1 Identify air conditioning system problems. |  |
| CTE HVAC.17.1.2 Prescribe air conditioning system problem solutions. |  |
| CTE HVAC.17.1.3 Identify gas heating system problems. |  |
| CTE HVAC.17.1.4 Prescribe gas heating system problem solutions. |  |
| CTE HVAC.17.1.5 Identify oil heating system problems. |  |
| CTE HVAC.17.1.6 Prescribe oil heating system problem solutions. |  |
| CTE HVAC.17.1.7 Identify electric heating system problems. |  |
| CTE HVAC.17.1.8 Prescribe electric heating system problem solutions. |  |
| CTE HVAC.17.1.9 List gas, oil, and electric heating and air conditioning maintenance procedures. |  |

## YEAR THREE Standard HVAC.18.0: Advanced HVAC Systems

### YEAR THREE Performance Standard HVAC.18.1 HVAC Systems

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.18.1.1 Explain commercial fan coil unit operation. |  |
| CTE HVAC.18.1.2 Explain package unit building system configurations. |  |
| CTE HVAC.18.1.3 Describe building chilled water system operation. |  |
| CTE HVAC.18.1.4 Describe induced and forced draft cooling tower operation. |  |

## YEAR FOUR Standard HVAC.1.0: Trade Math

### YEAR FOUR Performance Standard HVAC.1.1 Basic Math

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.1.1.1 Perform addition, subtraction, multiplication, and division calculations of whole numbers. |  |
| CTE HVAC.1.1.2 Perform addition and subtraction calculations of common fractions. |  |
| CTE HVAC.1.1.3 Perform multiplication and division calculations of common fractions. |  |
| CTE HVAC.1.1.4 Perform addition, subtraction, multiplication, and division calculations of decimal fractions. |  |
| CTE HVAC.1.1.5 Perform ratio and proportion calculations. |  |
| CTE HVAC.1.1.6 Perform percent, percentage, and discount calculations. |  |
| CTE HVAC.1.1.7 Perform angular, length, and converted temperature measure calculations. |  |
| CTE HVAC.1.1.8 Perform area calculations. |  |
| CTE HVAC.1.1.9 Perform volume calculations. |  |
| CTE HVAC.1.1.10 Solve basic equations. |  |
| CTE HVAC.1.1.11 Demonstrate the use of order of operations. |  |

## YEAR FOUR Standard HVAC.2.0: General Safety

### YEAR FOUR Performance Standard HVAC.2.1 Workplace Safety

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.2.1.1 Describe potential excavation site hazards. |  |
| CTE HVAC.2.1.2 Explain proper personal protective equipment (PPE) use. |  |
| CTE HVAC.2.1.3 Describe proper material handling, storage, use, and disposal. |  |
| CTE HVAC.2.1.4 Describe ladder, stairway, and scaffold hazards and proper use. |  |
| CTE HVAC.2.1.5 Describe jobsite electrical hazards and proper lockout/tagout use. |  |
| CTE HVAC.2.1.6 Describe proper refrigerant and pressure vessel use and storage. |  |
| CTE HVAC.2.1.7 Identify safety data sheets (SDS) properties of chemicals specific to HVAC. |  |
| CTE HVAC.2.1.8 Identify and describe environmental hazards (e.g., lead, silica, asbestos, carbon monoxide). |  |
| CTE HVAC.2.1.9 Identify the hazards associated with confined spaces. |  |
| CTE HVAC.2.1.10 Use appropriate fire extinguishers and other safety devices. |  |
| CTE HVAC.2.1.11 Identify the importance of safety procedures for brazing and soldering. |  |

## YEAR FOUR Standard HVAC.3.0: Tools and Materials

### YEAR FOUR Performance Standard HVAC.3.1 Power and Hand Tool Use

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.3.1.1 Describe proper use of hand tools used in the HVAC industry. |  |
| CTE HVAC.3.1.2 Describe proper use of power tools used in the HVAC industry |  |
| CTE HVAC.3.1.3 Describe proper use of various types of torches. |  |
| CTE HVAC.3.1.4 Describe proper use of piping and tubing fabrication tools. |  |

