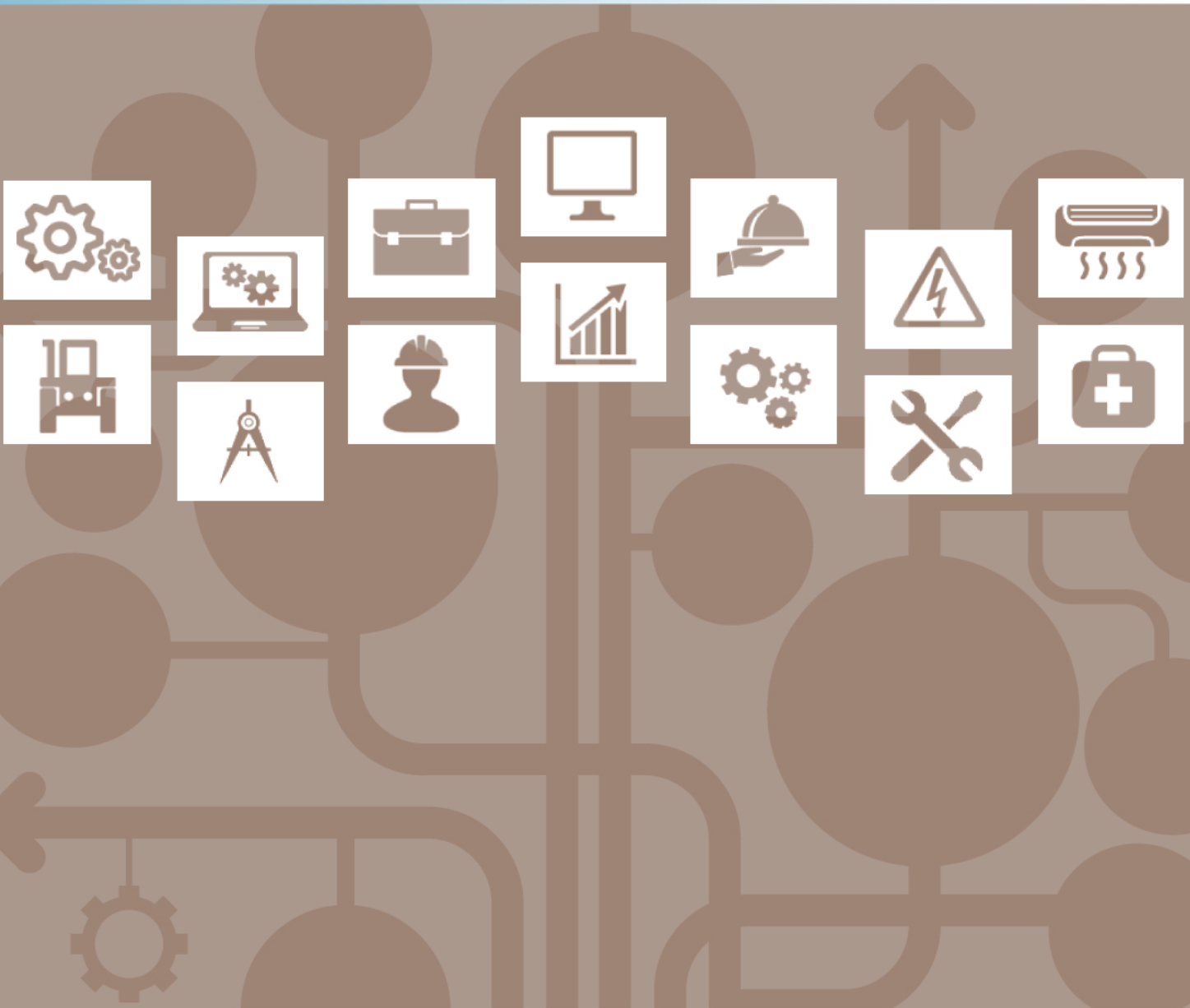


*Entry Level Assessment Blueprint*

**Heating, Ventilation and Air Conditioning (HVAC)**



## Specific Competencies and Skills Tested in this Assessment:

### Electricity

- Demonstrate understanding of basic AC/DC theory
- Understand and use electrical formulas
- Interpret and construct electrical diagrams
- Understand series and parallel circuits
- Understand and use ohmmeters, voltmeters, and ammeters
- Identify and test various electrical components
- Apply and manipulate Ohm's Law
- Demonstrate knowledge of wiring exercises
- Perform troubleshooting
- Understand and test transformers
- Replace 3-phase motors (wire for high and low volts)
- Wire residential heat pump control circuits
- Test capacitors and calculate multiple capacitors
- Test fuses and calculate fuse size



