|  |  |  |  |
| --- | --- | --- | --- |
| **CONTENT STANDARD 1.0: TRADE MATH** | | | |
| **Performance Standard 1.1: Basic Math** | | | |
| 1.1.1 | | | Perform addition, subtraction, multiplication, and division calculations of whole numbers. |
| 1.1.2 | | | Perform addition and subtraction calculations of common fractions. |
| 1.1.3 | | | Perform multiplication and division calculations of common fractions. |
| 1.1.4 | | | Perform addition, subtraction, multiplication, and division calculations of decimal fractions. |
| 1.1.5 | | | Perform ratio and proportion calculations. |
| 1.1.6 | | | Perform percent, percentage, and discount calculations. |
| 1.1.7 | | | Perform angular, length, and converted temperature measure calculations. |
| 1.1.8 | | | Perform area calculations. |
| 1.1.9 | | | Perform volume calculations. |
| 1.1.10 | | | Solve basic equations. |
| 1.1.11 | | | Demonstrate the use of order of operations. |
| **CONTENT STANDARD 2.0: GENERAL SAFETY** | | | |
| **Performance Standard 2.1: Workplace Safety** | | | |
| 2.1.1 | | | Describe potential excavation site hazards. |
| 2.1.2 | | | Explain proper personal protective equipment (PPE) use. |
| 2.1.3 | | | Describe proper material handling, storage, use, and disposal. |
| 2.1.4 | | | Describe ladder, stairway, and scaffold hazards and proper use. |
| 2.1.5 | | | Describe jobsite electrical hazards and proper lockout/tagout use. |
| 2.1.6 | | | Describe proper refrigerant and pressure vessel usage and storage. |
| 2.1.7 | | | Identify safety data sheets (SDS) properties of chemicals specific to HVAC. |
| 2.1.8 | | | Identify and describe environmental hazards (e.g. lead, silica, asbestos, carbon monoxide). |
| 2.1.9 | | | Identify the hazards associated with confined spaces. |
| 2.1.10 | | | Use appropriate fire extinguishers and other such safety devices. |
| 2.1.11 | | | Identify the importance safety procedures for brazing and soldering. |
| **CONTENT STANDARD 3.0: TOOLS AND MATERIALS** | | | |
| **Performance Standard 3.1: Power and Hand Tool Use** | | | |
| 3.1.1 | | | Describe proper hand tool use. |
| 3.1.2 | | | Describe proper power tool use. |
| 3.1.3 | | | Identify proper use of various types of torches. |
| 3.1.4 | | | Identify proper use of piping and tubing fabrication tools. |
| **CONTENT STANDARD 4.0: ENERGY SOURCES** | | | |
| **Performance Standard 4.1: Energy Sources** | | | |
| 4.1.1 | | | Explain natural, LP gas, and fuel oil combustion characteristics. |
| 4.1.2 | | | Describe the application of geothermal systems. |
| 4.1.3 | | | Describe the application of renewable energy systems. |
| 4.1.4 | | | Describe the application of electric production systems. |
| **CONTENT STANDARD 5.0: BASIC SYSTEMS OVERVIEW** | | | |
| **Performance Standard 5.1: Basic Systems Overview** | | | |
| 5.1.1 | | | Describe fossil-fuel and electrical furnace operations. |
| 5.1.2 | | | Describe the typical configuration of residential split air conditioning systems. |
| 5.1.3 | | | List various types of commercial air conditioning systems and their application. |
| 5.1.4 | | | Describe the configuration of common duct systems. |
| **CONTENT STANDARD 6.0: INTRO TO APPLIED SCIENCE** | | | |
| **Performance Standard 6.1: Intro to Applied Science** | | | |
| 6.1.1 | | | Perform energy conversion calculations. |
| 6.1.2 | | | Perform sensible, latent, and total heat calculations. |
| 6.1.3 | | | Differentiate between saturated, superheated, and subcooled refrigerant. |
| 6.1.4 | | | Explain atmospheric, absolute, and gauge pressure relationship. |
| 6.1.5 | | | Convert gauge pressure, absolute pressure, and vacuum. |
| 6.1.6 | | | Diagram a basic refrigeration cycle identifying pressure, temperature, and state of refrigerant. |
| 6.1.7 | | | List the type and function of the four major refrigeration components. |
| 6.1.8 | | | Describe the methods of heat transfer. |
| **CONTENT STANDARD 7.0: APPLIANCE INSTALLATION** | | | |
| **Performance Standard 7.1: Appliance Installation** | | | |
| 7.1.1 | | | Apply NEC standards to HVAC electrical circuit installations. |
| 7.1.2 | | | Interpret HVAC manufacturer electrical name plate data. |
| 7.1.3 | | | Apply appropriate code standards. |
| 7.1.4 | | | Describe gas, oil, and electrical appliance installation, start-up, and checkout procedures. |
| 7.1.5 | | | Describe sheet metal, fiberglass, and flex duct installation procedures. |
| 7.1.6 | | | Describe split and packaged air conditioning system installation, start-up, and checkout procedures. |