## YEAR FOUR Standard HVAC.4.0: Fuel Gas Piping and Venting

### YEAR FOUR Performance Standard HVAC.4.1 Fuel Gas Piping and Venting

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.4.1.1 Identify HVAC Idaho Administrative Procedures Act (IDAPA) rules and statutes. |  |
| CTE HVAC.4.1.2 Define key terms as applied to the International Fuel Gas Code (IFGC). |  |
| CTE HVAC.4.1.3 Describe the building structural safety requirements for fuel gas equipment installation. |  |
| CTE HVAC.4.1.4 Determine proper fuel gas equipment combustion, ventilation, and dilution air requirements. |  |
| CTE HVAC.4.1.5 Identify the requirements for installation of fuel gas fired equipment in a masonry chimney. |  |
| CTE HVAC.4.1.6 Identify fuel gas equipment location, access, and service space requirements. |  |
| CTE HVAC.4.1.7 Describe proper appliance condensate disposal and clearance reduction methods. |  |
| CTE HVAC.4.1.8 Perform gas pipe sizing exercises. |  |
| CTE HVAC.4.1.9 Identify proper gas pipe installation methods. |  |
| CTE HVAC.4.1.10 Describe proper gas pipe inspection, testing, and purging procedures. |  |
| CTE HVAC.4.1.11 Describe chimney and vent types and construction. |  |
| CTE HVAC.4.1.12 Determine chimney installation requirements. |  |
| CTE HVAC.4.1.13 Determine gas vent installation requirements. |  |
| CTE HVAC.4.1.14 Describe gas appliance category I, II, III, and IV characteristics. |  |
| CTE HVAC.4.1.15 Identify proper gas vent connector installation requirements. |  |
| CTE HVAC.4.1.16 Describe category I venting principles. |  |
| CTE HVAC.4.1.17 Perform single appliance category I vent sizing exercises. |  |
| CTE HVAC.4.1.18 Perform multiple appliance category I vent sizing exercises. |  |
| CTE HVAC.4.1.19 Determine capacity penalties for offsets in common vent and vent connectors. |  |
| CTE HVAC.4.1.20 Determine specific fuel gas appliance installation requirements. |  |
| CTE HVAC.4.1.21 Determine mechanical equipment location, access, and service space requirements. |  |
| CTE HVAC.4.1.22 Determine combustion air location and sizing requirements. |  |

## YEAR FOUR Standard HVAC.5.0: Energy Sources

### YEAR FOUR Performance Standard HVAC.5.1 Energy Sources

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.5.1.1 Explain natural, LP gas, and fuel oil combustion characteristics. |  |
| CTE HVAC.5.1.2 Describe the application of geothermal systems. |  |
| CTE HVAC.5.1.3 Describe the application of renewable energy systems. |  |
| CTE HVAC.5.1.4 Describe the application of electric production systems. |  |

## YEAR FOUR Standard HVAC.6.0: Basic Systems Overview

### YEAR FOUR Performance Standard HVAC.6.1 Basic Systems Overview

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.6.1.1 Describe fossil-fuel and electrical furnace operations. |  |
| CTE HVAC.6.1.2 Describe the typical configuration of residential split air conditioning systems. |  |
| CTE HVAC.6.1.3 List various types of commercial air conditioning systems and their application. |  |
| CTE HVAC.6.1.4 Describe the configuration of common duct systems. |  |

## YEAR FOUR Standard HVAC.7.0: Intro to Applied Science

### YEAR FOUR Performance Standard HVAC.7.1 Intro to Applied Science

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.7.1.1. Perform energy conversion calculations. |  |
| CTE HVAC.7.1.2 Perform sensible, latent, and total heat calculations. |  |
| CTE HVAC.7.1.3 Differentiate between saturated, superheated, and subcooled refrigerant. |  |
| CTE HVAC.7.1.4 Explain atmospheric, absolute, and gauge pressure relationship. |  |
| CTE HVAC.7.1.5 Convert gauge pressure, absolute pressure, and vacuum. |  |
| CTE HVAC.7.1.6 Diagram a basic refrigeration cycle identifying pressure, temperature, and state of refrigerant. |  |
| CTE HVAC.7.1.7 List the type and function of the four major refrigeration components. |  |
| CTE HVAC.7.1.8 Describe the methods of heat transfer. |  |