### Soldering, Brazing, and Welding

- Identify types of solder and alloys
- Choose proper flux for each alloy
- Understand soldering and brazing of tubings and fittings
- Use nitrogen or carbon dioxide when brazing
- Understand measurement taking
- Set-up/use of torch and equipment
- Demonstrate understanding of gas welder usage
- Understand leak check procedures
- Indicate melting temperatures

### ***Specific Competencies and Skills continued:***

#### **Pipefitting**

- Interpret drawings on blueprints
- Display knowledge of working with tubing and/or pipe
- Identify valves and fittings

#### **Controls**

- Differentiate types of metering valves
- Demonstrate knowledge of the function of a distributor
- Identify methods of defrosting refrigeration systems
- Identify, test, and calibrate controls
- Demonstrate knowledge of thermostat installation
- Test motor starting relays

#### **Installation and Service**

- Identify and use appropriate hand and power tools
- Test, analyze, troubleshoot, and repair system
- Service motor components
- Service coolers (reach-in and walk-in)
- Demonstrate knowledge of code regulations

#### **Related Math and Science**

- Use temperature conversion scales
- Identify modes of heat transfer
- Demonstrate understanding of British Thermal Unit (BTU)
- Demonstrate understanding of compression ratio
- Measuring in increments
- Calculate GPM, CFM, and CFM per ton
- Calculate materials cost

## ***Specific Competencies and Skills continued:***

### **Refrigeration**

- Identify refrigerant types for proper application
- Understand how to evacuate and charge a refrigeration system
- Service and troubleshoot refrigeration systems
- Size refrigerant lines
- Understand compressor operation
- Identify absorption and centrifugal system components
- Understand defrost procedures
- Measure superheat
- Understand refrigeration safety techniques

### **Refrigerant Recovery**

- Define recovery, reclamation, and recycling
- Demonstrate knowledge of the Montreal Protocol
- Identify refrigerants by chemical family
- Properly handle and dispose of refrigerants



### **General Safety**

- Demonstrate knowledge of basic first-aid skills and procedures
- Demonstrate knowledge of ladder safety
- Demonstrate knowledge of personal protective equipment (PPE)
- Identify and use fire extinguishers
- Demonstrate knowledge of electrical safety procedures
- Demonstrate knowledge of safe lifting techniques
- Demonstrate knowledge of correct handling and reporting of accidents
- Demonstrate knowledge of safe equipment repair practices
- Demonstrate knowledge of HVAC-specific safety procedures

### **Computer Literacy**

- Demonstrate basic understanding of common operating systems
- Demonstrate basic understanding of basic word processing procedures and techniques
- Identify and prepare basic spreadsheets
- Prepare and maintain basic database

## ***Specific Competencies and Skills continued:***

### **Employability Skills**

- Demonstrate understanding of resumé and job interview skills
- Identify the components and requirements for effective oral presentations
- Demonstrate understanding of proposal and technical writing
- Demonstrate knowledge of organizational skills

### **Air Conditioning**

- Identify refrigerants by pressures or color codes
- Identify types of compressors, condensing units, and evaporator units
- Perform troubleshooting, use test equipment
- Service air conditioning systems
- Measure superheat and subcooling
- Test, analyze, and replace compressors
- Identify and understand cooling towers



### **Heat Pumps and Electric Heat**

- Demonstrate understanding of refrigeration reversing cycle
- Identify different types of defrosting
- Perform troubleshooting of heat pumps
- Service heat pump systems
- Demonstrate understanding of emergency heat
- Demonstrate understanding of electric furnaces
- Identify sequencing contacts and coils
- Demonstrate knowledge of wire ampacity
- Identify types of heat pumps