| **CONTENT STANDARD 8.0: INTRODUCTION TO CONSTRUCTION DRAWINGS AND SPECIFICATIONS** | | | |
| **Performance Standard 8.1: Introduction to Construction Drawings and Specifications** | | | |
| 8.1.1 | | | Identify the application of architectural plans and specifications. |
| 8.1.2 | | | Interpret mechanical, plumbing, and electrical drawing symbols. |
| 8.1.3 | | | Interpret specification documents and apply to plans. |
| 8.1.4 | | | Interpret shop drawings and apply to plans and specifications. |
| 8.1.5 | | | Describe a submittal and its derivation, routing, and makeup. |
| 8.1.6 | | | Develop cut lists for duct runs from shop drawings. |
| 8.1.7 | | | Interpret as-built modifications on HVAC mechanical plans. |
| 8.1.8 | | | Perform HVAC equipment and material takeoff. |
| **CONTENT STANDARD 9.0: BASIC ELECTRICITY** | | | |
| **Performance Standard 9.1: Basic Electricity** | | | |
| 9.1.1 | | | Describe basic electrical theory. |
| 9.1.2 | | | Describe series, parallel, and combination circuit characteristics. |
| 9.1.3 | | | Calculate electrical circuit values. |
| 9.1.4 | | | Describe electrical meter functions. |
| 9.1.5 | | | Measure electrical circuit values. |
| 9.1.6 | | | Identify electrical symbols. |
| 9.1.7 | | | Draw basic HVAC electrical circuit diagrams. |
| 9.1.8 | | | Interpret basic residential HVAC schematic diagrams. |
| 9.1.9 | | | Interpret basic commercial HVAC schematic diagrams. |
| 9.1.10 | | | Explain AC circuit characteristics. |
| 9.1.11 | | | Describe power distribution transformer systems. |
| 9.1.12 | | | Calculate HVAC branch circuit conductor, breaker, and disconnect sizes. |
| 9.1.13 | | | Describe basic motor theory. |
| 9.1.14 | | | Describe the five single-phase motor types. |
| 9.1.15 | | | Identify single-phase motor diagrams. |
| 9.1.16 | | | Explain single-phase motor starting relay operation. |
| 9.1.17 | | | Calculate motor capacitor replacement values. |
| 9.1.18 | | | Explain three-phase motor operation. |
| 9.1.19 | | | Explain ECM motor operation. |
| 9.1.20 | | | Perform Ohm’s law calculations to series, parallel, and combination circuits. |
| **CONTENT STANDARD 10.0: INDOOR AIR QUALITY** | | | |
| **Performance Standard 10.1: Indoor Air Quality** | | | |
| 10.1.1 | | | Describe indoor air quality (IAQ) factors as related to HVAC. |
| 10.1.2 | | | Identify various indoor air quality pollutant and pollutant pathways. |
| 10.1.3 | | | Describe indoor air quality evaluation and measurement tools. |
| 10.1.4 | | | Explain appropriate prevention, control, and resolution strategies for IAQ issues. |
| 10.1.5 | | | Recognize when to involve IAQ professionals as necessary. |
| **CONTENT STANDARD 11.0: RESIDENTIAL LOAD CALCULATIONS** | | | |
| **Performance Standard 11.1: Residential Load Calculations** | | | |
| 11.1.1 | | | Identify the importance of heat load calculation in building design. |
| 11.1.2 | | | Differentiate sensible, latent, and total heat gain/loss. |
| 11.1.3 | | | Determine U values and R values for various building construction components. |
| 11.1.4 | | | Calculate Btu gain/loss values using HTM and temperature difference factors. |
| 11.1.5 | | | Determine heating and cooling load temperature difference and daily range values. |
| 11.1.6 | | | Explain the relationship between house orientation and solar heat gain. |
| 11.1.7 | | | Perform building component area and volume calculations from construction drawings. |
| 11.1.8  11.1.9  11.1.10  11.1.12 | | | Perform winter/summer infiltration calculations using Manual J procedures.  Perform heat gain calculations using Manual J procedures.  Perform heat loss calculations using Manual J procedures.  Determine sensible, latent, and total heat for house block and room values. |
| **CONTENT STANDARD 12.0: BASIC CONTROLS** | | | |
| **Performance Standard 12.1: Basic Controls** | | | |
| 12.1.1 | | Differentiate between operating and safety controls. | |
| 12.1.2 | | Describe the sequence of operation of standing pilot, intermittent, and direct ignition control systems. | |
| 12.1.3 | | Interpret basic gas furnace wiring diagrams. | |
| 12.1.4 | | Explain oil furnace primary control operation. | |
| 12.1.5 | | Describe electric furnace operating sequence. | |
| 12.1.6 | | Describe hydronic heating system controls. | |
| 12.1.7 | | Describe basic motor circuit troubleshooting procedures. | |
| 12.1.8 | | Interpret packaged and split air conditioning systems and wiring diagrams. | |
| 12.1.9 | | Identify commercial and industrial air conditioning system control methods. | |
| 12.1.10 | | Describe basic electronic control system troubleshooting procedures. | |
