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**Heating, Ventilation,  
Air Conditioning,  
and Refrigeration  
(HVAC/R)**

Code: 3064 / Version: 01  
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## 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, Air Conditioning, and Refrigeration (HVAC/R) industry-based credential 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.



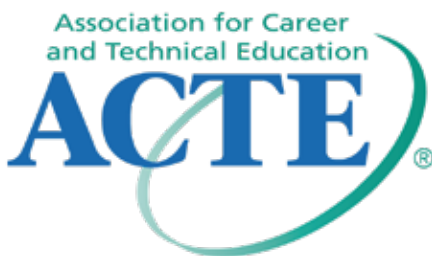
47.0201- Heating, Air Conditioning, Ventilation, and Refrigeration Maintenance Technology/Technician



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.



NATIONAL COLLEGE CREDIT RECOMMENDATION SERVICE  
University of the State of New York - Regents Research Fund

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

## Written Assessment

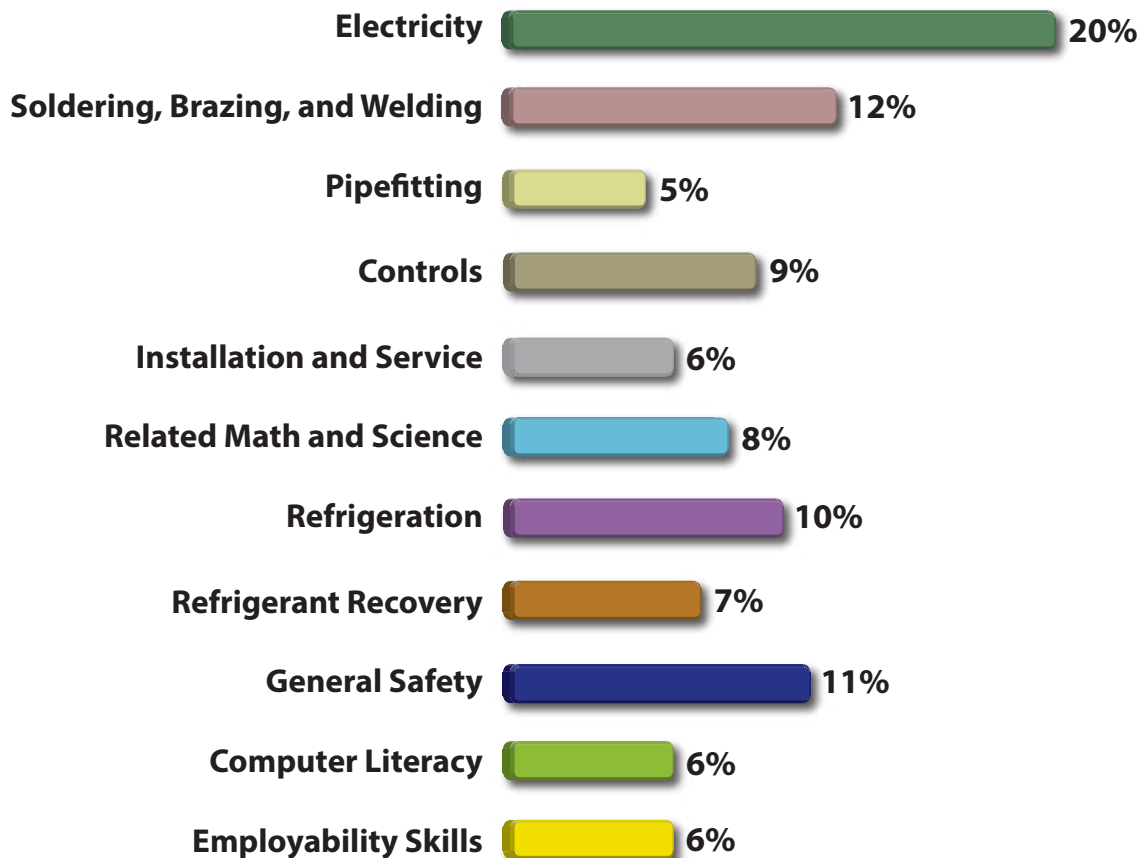
NOCTI written assessments consist of questions to measure an individual's factual theoretical knowledge.

**Administration Time:** 3 hours

**Number of Questions:** 118

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

### Areas Covered



## Specific Standards and Competencies Included 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



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## Specific Standards and Competencies (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



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## Specific Standards and Competencies (continued)

### 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

### 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

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## Specific Standards and Competencies (continued)

### 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



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## Specific Standards and Competencies (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





## Sample Questions

**A heat pump changes from cooling to heating by**

- A. a reversing valve
- B. compressor rotation
- C. heat application to the refrigerant
- D. de-energizing the outdoor fan

**A 50/50 solder is a combination of lead and**

- A. tin
- B. nickel
- C. antimony
- D. zinc

**When calculating heat loss, the HTM means the**

- A. heat temperature menu
- B. house thermal material
- C. heat transfer multiplier
- D. heating thermostat method

**The refrigerant used in smaller centrifugal compressors is**

- A. R-11
- B. R-12
- C. R-13
- D. R-22

**When writing a resume, it is best to**

- A. prepare a single handwritten page
- B. accurately list education and work history
- C. use double-spacing
- D. use only Times Roman font

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Sample Questions (continued)

**Of the following, \_\_\_\_\_ silver has the highest melting point.**

- A. 6 percent
- B. 15 percent
- C. 45 percent
- D. 65 percent

**What is the angle of the flare shoulder?**

- A. 30 degrees
- B. 45 degrees
- C. 50 degrees
- D. 60 degrees

**All refrigerant lines that are installed horizontally should**

- A. pitch away from the compressor
- B. pitch toward the compressor
- C. be maintained level
- D. pitch toward the direction of the refrigerant flow

**When working with sharp or rough metal, the sheet metal worker should**

- A. peen the metal with a sheet metal hammer
- B. grind the edges of the metal smooth
- C. wear gloves and thick glasses
- D. request help from a co-worker

**When filling out the service invoice during a routine preventive maintenance call, the worker should record the**

- A. volts and amps readings
- B. customer's age and gender
- C. estimated mileage
- D. wholesale costs

## 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

**Number of Jobs:** 2

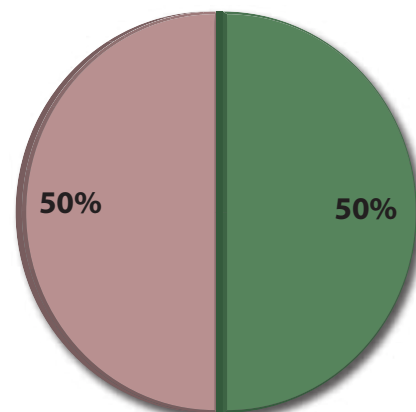
### Areas Covered:

#### **50% Gas Furnace Start-up and Check**

Participants will leak test gas connections, test supply gas pressure and electrical connection, start equipment, adjust thermostat heat anticipator, test manifold gas pressure, temperature rise, and fan motor amperage draw, perform steady state efficiency test, and complete system conditions sheet.

#### **50% Refrigerant Recovery and System Recharge**

Participants will adjust manifold gauges, install gauges, purge gauge hoses, adjust service valves, recover refrigerant, replace filter dryer and sight glass, vacuum system, install new refrigerant, restart system, check system operation, and complete system conditions.



## Sample Job

### Refrigerant Recovery and System Recharge

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

**Participant Activity:** The participant will perform refrigerant recovery and system recharge utilizing the vapor recovery method.

