

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: FUEL GAS PIPING AND VENTING**Performance Standard 4.1: Fuel Gas Piping and Venting**

- 4.1.1 Identify HVAC IDAPA (define) rules and statutes.
- 4.1.2 Define key terms as applied to the IFGC.
- 4.1.3 Describe the building structural safety requirements for fuel gas equipment installation.

- 4.1.4 Determine proper fuel gas equipment combustion, ventilation, and dilution air requirements.
- 4.1.5 Identify the requirements for installation of fuel gas fired equipment in a masonry chimney.
- 4.1.6 Identify fuel gas equipment location, access, and service space requirements.
- 4.1.7 Describe proper appliance condensate disposal and clearance reduction methods.
- 4.1.8 Perform gas pipe sizing exercises.
- 4.1.9 Identify proper gas pipe installation methods.
- 4.1.10 Describe proper gas pipe inspection, testing, and purging procedures.
- 4.1.11 Describe chimney and vent types and construction.
- 4.1.12 Determine chimney installation requirements.
- 4.1.13 Determine gas vent installation requirements.
- 4.1.14 Describe gas appliance category I, II, III, IV characteristics.
- 4.1.15 Identify proper gas vent connector installation requirements.
- 4.1.16 Describe category I venting principles.
- 4.1.17 Perform single appliance category I vent sizing exercises.
- 4.1.18 Perform multiple appliance category I vent sizing exercises.
- 4.1.19 Determine capacity penalties for offsets in common vent and vent connectors.
- 4.1.20 Determine specific fuel gas appliance installation requirements.
- 4.1.21 Determine mechanical equipment location, access, and service space requirements.
- 4.1.22 Determine combustion air location and sizing requirements.

CONTENT STANDARD 5.0: ENERGY SOURCES

Performance Standard 5.1: Energy Sources

- 5.1.1 Explain natural, LP gas, and fuel oil combustion characteristics.
- 5.1.2 Describe the application of geothermal systems.
- 5.1.3 Describe the application of renewable energy systems.
- 5.1.4 Describe the application of electric production systems.

CONTENT STANDARD 6.0: BASIC SYSTEMS OVERVIEW

Performance Standard 6.1: Basic Systems Overview

- 6.1.1 Describe fossil-fuel and electrical furnace operations.
- 6.1.2 Describe the typical configuration of residential split air conditioning systems.
- 6.1.3 List various types of commercial air conditioning systems and their application.
- 6.1.4 Describe the configuration of common duct systems.

CONTENT STANDARD 7.0: INTRO TO APPLIED SCIENCE

Performance Standard 7.1: Intro to Applied Science

- 7.1.1 Perform energy conversion calculations.
- 7.1.2 Perform sensible, latent, and total heat calculations.
- 7.1.3 Differentiate between saturated, superheated, and subcooled refrigerant.
- 7.1.4 Explain atmospheric, absolute, and gauge pressure relationship.
- 7.1.5 Convert gauge pressure, absolute pressure, and vacuum.
- 7.1.6 Diagram a basic refrigeration cycle identifying pressure, temperature, and state of refrigerant.

- 7.1.7 List the type and function of the four major refrigeration components.
- 7.1.8 Describe the methods of heat transfer.

CONTENT STANDARD 8.0: APPLIANCE INSTALLATION

Performance Standard 8.1: Appliance Installation

- 8.1.1 Apply NEC standards to HVAC electrical circuit installations.
- 8.1.2 Interpret HVAC manufacturer electrical name plate data.
- 8.1.3 Apply appropriate code standards.
- 8.1.4 Describe gas, oil, and electrical appliance installation, start-up, and checkout procedures.
- 8.1.5 Describe sheet metal, fiberglass, and flex duct installation procedures.
- 8.1.6 Describe split and packaged air conditioning system installation, start-up, and checkout procedures.

CONTENT STANDARD 9.0: INTRODUCTION TO CONSTRUCTION DRAWINGS AND SPECIFICATIONS

Performance Standard 9.1: Introduction to Construction Drawings and Specifications

- 9.1.1 Identify the application of architectural plans and specifications.
- 9.1.2 Interpret mechanical, plumbing, and electrical drawing symbols.
- 9.1.3 Interpret specification documents and apply to plans.
- 9.1.4 Interpret shop drawings and apply to plans and specifications.
- 9.1.5 Describe a submittal and its derivation, routing, and makeup.
- 9.1.6 Develop cut lists for duct runs from shop drawings.
- 9.1.7 Interpret as-built modifications on HVAC mechanical plans.
- 9.1.8 Perform HVAC equipment and material takeoff.