## YEAR FOUR Standard HVAC.8.0: Appliance Installation

### YEAR FOUR Performance Standard HVAC.8.1 Appliance Installation

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.8.1.1 Apply National Electric Code (NEC) standards to HVAC electrical circuit installations. |  |
| CTE HVAC.8.1.2 Interpret HVAC manufacturer electrical name plate data. |  |
| CTE HVAC.8.1.3 Apply appropriate code standards to appliance installation. |  |
| CTE HVAC.8.1.4 Describe gas, oil, and electrical appliance installation, start-up, and checkout procedures. |  |
| CTE HVAC.8.1.5 Describe sheet metal, fiberglass, and flex duct installation procedures. |  |
| CTE HVAC.8.1.6 Describe split and packaged air conditioning system installation, start-up, and checkout procedures. |  |

## YEAR FOUR Standard HVAC.9.0: Introduction to Construction Drawings and Specifications

### YEAR FOUR Performance Standard HVAC.9.1 Introduction to Construction Drawings and Specifications

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.9.1.1 Describe the application of architectural plans and specifications. |  |
| CTE HVAC.9.1.2 Interpret mechanical, plumbing, and electrical drawing symbols. |  |
| CTE HVAC.9.1.3 Interpret specification documents and apply to plans. |  |
| CTE HVAC.9.1.4 Interpret shop drawings and apply to plans and specifications. |  |
| CTE HVAC.9.1.5 Describe a submittal and its derivation, routing, and makeup. |  |
| CTE HVAC.9.1.6 Develop cut lists for duct runs from shop drawings. |  |
| CTE HVAC.9.1.7 Interpret as-built modifications on HVAC mechanical plans. |  |
| CTE HVAC.9.1.8 Perform HVAC equipment and material takeoff. |  |

## YEAR FOUR Standard HVAC.10.0: Basic Electricity

### YEAR FOUR Performance Standard HVAC.10.1 Basic Electricity

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.10.1.1 Describe basic electrical theory. |  |
| CTE HVAC.10.1.2 Describe series, parallel, and combination circuit characteristics. |  |
| CTE HVAC.10.1.3 Calculate electrical circuit values. |  |
| CTE HVAC.10.1.4 Describe electrical meter functions. |  |
| CTE HVAC.10.1.5 Measure electrical circuit values. |  |
| CTE HVAC.10.1.6 Identify electrical symbols. |  |
| CTE HVAC.10.1.7 Draw basic HVAC electrical circuit diagrams. |  |
| CTE HVAC.10.1.8 Interpret basic residential HVAC schematic diagrams. |  |
| CTE HVAC.10.1.9 Interpret basic commercial HVAC schematic diagrams. |  |
| CTE HVAC.10.1.10 Explain AC circuit characteristics. |  |
| CTE HVAC.10.1.11 Describe power distribution transformer systems. |  |
| CTE HVAC.10.1.12 Calculate HVAC branch circuit conductor, breaker, and disconnect sizes. |  |
| CTE HVAC.10.1.13 Describe basic motor theory. |  |
| CTE HVAC.10.1.14 Describe the five single-phase motor types. |  |
| CTE HVAC.10.1.15 Identify single-phase motor diagrams. |  |
| CTE HVAC.10.1.16 Explain single-phase motor starting relay operation. |  |
| CTE HVAC.10.1.17 Calculate motor capacitor replacement values. |  |
| CTE HVAC.10.1.18 Explain three-phase motor operation. |  |
| CTE HVAC.10.1.19 Explain ECM motor operation. |  |
| CTE HVAC.10.1.20 Perform Ohm’s law calculations to series, parallel, and combination circuits. |  |

## YEAR FOUR Standard HVAC.11.0: Indoor Air Quality

### YEAR FOUR Performance Standard HVAC.11.1 Indoor Air Quality

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.11.1.1 Describe indoor air quality (IAQ) factors as related to HVAC. |  |
| CTE HVAC.11.1.2 Identify various indoor air quality pollutant and pollutant pathways. |  |
| CTE HVAC.11.1.3 Describe indoor air quality evaluation and measurement tools. |  |
| CTE HVAC.11.1.4 Explain appropriate prevention, control, and resolution strategies for IAQ issues. |  |
| CTE HVAC.11.1.5 Identify when to involve IAQ professionals as necessary. |  |