### **Hydronic Systems**

- Demonstrate understanding of hydronic system operation
- Identify hydronic components
- Demonstrate understanding of hydronic operating pressures and temperatures
- Demonstrate understanding of temperature controls
- Demonstrate understanding of steam traps
- Demonstrate knowledge of low water cut-offs

### ***Specific Competencies and Skills continued:***

#### **Forced Air, Gas, and Oil Units**

- Explain theory of operation
- Explain temperature rise
- Identify type of furnace by air flow
- Identify different types of blowers
- Identify types of burners
- Understand removal and installation of burner assembly
- Understand reassembly of burner tubes
- Identify and use components (high limits, pressure regulators)
- Use proper hand tools for application
- Troubleshoot forced air, gas, or oil units
- Understand operation principles for pilot proving devices
- Understand proper operation adjustments (measure gas pressure, etc.)
- Demonstrate knowledge of reading gas meters, calculating gas consumption
- Determine proper orifice size
- Test thermocouples, power piles, etc.
- Understand flue installation
- Demonstrate understanding of primary controls
- Demonstrate knowledge of purging and adjusting an oil pump
- Understand how to select single and/or dual-stage pumps

#### **Humidity and Air Movement**

- Understand the concept of humidity and its effects
- Distinguish between wet and dry bulb thermometers
- Test electronic air cleaners
- Identify humidifiers and associated components

***Specific Competencies and Skills continued:***

**Sheet Metal and Ductwork**

- Identify fittings used in ductwork systems
- Understand how to calculate materials list for a duct system
- Use measurements from blueprints
- Understand how to fabricate a fiberglass and a metal duct
- Understand use of duct fasteners and supports
- Understand how to line ducts
- Understand how to layout duct fittings and components
- Identify sheet metals
- Measure sheet thickness
- Identify sheet metal tools
- Identify the terms "IC" and "IX"



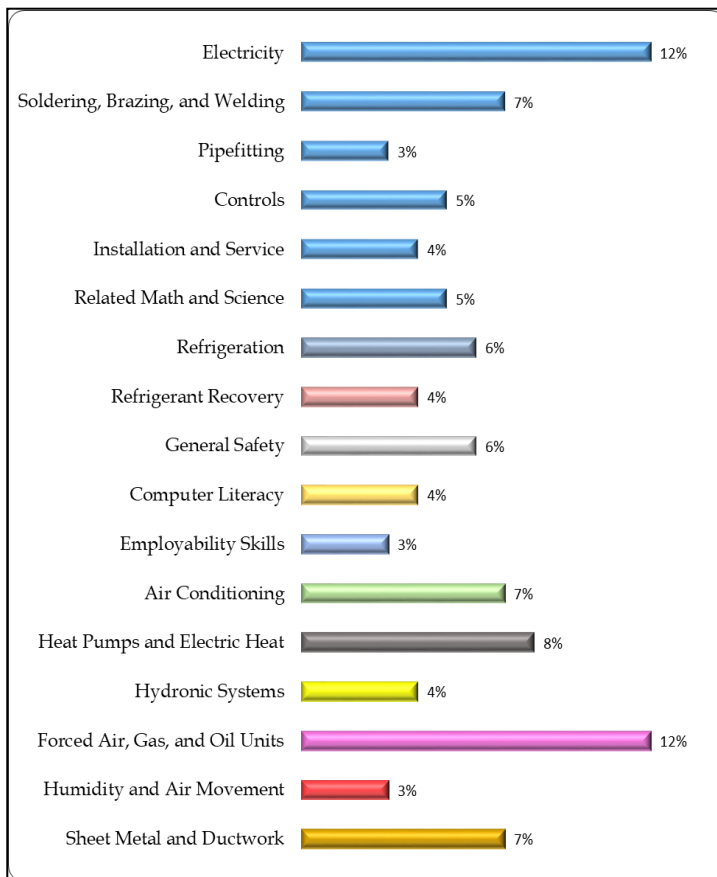
## Written Assessment:

