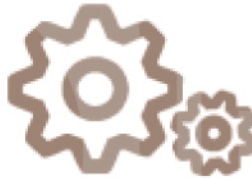


*Experienced Worker Assessment Blueprint*

*HVAC - Heating, Ventilation and Air Conditioning*



## **Specific Competencies and Skills Tested in this Assessment:**

### **Electricity**

- Demonstrate understanding of basic AC/DC theory
- Demonstrate understanding of series/parallel circuits
- Use electrical formulas
- Interpret symbols on an electrical diagram
- Interpret and construct electrical diagrams
- Use ohmmeters, voltmeters, ammeters
- Identify different electrical components (motor, starter, relays, etc.)
- Identify and classify types of electrical motors
- Perform troubleshooting
- Distinguish between different kinds of wiring diagrams
- Apply and manipulate Ohm's Law
- Test motors (and identify motor protection)
- Test transformers
- Replace 3-phase motors (wire for high and low volts)
- Test capacitors and calculate multiple capacitors
- Test fuses and calculate size

### **Soldering, Brazing, and Welding**

- Identify types of solder and alloys
- Choose proper flux for each alloy
- Indicate melting temperatures
- Prepare materials
- Set up and use torch and equipment
- Demonstrate techniques of soldering and brazing
- Take measurements
- Check for leaks
- Weld with an arc, MIG, and TIG welder
- Weld with a gas welder
- Solder sheet metal
- Cut with a plasma cutter
- Use nitrogen or carbon dioxide when brazing
- Braze tubing
- Braze copper to brass
- Solder tubing

***Specific Competencies and Skills continued:*****Air Conditioning**

- Identify refrigerants by pressures or color codes
- Identify types of compressors, condensing units, and evaporator units
- Demonstrate understanding of thermodynamic charts
- Use refrigerant pressure-temperature charts
- Explain concept of Btu (heat)
- Demonstrate understanding of heat transfer
- Explain a ton of cooling
- Use test equipment (refrigerant gauges, temperature meters, etc.)
- Use hand tools
- Perform troubleshooting
- Repair and maintain cooling towers
- Service air conditioning systems
- Measure superheat
- Measure subcooling
- Demonstrate adjustment of TXV
- Test, analyze, and replace compressors

**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 delta T
- Identify Btu content of each fuel
- Calculate amount of heat in electricity
- Identify and use components (high limits, pressure regulators, etc.)
- Explain sizing of fuel pipes
- Identify difference between conventional and new condensing units
- Explain combustion process
- Demonstrate methods of cleaning air
- Use hand tools
- Perform troubleshooting
- Contrast natural and liquefied petroleum gas
- Identify types of gas valves and fittings
- Explain principle of operation of pilot proving devices
- Determine difference between input Btu and output Btu

***Specific Competencies and Skills continued:*****Forced Air, Gas, and Oil Units continued:**

- Adjust for proper operation (gas pressure, primary/secondary air)
- Calibrate and adjust thermostat
- Adjust air flow, high limit, and fan control settings
- Read gas meters
- Calculate gas consumption
- Determine proper orifice size
- Convert from one fuel to another
- Use test equipment
- Test thermocouples and power piles
- Measure gas pressure
- Test for combustible gas leaks
- Test combustion
- Demonstrate reassembly of burner tubes
- Demonstrate knowledge of flue installation
- Demonstrate knowledge of gas codes
- Select components (fuel pumps, nozzles, transformers, electrodes)
- Use and adjust barometric dampers
- Determine Btu content of fuel oils
- Explain operation of high-pressure, gun-type burners
- Demonstrate understanding of primary controls
- Explain the effects of air in the fuel system
- Use test equipment
- Install flue systems
- Use combustion test equipment
- Set electrodes
- Demonstrate cleaning of heat exchanger
- Demonstrate belt tension adjustment
- Remove and install burner assembly
- Purge and adjust oil pump
- Select single- and dual-stage pumps