## YEAR FOUR Standard HVAC.12.0: Residential Load Calculations

### YEAR FOUR Performance Standard HVAC.12.1 Residential Load Calculations

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.12.1.1 Identify the importance of heat load calculation in building design. |  |
| CTE HVAC.12.1.2 Differentiate sensible, latent, and total heat gain/loss. |  |
| CTE HVAC.12.1.3 Determine U values and R values for various building construction components. |  |
| CTE HVAC.12.1.4 Calculate Btu gain/loss values using HTM and temperature difference factors. |  |
| CTE HVAC.12.1.5 Determine heating and cooling load temperature difference and daily range values. |  |
| CTE HVAC.12.1.6 Explain the relationship between house orientation and solar heat gain. |  |
| CTE HVAC.12.1.7 Perform building component area and volume calculations from construction drawings. |  |
| CTE HVAC.12.1.8 Perform winter/summer infiltration calculations using Manual J procedures. |  |
| CTE HVAC.12.1.9 Perform heat gain calculations using Manual J procedures. |  |
| CTE HVAC.12.1.10 Perform heat loss calculations using Manual J procedures. |  |
| CTE HVAC.12.1.11 Determine sensible, latent, and total heat for house block and room values. |  |

## YEAR FOUR Standard HVAC.13.0: Basic Controls

### YEAR FOUR Performance Standard HVAC.13.1 Basic Controls

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.13.1.1 Differentiate between operating and safety controls. |  |
| CTE HVAC.13.1.2 Describe the sequence of operation of standing pilot, intermittent, and direct ignition control systems. |  |
| CTE HVAC.13.1.3 Interpret basic gas furnace wiring diagrams. |  |
| CTE HVAC.13.1.4 Explain oil furnace primary control operation. |  |
| CTE HVAC.13.1.5 Describe electric furnace operating sequence. |  |
| CTE HVAC.13.1.6 Describe hydronic heating system controls. |  |
| CTE HVAC.13.1.7 Describe basic motor circuit troubleshooting procedures. |  |
| CTE HVAC.13.1.8 Interpret packaged and split air conditioning systems and wiring diagrams. |  |
| CTE HVAC.13.1.9 Identify commercial and industrial air conditioning system control methods. |  |
| CTE HVAC.13.1.10 Describe basic electronic control system troubleshooting procedures. |  |

## YEAR FOUR Standard HVAC.14.0: System Air Flow and Duct Sizing

### YEAR FOUR Performance Standard HVAC.14.1 System Air Flow and Duct Sizing

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.14.1.1 Describe basic air flow characteristics. |  |
| CTE HVAC.14.1.2 Explain duct system pressures. |  |
| CTE HVAC.14.1.3 Calculate duct system air flow. |  |
| CTE HVAC.14.1.4 Determine proper air flow requirements. |  |
| CTE HVAC.14.1.5 Describe air distribution system configurations. |  |
| CTE HVAC.14.1.6 Select primary heating/cooling equipment using nationally recognized standards. |  |
| CTE HVAC.14.1.7 Determine air-side component pressure drops from manufacturer tables. |  |
| CTE HVAC.14.1.8 Sketch a residential duct system layout using nationally recognized standards. |  |
| CTE HVAC.14.1.9 Determine duct size based on nationally recognized standards. |  |

## YEAR FOUR Standard HVAC.15.0: Basic Air Conditioning and Refrigeration

### YEAR FOUR Performance Standard HVAC.15.1 Basic Air Conditioning and Refrigeration

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.15.1.1 Explain latent, sensible, and total heat differences. |  |
| CTE HVAC.15.1.2 Diagram refrigeration cycle conditions and components. |  |
| CTE HVAC.15.1.3 Explain pressure-enthalpy diagrams. |  |
| CTE HVAC.15.1.4 Describe compressor design differences, efficiencies, and applications. |  |
| CTE HVAC.15.1.5 Explain water/air-cooled condenser operation and performance. |  |
| CTE HVAC.15.1.6 Describe metering device design and operation. |  |
| CTE HVAC.15.1.7 Describe refrigeration accessory components and operation. |  |
| CTE HVAC.15.1.8 Describe evaporator types. |  |
| CTE HVAC.15.1.9 Identify proper refrigerant line sizing and installation practices. |  |
| CTE HVAC.15.1.10 Explain various refrigerant physical and chemical properties. |  |
| CTE HVAC.15.1.11 Explain refrigerant oil properties and application. |  |
| CTE HVAC.15.1.12 Describe proper refrigeration system access procedures. |  |
| CTE HVAC.15.1.13 Differentiate between recovered, recycled, and reclaimed refrigerant. |  |
| CTE HVAC.15.1.14 Describe proper refrigerant recovery, evacuation, and charging procedures. |  |
| CTE HVAC.15.1.15 Describe the operation of a variable refrigerant flow system. |  |

