

Job Ready Assessment Blueprint

Heating, Ventilation, and Air Conditioning
(HVAC)



Test Code: 3045 / Version: 01

General Assessment Information

Blueprint Contents

General Assessment Information	Sample Written Items
Written Assessment Information	Performance Assessment Information
Specific Competencies Covered in the Test	Sample Performance Job

Test Type: The Heating, Ventilation, and Air Conditioning (HVAC) is included in NOCTI's Job Ready assessment battery. Job Ready assessments measure technical skills at the occupational level and include items which gauge factual and theoretical knowledge. Job Ready assessments typically offer both a written and performance component and can be used at the secondary and post-secondary levels. Job Ready assessments can be delivered in an online or paper/pencil format.

Revision Team: The assessment content is based on input from secondary, post-secondary, and business/industry representatives from the states of Connecticut, Mississippi, New Jersey, New York, Pennsylvania, and Tennessee.



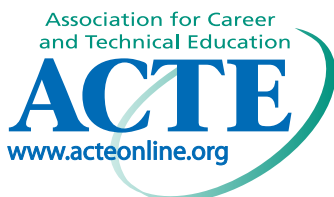
47.0201- Heating, Air Conditioning, Ventilation, and Refrigeration Maintenance Technology/Technician



Career Cluster 2- Architecture and Construction



49-9021.01- Heating and Air Conditioning Mechanics and Installers



The Association for Career and Technical Education (ACTE), the leading professional organization for career and technical educators, commends all students who participate in career and technical education programs and choose to validate their educational attainment through rigorous technical assessments. In taking this assessment you demonstrate to your school, your parents and guardians, your future employers and yourself that you understand the concepts and knowledge needed to succeed in the workplace. Good Luck!



The Pennsylvania Builder's Association utilizes this assessment to assist in determining competencies for granting skill certificates to students graduating from Pennsylvania secondary trade programs that have been endorsed by the Pennsylvania Builder's Association (PBA)

PBA's services include support to workforce training and education by linking industry employers with educators to grow the workforce of tomorrow. PBA serves Pennsylvania communities and consumers through its steadfast efforts to protect homeownership rights and advocate for affordable housing options. PBA is affiliated with the National Association of Home Builders.



Home Builders Institute (HBI), an affiliate of the National Association of Home Builders (NAHB), is a national leader for career training in the building industry. HBI's educational materials are designed to be relevant in today's rapidly changing environment, bringing increased professionalism, competency and effectiveness to those entering the residential construction workforce.

HBI/NAHB assessments are based on national skill standards set by NAHB industry professionals and educators as are the materials contained in the Residential Construction Academy Series. Participants passing the assessments are eligible for certification through HBI/NAHB at the entry, semi-skilled or skilled levels.



In the lower division baccalaureate/associate degree category, 3 semester hours in HVAC, or General Technology.

Written Assessment

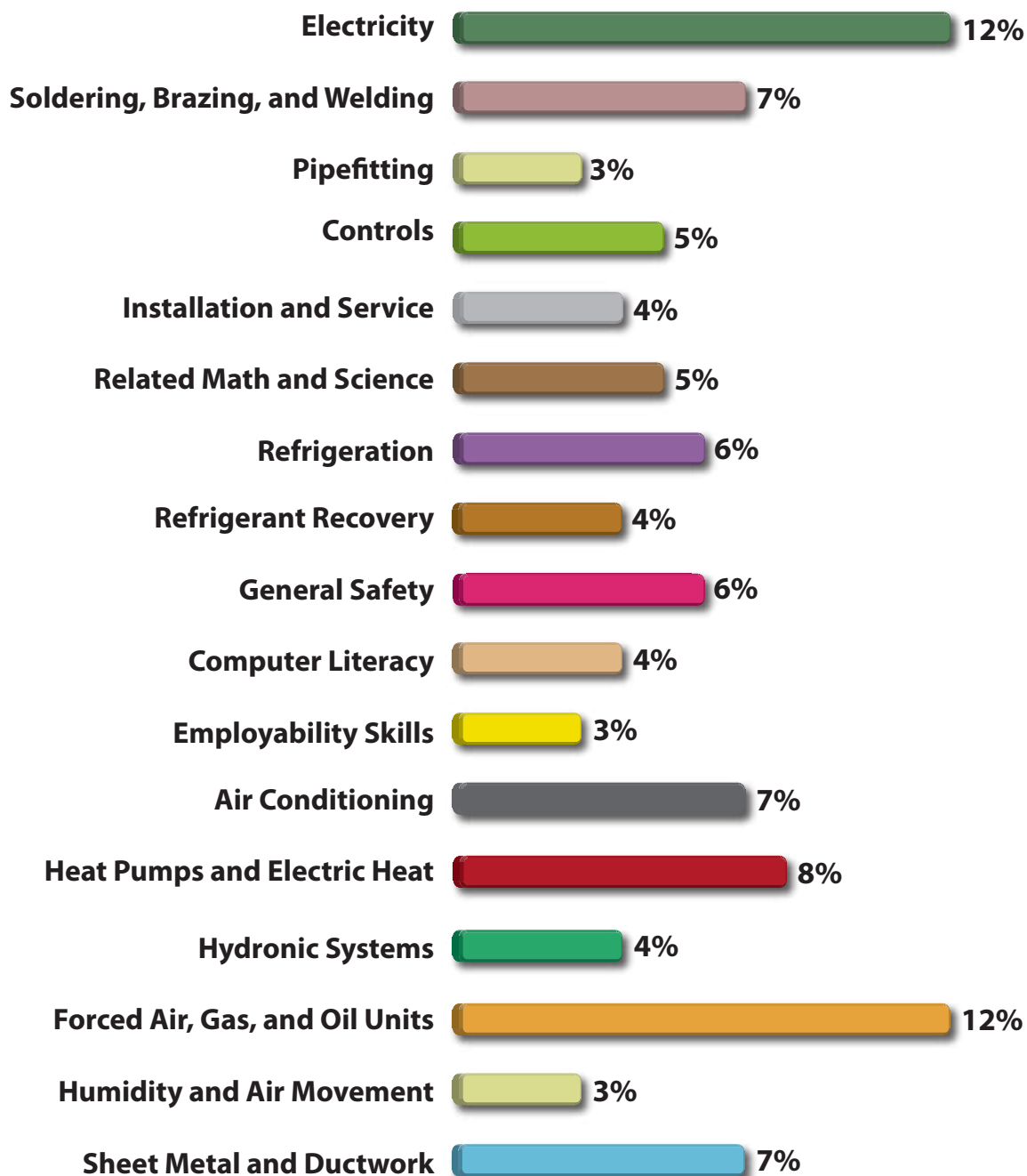
NOCTI written assessments consist of questions to measure an individual’s factual theoretical knowledge.