**Administration Time:** 3 hours

**Number of Questions:** 200

### Areas Covered:

12%	Electricity
7%	Soldering, Brazing, and Welding
3%	Pipefitting
5%	Controls
4%	Installation and Service
5%	Related Math and Science
6%	Refrigeration
4%	Refrigerant Recovery
6%	General Safety
4%	Computer Literacy
3%	Employability Skills
7%	Air Conditioning
8%	Heat Pumps and Electric Heat
4%	Hydronic Systems
12%	Forced Air, Gas, and Oil Units
3%	Humidity and Air Movement
7%	Sheet Metal and Ductwork





## Sample Questions:

Heater elements in a magnetic starter are used to

- A. mount the starter on the panel board
- B. keep the starter warm during cold weather
- C. protect the motor from overloads
- D. increase rpms

A complete refrigeration system consists of a compressor, condenser, metering device, and a/an

- A. evaporator
- B. expansion valve
- C. high pressure coil
- D. accumulator

The liquid line temperature is used to determine the \_\_\_\_\_ of a condenser.

- A. superheat
- B. lowside pressure
- C. suction pressure
- D. subcooling

Wet and dry-bulb thermometers will read the same under conditions of \_\_\_\_\_ humidity.

- A. 10 percent
- B. 50 percent
- C. 75 percent
- D. 100 percent

The bottom edge of the circumference scale is used for finding the \_\_\_\_\_ of a circle.

- A. area
- B. volume
- D. circumference
- D. radius

## Performance Assessment:

**Administration Time:** 3 hours and 30 minutes

**Number of Jobs:** 2

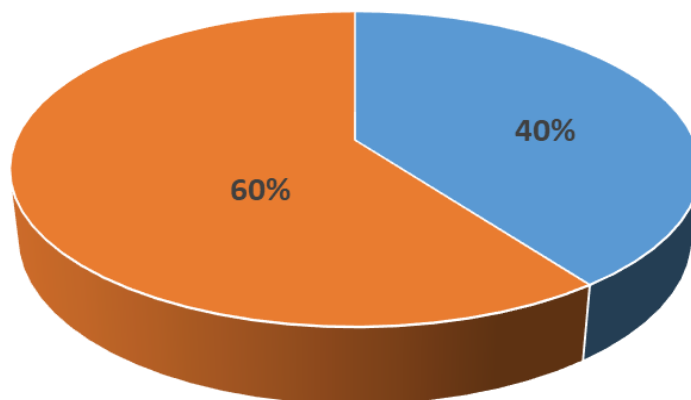
### Areas Covered:

#### 40% **Gas Furnace Start-up and Check**

Evaluation of assigned order, leak test gas connections, test supply gas pressure, test electric connection for voltage and polarity, start equipment, adjust thermostat heat anticipator setting, test manifold gas pressure, test temperature rise through unit, check fan motor amperage draw, perform steady state efficiency test, complete system operation sheet, time to complete Job 1.

#### 60% **Air Conditioning**

Evaluation of assigned order, remove unit panels and service caps, wire low voltage control circuit, verify no voltage on all wires, test capacitors, perform compressor checks, check line voltage upstream of disconnect fuses, close disconnect, check line voltage downstream of disconnect fuses, verify and record line voltage at the condensing unit, perform transformer terminals check, measure fan motor common leg amperage, calculate CFM, connect refrigeration gauges and purge air, record/correct/convert pressures, check suction line temperature at evaporator outlet, check/diagnose liquid line drier, evacuate line set and indoor coil, charge refrigerant into system, perform system check, check voltage at air handling unit/heat strips, check heat strips current draw, check dry bulb temperature rise, verify heating/cooling to specifications/enthalpy chart, reinstall unit panels and service caps, time to complete Job 2.



**Sample Job:** Gas Furnace Start-Up and Check

**Maximum Time:** 1 hour and 30 minutes

**Participant Activity:** Following the instructions provided, the participant will perform start-up tests on a high efficiency (90 +) gas furnace. The participant will make the necessary adjustments to meet manufacturer's specification for proper operation and perform a steady state efficiency test.