## YEAR FOUR Standard HVAC.16.0: Introduction to Hydronic Systems

### YEAR FOUR Performance Standard HVAC.16.1 Introduction to Hydronic Systems

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.16.1.1 Identify hydronic piping system configurations. |  |
| CTE HVAC.16.1.2 Describe hydronic system components. |  |
| CTE HVAC.16.1.3 Explain hydronic systems drain and fill procedures. |  |
| CTE HVAC.16.1.4 Diagram basic hydronic system control circuits. |  |

## YEAR FOUR Standard HVAC.17.0: Basic Sheet Metal

### YEAR FOUR Performance Standard HVAC.17.1 Basic Sheet Metal

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.17.1.1 Define sheet metal layout terms. |  |
| CTE HVAC.17.1.2 Explain parallel line development procedures. |  |
| CTE HVAC.17.1.3 Layout and fabricate the following sheet metal fitting: Pittsburgh seam and square elbow. |  |
| CTE HVAC.17.1.4 Layout and fabricate the following sheet metal fitting: 90 degree elbow and transition. |  |
| CTE HVAC.17.1.5 Explain radial line development procedures. |  |
| CTE HVAC.17.1.6 Layout and fabricate the following sheet metal fitting: symmetrical tapered duct. |  |
| CTE HVAC.17.1.7 Layout and fabricate the following sheet metal fitting: square to square tapered duct. |  |
| CTE HVAC.17.1.8 Explain triangulation development procedures. |  |
| CTE HVAC.17.1.9 Layout and fabricate the following sheet metal fitting: two-way offset transition. |  |
| CTE HVAC.17.1.10 Layout and fabricate the following sheet metal fitting: tapered duct section. |  |

## YEAR FOUR Standard HVAC.18.0: Introduction to Service

### YEAR FOUR Performance Standard HVAC.18.1 Introduction to Service

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.18.1.1 Identify air conditioning system problems. |  |
| CTE HVAC.18.1.2 Prescribe air conditioning system problem solutions. |  |
| CTE HVAC.18.1.3 Identify gas heating system problems. |  |
| CTE HVAC.18.1.4 Prescribe gas heating system problem solutions. |  |
| CTE HVAC.18.1.5 Identify oil heating system problems. |  |
| CTE HVAC.18.1.6 Prescribe oil heating system problem solutions. |  |
| CTE HVAC.18.1.7 Identify electric heating system problems. |  |
| CTE HVAC.18.1.8 Prescribe electric heating system problem solutions. |  |
| CTE HVAC.18.1.9 List gas, oil, and electric heating and air conditioning maintenance procedures. |  |

## YEAR FOUR Standard HVAC.19.0: Fundamentals of Psychometrics

### YEAR FOUR Performance Standard HVAC.19.1 Fundamentals of Psychometrics

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.19.1.1 Explain psychometric properties. |  |
| CTE HVAC.19.1.2 Diagram psychometric conditions. |  |
| CTE HVAC.19.1.3 Describe comfort conditions as applied to psychometric properties. |  |
| CTE HVAC.19.1.4 Use the psychometric chart to measure enthalpy. |  |

## YEAR FOUR Standard HVAC.20.0: Testing and Balancing

### YEAR FOUR Performance Standard HVAC.20.1 Testing and Balancing

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.20.1.1 Describe air flow and water flow measuring devices. |  |
| CTE HVAC.20.1.2 Explain basic air flow and water flow balancing procedures. |  |

## YEAR FOUR Standard HVAC.21.0: Introduction to HVAC Control Strategies

### YEAR FOUR Performance Standard HVAC.21.1 Introduction to HVAC Control Strategies

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.21.1.1 Describe basic HVAC control principles. |  |
| CTE HVAC.21.1.2 Interpret basic HVAC pneumatic control diagrams. |  |