Administration Time: 3 hours

Number of Questions: 200

Number of Sessions: This assessment may be administered in one, two, or three sessions.

Areas Covered



Specific Competencies and Skills Tested in this Assessment

Electricity

- Demonstrate understanding of basic AC/DC theory
- Understand/use electrical formulas
- Interpret/construct electrical diagrams
- Understand series/parallel circuits
- Understand/use ohmmeters, voltmeters, and ammeters
- Identify/test various electrical components
- Apply/manipulate Ohm's Law
- Demonstrate knowledge of wiring exercises
- Perform troubleshooting
- Understand/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/brazing of tubings and fittings
- Use of nitrogen or carbon dioxide when brazing
- Understand measurement taking
- Set-up/use of torch and equipment
- Demonstrate understanding of gas welder usage
- Understanding leak check procedures
- Indicate melting temperatures

(Continued on the following page)

Specific Competencies and Skills (continued)

Pipefitting

- Interpret drawings on blueprints
- 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/calibrate controls
- Demonstrate knowledge of thermostat installation
- Test motor starting relays

Installation and Service

- Identify/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

(Continued on the following page)

Specific Competencies and Skills (continued)

Refrigeration

- Identify refrigerant types for proper application
- Understand how to evacuate and charge a refrigeration system
- Service/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
- Proper handling/disposal 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)
- Identification/use of fire extinguishers
- Demonstrate knowledge of electrical safety procedures
- Demonstrate knowledge of safe lifting techniques
- Knowledge of correct handling and reporting of accidents
- Knowledge of safe equipment repair practices
- Demonstrate knowledge of HVAC-specific safety procedures

(Continued on the following page)

Specific Competencies and Skills (continued)

Computer Literacy

- Demonstrate basic understanding of common operating systems
- Demonstrate basic understanding of basic word processing procedures/techniques
- Basic identification/preparation of spreadsheets
- Basic preparation/maintenance of database

Employability Skills

- Demonstrate understanding of resume and job interview skills
- Identify the components/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

(Continued on the following page)

Specific Competencies and Skills (continued)

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

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/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/adjusting an oil pump
- Understand how to select single and/or dual-stage pumps

(Continued on the following page)

Specific Competencies and Skills (continued)

Humidity and Air Movement

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

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"



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

(Continued on the following page)

Sample Questions (continued)

On a continuous basis, a fuse will hold _____ of its rating.

- A. 40 percent
- B. 60 percent
- C. 80 percent
- D. 100 percent

Properly dispose of refrigerants by

- A. incinerating
- B. dumping
- C. recycling
- D. releasing

When a single sequencer has 3 pairs of electric terminals, it can control _____ stages of heat.

- A. 2
- B. 4
- C. 6
- D. 8

In the sheet metal trade, the terms IC and IX mean

- A. galvanized steel
- B. tin plate
- C. copper sheet
- D. stainless steel

Measure relative humidity with a

- A. barometer
- B. hydrometer
- C. psychrometer
- D. relativometer

Performance Assessment

NOCTI performance assessments allow individuals to demonstrate their acquired skills by completing actual jobs using the tools, materials, machines, and equipment related to the technical area.

Administration Time: 3 hours and 30 minutes

Number of Jobs: 2

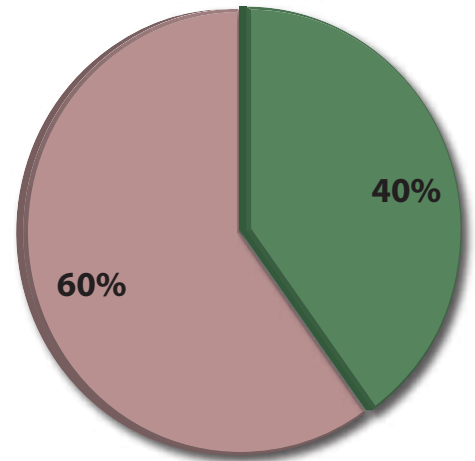
Areas Covered:

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.