CONTENT STANDARD 10.0: BASIC ELECTRICITY

Performance Standard 10.1: Basic Electricity

- 10.1.1 Describe basic electrical theory.
- 10.1.2 Describe series, parallel, and combination circuit characteristics.
- 10.1.3 Calculate electrical circuit values.
- 10.1.4 Describe electrical meter functions.
- 10.1.5 Measure electrical circuit values.
- 10.1.6 Identify electrical symbols.
- 10.1.7 Draw basic HVAC electrical circuit diagrams.
- 10.1.8 Interpret basic residential HVAC schematic diagrams.
- 10.1.9 Interpret basic commercial HVAC schematic diagrams.
- 10.1.10 Explain AC circuit characteristics.
- 10.1.11 Describe power distribution transformer systems.
- 10.1.12 Calculate HVAC branch circuit conductor, breaker, and disconnect sizes.
- 10.1.13 Describe basic motor theory.
- 10.1.14 Describe the five single-phase motor types.
- 10.1.15 Identify single-phase motor diagrams.

- 10.1.16 Explain single-phase motor starting relay operation.
- 10.1.17 Calculate motor capacitor replacement values.
- 10.1.18 Explain three-phase motor operation.
- 10.1.19 Explain ECM motor operation.
- 10.1.20 Perform Ohm's law calculations to series, parallel, and combination circuits.

CONTENT STANDARD 11.0: INDOOR AIR QUALITY

Performance Standard 11.1: Indoor Air Quality

- 11.1.1 Describe indoor air quality (IAQ) factors as related to HVAC.
- 11.1.2 Identify various indoor air quality pollutant and pollutant pathways.
- 11.1.3 Describe indoor air quality evaluation and measurement tools.
- 11.1.4 Explain appropriate prevention, control, and resolution strategies for IAQ issues.
- 11.1.5 Recognize when to involve IAQ professionals as necessary.

CONTENT STANDARD 12.0: RESIDENTIAL LOAD CALCULATIONS

Performance Standard 12.1: Residential Load Calculations

- 12.1.1 Identify the importance of heat load calculation in building design.
- 12.1.2 Differentiate sensible, latent, and total heat gain/loss.
- 12.1.3 Determine U values and R values for various building construction components.
- 12.1.4 Calculate Btu gain/loss values using HTM and temperature difference factors.
- 12.1.5 Determine heating and cooling load temperature difference and daily range values.
- 12.1.6 Explain the relationship between house orientation and solar heat gain.
- 12.1.7 Perform building component area and volume calculations from construction drawings.
- 12.1.8 Perform winter/summer infiltration calculations using Manual J procedures.
- 12.1.9 Perform heat gain calculations using Manual J procedures.
- 12.1.10 Perform heat loss calculations using Manual J procedures.
- 12.1.11 Determine sensible, latent, and total heat for house block and room values.

CONTENT STANDARD 13.0: BASIC CONTROLS

Performance Standard 13.1: Basic Controls

- 13.1.1 Differentiate between operating and safety controls.
- 13.1.2 Describe the sequence of operation of standing pilot, intermittent, and direct ignition control systems.
- 13.1.3 Interpret basic gas furnace wiring diagrams.
- 13.1.4 Explain oil furnace primary control operation.
- 13.1.5 Describe electric furnace operating sequence.
- 13.1.6 Describe hydronic heating system controls.
- 13.1.7 Describe basic motor circuit troubleshooting procedures.
- 13.1.8 Interpret packaged and split air conditioning systems and wiring diagrams.
- 13.1.9 Identify commercial and industrial air conditioning system control methods.
- 13.1.10 Describe basic electronic control system troubleshooting procedures.

CONTENT STANDARD 14.0: SYSTEM AIR FLOW AND DUCT SIZING

Performance Standard 14.1: System Air Flow and Duct Sizing

- 14.1.1 Describe basic air flow characteristics.

- 14.1.2 Explain duct system pressures.
- 14.1.3 Calculate duct system air flow.
- 14.1.4 Determine proper air flow requirements.
- 14.1.5 Describe air distribution system configurations.
- 14.1.6 Select primary heating/cooling equipment using nationally recognized standards.
- 14.1.7 Determine air-side component pressure drops from manufacturer tables.
- 14.1.8 Sketch a residential duct system layout using nationally recognized standards.
- 14.1.9 Determine duct size based on nationally recognized standards.

CONTENT STANDARD 15.0: BASIC AIR CONDITIONING AND REFRIGERATION

Performance Standard 15.1: Basic Air Conditioning and Refrigeration

- 15.1.1 Explain latent, sensible, and total heat differences.
- 15.1.2 Diagram refrigeration cycle conditions and components.
- 15.1.3 Explain pressure-enthalpy diagrams.
- 15.1.4 Describe compressor design differences, efficiencies, and applications.
- 15.1.5 Explain water/air-cooled condenser operation and performance.
- 15.1.6 Describe metering device design and operation.
- 15.1.7 Describe refrigeration accessory components and operation.
- 15.1.8 Describe evaporator types.
- 15.1.9 Identify proper refrigerant line sizing and installation practices.
- 15.1.10 Explain various refrigerant physical and chemical properties.
- 15.1.11 Explain refrigerant oil properties and application.
- 15.1.12 Describe proper refrigeration system access procedures.
- 15.1.13 Differentiate between recovered, recycled, and reclaimed refrigerant.
- 15.1.14 Describe proper refrigerant recovery, evacuation, and charging procedures.
- 15.1.15 Describe the operation of a variable refrigerant flow system.