## YEAR FOUR Standard HVAC.22.0: Advanced HVAC Systems

### YEAR FOUR Performance Standard HVAC.22.1 HVAC Systems

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.22.1.1 Explain commercial fan coil unit operation. |  |
| CTE HVAC.22.1.2 Explain package unit building system configurations. |  |
| CTE HVAC.22.1.3 Describe building chilled water system operation. |  |
| CTE HVAC.22.1.4 Describe induced and forced draft cooling tower operation. |  |

### YEAR FOUR Performance Standard HVAC.22.2 Heat Pump Systems

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.22.2.1 Explain heat pump heating and cooling cycles. |  |
| CTE HVAC.22.2.2 Describe the purpose and operation of various heat pump components. |  |
| CTE HVAC.22.2.3 Prescribe heat pump charging procedures. |  |
| CTE HVAC.22.2.4 Differentiate heat pump time/temperature and demand defrost control systems. |  |
| CTE HVAC.22.2.5 Explain geothermal heat pump system applications. |  |
| CTE HVAC.22.2.6 Describe water-to-air and air-to-water heat pump operation. |  |

## YEAR FOUR Standard HVAC.23.0: Advanced Troubleshooting

### YEAR FOUR Performance Standard HVAC.23.1 Advanced Troubleshooting

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.23.1.1 Describe air flow troubleshooting procedures. |  |
| CTE HVAC.23.1.2 Determine operating conditions at variable loads. |  |
| CTE HVAC.23.1.3 Describe refrigeration side troubleshooting procedures. |  |
| CTE HVAC.23.1.4 Troubleshoot residential and commercial control systems. |  |
| CTE HVAC.23.1.5 Interpret manufacturer schematics. |  |
| CTE HVAC.23.1.6 Analyze furnace troubleshooting values. |  |
| CTE HVAC.23.1.7 Apply furnace troubleshooting values. |  |

## YEAR FOUR Standard HVAC.24.0: Code Review

### YEAR FOUR Performance Standard HVAC.24.1 Code Review

| Student Competencies by Performance Standard | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| CTE HVAC.24.1.1 Apply international fuel gas code standards. |  |
| CTE HVAC.24.1.2 Apply international mechanical code standards. |  |
| CTE HVAC.24.1.3 Apply HVAC rules and statutes as it pertains to the IDAPA administrative code. |  |

# Indicators of quality Rubric:

Standards aligned and Integrated Curriculum:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. The curriculum is based on industry-validated technical standards and competencies. |  |
| 1. The curriculum is aligned with relevant content and standards for core subjects, such as reading, math and science, including federal, state and/or local standards, as appropriate. |  |
| 1. The curriculum incorporates employability skill standards that help students succeed in the workplace, such as problem solving, critical thinking, teamwork, communications and workplace etiquette. |  |
| 1. The curriculum allows for student application of integrated knowledge and skills in authentic scenarios. |  |
| 1. Materials used reflect current workplace, industry and/or occupational practices and requirements. |  |

Access and Equity:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. Materials are provided in a way that ensures all students have the opportunity to achieve success in the program of study, including by meeting Title IX, Americans with Disabilities Act and other accessibility requirements. |  |
| 1. Materials and assessments are free from bias, inclusive and non-discriminatory, and offered in a way that ensures all students have the opportunity to achieve success in the program of study. |  |
| 1. Contains guidance to support differentiated and culturally responsive (i.e., purposefully represents diverse cultures, linguistic backgrounds, learning styles and interests) instruction in the classroom so that every student’s need are addressed by including:    1. Suggestions for how to promote equitable instruction by making connections to culture, home, neighborhood, and community as appropriate.    2. Appropriate scaffolding, interventions, and supports, including integrated and appropriate reading, writing, listening, and speaking alternatives (e.g., translations, picture support, graphic organizers) that neither sacrifice content nor avoid language development for English language learners, special needs, or below grade level readers.    3. Digital and print resources that provide various levels of readability.    4. Modifications and extensions for all students, including those performing above their grade level, to deepen understanding of the content.    5. Materials in multiple language formats. |  |