**Hydronic Systems**

- Demonstrate understanding of hydronic system operation
- Differentiate between types of systems (series loop, monoflow, etc.)
- Identify components (regulating valves, safety-relief valves, etc.)
- Demonstrate understanding of operating pressures and temperatures
- Demonstrate understanding of temperature controls
- Use hand tools
- Demonstrate understanding of steam traps

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

#### **Hydronic Systems continued:**

- Identify heat exchanger types
- Demonstrate knowledge of low water cut-offs

#### **Refrigerant Recovery**

- Define recovery, reclamation, and recycling
- Demonstrate knowledge of venting law
- Demonstrate proper handling and disposal of refrigerants
- Demonstrate knowledge of certification types
- Demonstrate use of recovery equipment – passive
- Demonstrate use of recovery equipment – active
- Explain the Montreal Protocol
- Identify refrigerants by chemical family



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

- Demonstrate understanding of refrigeration reversing cycle
- Identify different types of defrosting
- Identify refrigerant types
- Calculate CFM
- Perform troubleshooting
- Service heat pump systems
- Demonstrate understanding of emergency heat
- Demonstrate understanding of electric furnaces
- Identify sequencing contacts and coil
- Demonstrate knowledge of wire ampacity
- Wire control circuits
- Identify types of heat pumps

#### **Pipefitting**

- Interpret drawing on blueprints
- Measure and cut tubing or pipe
- Ream or deburr tubing or pipe
- Assemble sections of tubing or pipe
- Flare tubing
- Thread pipe

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

#### **Pipefitting continued:**

- Drill or cut holes for installation of tubing or pipe
- Identify valves and fittings
- Measure and bend tubing or pipe
- Calculate offsets
- Demonstrate rigging skills
- Install pipe supports

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

- Apply fan laws
- Balance ductwork system
- Identify fittings used in a ductwork system
- Determine make-up air requirements
- Demonstrate understanding of humidity
- Explain the effect of humidity on the movement of air
- Distinguish between wet and dry bulb
- Use psychometric instruments
- Test electronic air cleaners
- Test humidifiers
- Identify system components
- Locate diffuser and return grills
- Measure air movement
- Design residential duct system
- Calculate materials list for a duct system
- Fabricate fiberglass duct

#### **Controls**

- Identify low- and high-pressure controls
- Differentiate between a range and a differential adjustment
- Explain pressures required to operate an oil safety switch
- Differentiate between types of metering valves
- Explain the function of a distributor
- Explain application, function, and operation of refrigerant controls
- Test and set fan and limit controls
- Test and calibrate thermostats
- Install thermostats
- Test cad cells
- Test aquastats
- Test refrigerant system oil safety controls

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

- Test motor starting relays
- Test defrost system components
- Test motor safety controls
- Test high/low pressure switches

**Installation and Service**

- Identify and use appropriate hand and power tools
- Test, analyze, troubleshoot, and repair system
- Service motor components (V-belts, mounts, pulleys, etc.)
- Install an A/C system
- Install and service forced air systems
- Install and service hydronic systems
- Install and service heat pump systems
- Install and service chilled water systems
- Install and service oil fired systems
- Demonstrate knowledge of local and state codes

**General Safety**

- Demonstrate ladder safety
- Use personal protective wear
- Demonstrate fire extinguisher use
- Demonstrate safe tools use
- Demonstrate electrical safety
- Demonstrate safe lifting
- Demonstrate reporting accidents
- Use goggles/helmet when welding
- Demonstrate safe equipment repair practices
- Demonstrate eye washing techniques

**Related Math and Science**

- Use temperature conversion scales
- Identify modes of heat transfer
- Demonstrate understanding of British thermal unit
- Explain total enthalpy related to latent and sensible heat
- Demonstrate understanding of compression ratio
- Explain how compression ratio applies to system efficiency
- Demonstrate understanding of gas laws
- Chart wet- and dry-bulb temperature