| **CONTENT STANDARD 13.0: SYSTEM AIR FLOW AND DUCT SIZING** | | | |
| **Performance Standard 13.1: System Air Flow and Duct Sizing** | | | |
| 13.1.1 | | Describe basic air flow characteristics. | |
| 13.1.2 | | Explain duct system pressures. | |
| 13.1.3 | | Calculate duct system air flow. | |
| 13.1.4 | | Determine proper air flow requirements. | |
| 13.1.5 | | Describe air distribution system configurations. | |
| 13.1.6 | | Select primary heating/cooling equipment using nationally recognized standards. | |
| 13.1.7 | | Determine air-side component pressure drops from manufacturer tables. | |
| 13.1.8 | | Sketch a residential duct system layout using nationally recognized standards. | |
| 13.1.9 | | Determine duct size based on nationally recognized standards. | |
| **CONTENT STANDARD 14.0: BASIC AIR CONDITIONING AND REFRIGERATION** | | | |
| **Performance Standard 14.1: Basic Air Conditioning and Refrigeration** | | | |
| 14.1.1 | | Explain latent, sensible, and total heat differences. | |
| 14.1.2 | | Diagram refrigeration cycle conditions and components. | |
| 14.1.3 | | Explain pressure-enthalpy diagrams. | |
| 14.1.4 | | Describe compressor design differences, efficiencies, and applications. | |
| 14.1.5 | | Explain water/air-cooled condenser operation and performance. | |
| 14.1.6 | | Describe metering device design and operation. | |
| 14.1.7 | | Describe refrigeration accessory components and operation. | |
| 14.1.8 | | Describe evaporator types. | |
| 14.1.9 | | Identify proper refrigerant line sizing and installation practices. | |
| 14.1.10 | | Explain various refrigerant physical and chemical properties. | |
| 14.1.11 | | Explain refrigerant oil properties and application. | |
| 14.1.12 | | Describe proper refrigeration system access procedures. | |
| 14.1.13 | | Differentiate between recovered, recycled, and reclaimed refrigerant. | |
| 14.1.14 | | Describe proper refrigerant recovery, evacuation, and charging procedures. | |
| 14.1.15 | | Describe the operation of a variable refrigerant flow system. | |
| **CONTENT STANDARD 15.0: INTRODUCTION TO HYDRONIC SYSTEMS** | | | |
| **Performance Standard 15.1: Introduction to Hydronic Systems** | | | |
| 15.1.1 | | Identify hydronic piping system configurations. | |
| 15.1.2 | | Describe hydronic system components. | |
| 15.1.3 | | Explain hydronic systems drain and fill procedures. | |
| 15.1.4 | | Diagram basic hydronic system control circuits. | |
| **CONTENT STANDARD 16.0: BASIC SHEET METAL** | | | |
| **Performance Standard 16.1: Basic Sheet Metal** | | | |
| 16.1.1 | | Define sheet metal layout terms. | |
| 16.1.2 | | Explain parallel line development procedures. | |
| 16.1.3 | | Layout and fabricate the following sheet metal fitting: Pittsburgh seam and square elbow. | |
| 16.1.4 | | Layout and fabricate the following sheet metal fitting: 90 degree elbow and transition. | |
| 16.1.5 | | Explain radial line development procedures. | |
| 16.1.6 | | Layout and fabricate the following sheet metal fitting: symmetrical tapered duct. | |
| 16.1.7 | | Layout and fabricate the following sheet metal fitting: square to square tapered duct. | |
| 16.1.8 | | Explain triangulation development procedures. | |
| 16.1.9 | | Layout and fabricate the following sheet metal fitting: two-way offset transition. | |
| 16.1.10 | | Layout and fabricate the following sheet metal fitting: tapered duct section. | |
| **CONTENT STANDARD 17.0: INTRODUCTION TO SERVICE** | | | |
| **Performance Standard 17.1: Introduction to Service** | | | |
| 17.1.1 | | Identify air conditioning system problems. | |
| 17.1.2 | | Prescribe air conditioning system problem solutions. | |
| 17.1.3 | | Identify gas heating system problems. | |
| 17.1.4 | | Prescribe gas heating system problem solutions. | |
| 17.1.5 | | Identify oil heating system problems. | |
| 17.1.6 | | Prescribe oil heating system problem solutions. | |
| 17.1.7 | | Identify electric heating system problems. | |
| 17.1.8 | | Prescribe electric heating system problem solutions. | |
| 17.1.9 | | List gas, oil, and electric heating and air conditioning maintenance procedures. | |
| **CONTENT STANDARD 18.0: ADVANCED HVAC SYSTEMS** | | | |
| **Performance Standard 18.1: HVAC Systems** | | | |
| 18.1.1 | Explain commercial fan coil unit operation. | | |
| 18.1.2 | Explain package unit building system configurations. | | |
| 18.1.3 | Describe building chilled water system operation. | | |
| 18.1.4 | Describe induced and forced draft cooling tower operation. | | |