Student Focus:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. The material supports the sequential and cumulative development of foundational skills and progresses in specificity to build students’ depth of knowledge and skills. Those skills are necessary for a student’s independent comprehension of grade-level complex texts and mastery of tasks called for by the standards. |  |
| 1. Content and standards within the program of study are non-duplicative and vertically aligned to prepare students to transition seamlessly to the next level of education. |  |
| 1. The material provides many and varied opportunities for students to work with each standard within the grade level. |  |
| 1. The material cross-refers and integrates other content areas. |  |
| 1. The material has a balance of text types and lengths that encourage close, in-depth reading and rereading, analysis, comparison, and synthesis of texts. |  |
| 1. The material includes sufficient supplementary activities or assignments that are appropriately integrated into the text. |  |
| 1. The material has activities and assignments that develop problem-solving skills and foster synthesis and inquiry at both an individual and group level. |  |
| 1. The material has activities and assignments that reflect varied learning styles of students. |  |
| 1. The material includes appropriate instructional strategies. |  |
| 1. Project-based learning and related instructional approaches, such as problem-based, inquiry-based and challenge-based learning, are fully integrated into the material. |  |

Pedagogical Approach:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. Provides guidance for teachers throughout for how learning experiences build on each other to support students in developing a deep understanding of the content. |  |
| 1. Provides scaffolded supports for teachers to facilitate learning of the content so that students are increasingly responsible for making sense of the content. |  |
| 1. The material provides opportunities for supporting English language learners to regularly and actively participate with grade-level text. |  |
| 1. The material gives clear and concise instruction to teachers and students. It is easy to navigate and understand. |  |
| 1. Includes appropriate academic and content-specific vocabulary in the context of the learning experience that is accessible, introduced, reinforced, reviewed, and augmented with visual representations when appropriate. |  |
| 1. Allows teachers to access, revise, and print form digital resources (e.g., readings, labs, assessments, rubrics). |  |
| 1. Uses varied modes (selected, constructed, project-based, extended response, and performance tasks) of instruction-embedded pre-, formative, summative, peer, and, self-assessment measures of learning. |  |
| 1. Includes editable and aligned rubrics, scoring guidelines, and exemplars that provide guidance for assessing student performance and to support teachers in planning instruction and providing ongoing feedback to students. |  |
| 1. Provides multiple opportunities for students to demonstrate and receive feedback on performance of practices connected with their understanding of concepts. |  |

Presentation and Design:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. The material has an aesthetically appealing appearance. |  |
| 1. Digital and print materials are consistently formatted, visually focused, and uncluttered for efficient use. |  |
| 1. The material has a reasonable and appropriate balance between text and illustration. The material has grade-appropriate font size. |  |
| 1. The illustrations clearly cross-reference the text, are directly relevant to the content (not simply decorative), and promote thinking, discussion, and problem solving. |  |
| 1. Non-text content (performance clips, images, maps, globes, graphs, pictures, charts, databases, and models) are accurate and well integrated into the text. |  |

Technology:

| Standards | Justification: Provide examples from materials as evidence to support each response for this section. Provide descriptions, not just page numbers. |
| --- | --- |
| 1. Technology and digital media support, extend, and enhance learning experiences. |  |
| 1. The material has “platform neutral” technology (i.e., cloud based) and availability for networking. |  |
| 1. The material has a user-friendly and interactive interface allowing the user to control (shift among activities). |  |

For Questions Contact

Content & Curriculum

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1. [Idaho T&I HVAC Apprenticeship Year 1 Program Standards](https://cte.idaho.gov/wp-content/uploads/2019/12/HVAC-Apprenticeship-Year-1-Standards-2.pdf) [↑](#footnote-ref-1)
2. [Idaho T&I HVAC Apprenticeship Year 2 Program Standards](https://cte.idaho.gov/wp-content/uploads/2019/12/HVAC-Apprenticeship-Year-2-Standards-2.pdf) [↑](#footnote-ref-2)
3. [Idaho T&I HVAC Apprenticeship Year 3 Program Standards](https://cte.idaho.gov/wp-content/uploads/2019/12/HVAC-Apprenticeship-Year-3-Standards.pdf) [↑](#footnote-ref-3)
4. [Idaho T&I HVAC Apprenticeship Year 4 Program Standards](https://cte.idaho.gov/wp-content/uploads/2019/12/HVAC-Apprenticeship-Year-4-Standards.pdf) [↑](#footnote-ref-4)