***Specific Competencies and Skills continued:*****Related Math and Science continued:**

- Calculate CFM
- Measure pressure
- Demonstrate understanding of combustion
- Calculate duct loss
- Calculate structure loss and gain
- Calculate area and volume
- Demonstrate understanding of balance points
- Calculate temperature rise
- Calculate solar energy
- Determine the solar constant
- Measure solar energy
- Measure in fractions
- Calculate circumference and diameter
- Measure pressures
- Calculate CFM per ton
- Use the psychometric chart
- Calibrate temperature- and pressure-measurement equipment
- Calculate GPM
- Calculate temperature rise
- Calculate materials cost
- Calculate trigonometry
- Interpolate values

**Sheet Metal and Ductwork**

- Demonstrate use of sheet metal table and hand tools
- Identify duct materials
- Use measurements from blueprints
- Layout duct fittings and components
- Identify sheet metals (copper, aluminum, galvanized, etc.)
- Identify terms IC and IX
- Measure sheet thickness
- Build metal ducts
- Build fiberglass ducts
- Determine fiberglass duct application limits
- Identify fiberglass duct building tools
- Install duct system components
- Line ducts
- Use duct fasteners
- Identify sheet metal tools
- Demonstrate knowledge of duct supports



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

#### **Employability Skills**

- Demonstrate CPR
- Demonstrate first aid
- Prepare a resume
- Demonstrate knowledge of blueprint reading
- Demonstrate oral presentation
- Demonstrate proposal writing
- Demonstrate technical writing
- Demonstrate use of income tax forms
- Apply recordkeeping skills
- Demonstrate personal hygiene

#### **Computer Literacy**

- Demonstrate knowledge of DOS
- Demonstrate word processing
- Demonstrate use of spreadsheets
- Demonstrate knowledge of databases
- Use a keyboard to input data