CONTENT STANDARD 16.0: INTRODUCTION TO HYDRONIC SYSTEMS

Performance Standard 16.1: Introduction to Hydronic Systems

- 16.1.1 Identify hydronic piping system configurations.
- 16.1.2 Describe hydronic system components.
- 16.1.3 Explain hydronic systems drain and fill procedures.
- 16.1.4 Diagram basic hydronic system control circuits.

CONTENT STANDARD 17.0: BASIC SHEET METAL

Performance Standard 17.1: Basic Sheet Metal

- 17.1.1 Define sheet metal layout terms.
- 17.1.2 Explain parallel line development procedures.
- 17.1.3 Layout and fabricate the following sheet metal fitting: Pittsburgh seam and square elbow.
- 17.1.4 Layout and fabricate the following sheet metal fitting: 90 degree elbow and transition.
- 17.1.5 Explain radial line development procedures.
- 17.1.6 Layout and fabricate the following sheet metal fitting: symmetrical tapered duct.
- 17.1.7 Layout and fabricate the following sheet metal fitting: square to square tapered duct.
- 17.1.8 Explain triangulation development procedures.

- 17.1.9 Layout and fabricate the following sheet metal fitting: two-way offset transition.
- 17.1.10 Layout and fabricate the following sheet metal fitting: tapered duct section.

CONTENT STANDARD 18.0: INTRODUCTION TO SERVICE**Performance Standard 18.1: Introduction to Service**

- 18.1.1 Identify air conditioning system problems.
- 18.1.2 Prescribe air conditioning system problem solutions.
- 18.1.3 Identify gas heating system problems.
- 18.1.4 Prescribe gas heating system problem solutions.
- 18.1.5 Identify oil heating system problems.
- 18.1.6 Prescribe oil heating system problem solutions.
- 18.1.7 Identify electric heating system problems.
- 18.1.8 Prescribe electric heating system problem solutions.
- 18.1.9 List gas, oil, and electric heating and air conditioning maintenance procedures.

CONTENT STANDARD 19.0: FUNDAMENTALS OF PSYCHOMETRICS**Performance Standard 19.1: Fundamentals of Psychometrics**

- 19.1.1 Explain psychometric properties.
- 19.1.2 Diagram psychometric conditions.
- 19.1.3 Describe comfort conditions as applied to psychometric properties.
- 19.1.4 Use the psychometric chart to measure enthalpy.

CONTENT STANDARD 20.0: TESTING AND BALANCING**Performance Standard 20.1: Testing and Balancing**

- 20.1.1 Describe air flow and water flow measuring devices.
- 20.1.2 Explain basic air flow and water flow balancing procedures.

CONTENT STANDARD 21.0: INTRODUCTION TO HVAC CONTROL STRATEGIES**Performance Standard 21.1: Introduction to HVAC Control Strategies**

- 21.1.1 Describe basic HVAC control principles.
- 21.1.2 Interpret basic HVAC pneumatic control diagrams.
- 21.1.3 Explain DDC control system basic operation.

CONTENT STANDARD 22.0: ADVANCED HVAC SYSTEMS**Performance Standard 22.1: HVAC Systems**

- 22.1.1 Explain commercial fan coil unit operation.
- 22.1.2 Explain package unit building system configurations.
- 22.1.3 Describe building chilled water system operation.
- 22.1.4 Describe induced and forced draft cooling tower operation.

Performance Standard 22.2: Heat Pump Systems

- 22.2.1 Explain heat pump heating and cooling cycles.
- 22.2.2 Describe the purpose and operation of various heat pump components.
- 22.2.3 Prescribe heat pump charging procedures.
- 22.2.5 Differentiate heat pump time/temperature and demand defrost control systems.
- 22.2.8 Explain geothermal heat pump system applications.
- 22.2.9 Describe water-to-air and air-to-water heat pump operation.

CONTENT STANDARD 23.0: ADVANCED TROUBLESHOOTING

Performance Standard 23.1: Advanced Troubleshooting

- 23.1.1 Describe air flow troubleshooting procedures.
- 23.1.2 Determine operating conditions at variable loads.
- 23.1.3 Describe refrigeration side troubleshooting procedures.
- 23.1.4 Troubleshoot residential and commercial control systems.
- 23.1.5 Interpret manufacturer schematics.
- 23.1.6 Analyze furnace troubleshooting values.
- 23.1.7 Apply furnace troubleshooting values.

CONTENT STANDARD 24.0: CODE REVIEW

Performance Standard 24.1: Code Review

- 24.1.1 Apply international fuel gas code standards.
- 24.1.2 Apply international mechanical code standards.
- 24.1.3 Apply HVAC rules and statutes as it pertains to the IDAPA administrative code.