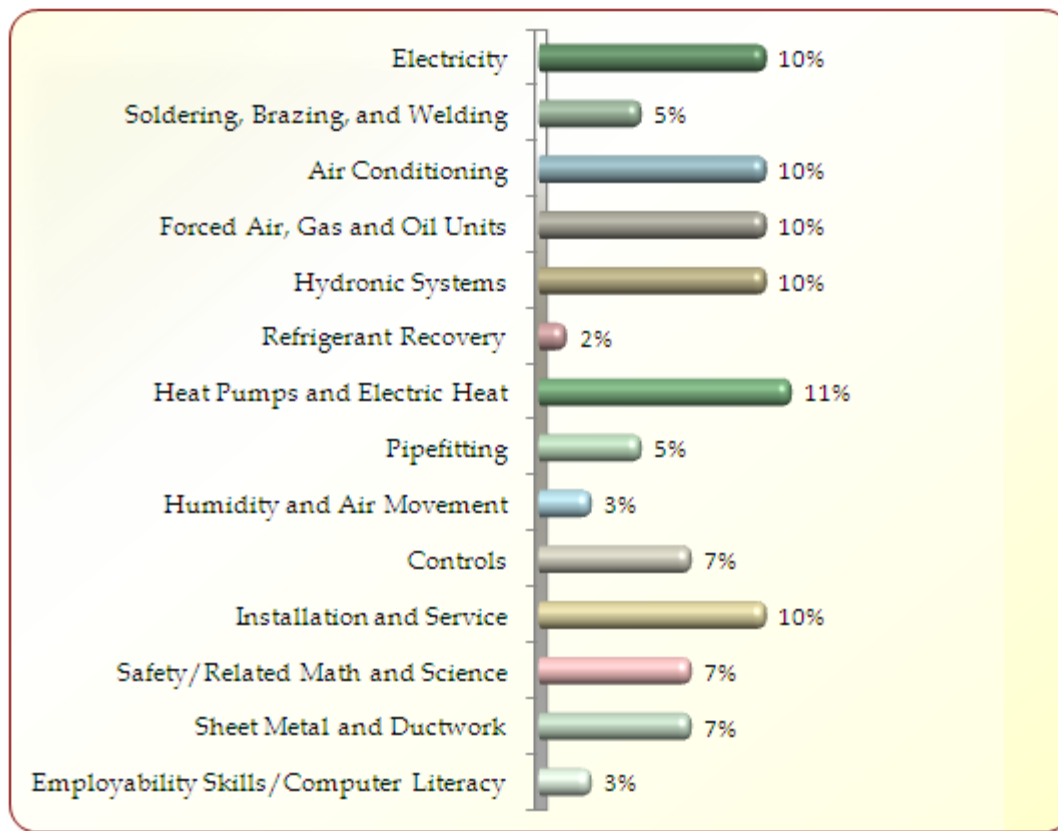


## Written Assessment:

**Administration Time:** 3 hours

**Number of Questions:** 199

## Areas Covered:



## Sample Questions:

When using a meter to check a load that is not operating, the first check that should be made is

- A. amperage
- B. voltage
- C. resistance
- D. wattage

50/50 solder has a melting temperature of approximately

- A. 450 degrees Fahrenheit
- B. 800 degrees Fahrenheit
- C. 1100 degrees Fahrenheit
- D. 1350 degrees Fahrenheit

Which of the following is not a system defect of an insufficient heat call?

- A. fan pulley loose
- B. fan does not stop running
- C. fan belt loose or off
- D. fan too small

When operating a steam system, the limit control is known as a/an

- A. astat
- B. pressure control
- C. flow-trol
- D. air switch

How would a service technician test an aquastat to see when it opens?

- A. Read a potential difference across the terminals.
- B. Touch his/her fingers across the points.
- C. Place a jumper across the terminals.
- D. Test with an ohmmeter when the pump is running.

## Performance Assessment:

**Administration Time:** 3 hours

**Number of Jobs:** 2

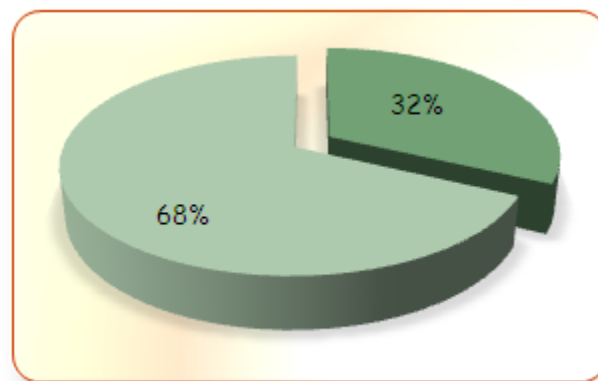
### Areas Covered:

#### **32% Fabricate a Heat Exchanger**

*Interpretation of drawing, measurement and cutting, reaming and deburring, flaring, drilling, soldering, assembly, selection of solder, measurement of parts, performance of leak test and overall quality.*

#### **68% Air Conditioning**

*Selection of tools and test instruments, voltage check, connection of refrigeration gauges, identification of compressor terminal sequence, testing of capacitors, measurements of amperage and voltage, recording of pressures, recording of dry bulb air temperature rise and drop, recording of heat strip current draw, recording of suction line temperature, recording of liquid line temperature, diagnosis of restricted liquid line drier, evacuation of liquid line drier, evaporator coil and suction line, checking of system for superheat, subcooling, air temperature, evaporating and condensing temperature difference, removal and reinstallation of unit panels, reading and recording of system pressures.*



**Sample Job:** Fabricate a Heat Exchanger

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

**Participant Activity:** The participant will fabricate a heat exchanger in accordance with the diagram provided in the participant's test booklet. When finished, the evaluator will pressurize and test the unit. Proper use of tools and knowledge of safety regulations must be demonstrated.

