

# National Construction CAREER TESTS

## *Comprehensive Objectives for HVAC*

### **ENHANCE ACADEMIC STANDARDS**

#### **National Construction Career Tests**

Standardized achievement tests based upon industry skill standards



#### **NCCT Development**

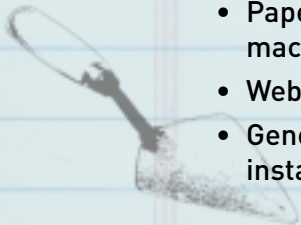
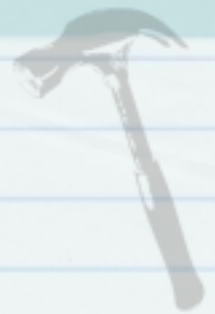
- Aligned to national industry skill standards (linked to industry-developed curricula, Contren™ Learning Series)
- Validated by a team of industry and academic experts
- Measures the nation's 10 foundation knowledge and skill areas for the national Career Clusters initiative
- Meets the standards of the American Psychological Association

#### **NCCT Administration**

- Paper/pencil or Web-based
- Proctored tests
- Test results under strict security
- Test administration controlled by Prov

#### **NCCT Scoring**

- Paper/pencil scoring results via your fax machine in 30 minutes
- Web-based scoring results within two minutes
- Generates custom student/test site reports instantly



**National Center for Construction Education and Research**

PO Box 141104 • Gainesville, FL 32614-1104

(352) 334-0911 • Fax (352) 334-0932 • [www.nccer.org](http://www.nccer.org)



## HVAC Contents

### NATIONAL CONSTRUCTION CAREER TEST



#### **Overview:**

This written test is a two (2) hour closed book examination. You will be permitted to use a basic function, non-printing calculator during the examination. The test center will provide any necessary pencils. No extra papers, books, notes or study material are allowed in the testing area.

#### **Test Development:**

All questions on each Test have been developed and approved by Subject Matter Experts from the respective craft. Test item development and test administration is under the direction of Prov, a test development company partner.

#### **Test Results:**

Each student will be provided an individualized Test Report by the test center. This Test Report will provide results by topic area covered in the assessment as well as the overall score.

Topic Area	Number of Questions	*Module Number
Basic Safety	10	00101-00
Introduction to Construction Math	7	00102-00
Introduction to Hand Tools	5	00103-00
Introduction to Power Tools	4	00104-00
Introduction to Blueprints	4	00105-00
Basic Rigging	4	00106-00
Tools for Success – Communications	7	00107-04
Tools for Success – Employability Skills	9	00108-04
Introduction to HVAC	2	03101-01
Trade Mathematics	2	03102-01
Tools of the Trade	2	03103-01
Copper and Plastic Piping Practices	2	03104-01
Soldering and Brazing	4	03105-01
Ferrous Metal Piping Practices	3	03106-01
Basic Electricity	5	03107-01
Introduction to Cooling	8	03108-01
Introduction to Heating	8	03109-01
Air Distribution Systems	5	03201-01
Chimneys, Vents and Flues	2	03203-01
Alternating Current	5	03204-01
Electric Heating	2	03206-01
Introduction to Control Circuit Troubleshooting	6	03207-01
Metering Devices	2	03209-01
Heat Pumps	2	03211-01
Leak Detection, Evacuation, Recovery and Charging	4	03212-01
<b>Total Number of Questions</b>	<b>114</b>	

*\*All NCCER Written Tests are referenced to Contren™ Learning Series modules. You may order modules from Prentice Hall at 1-800-922-0579 or by visiting [www.crafttraining.com](http://www.crafttraining.com).*



## **HVAC**

### **Competencies/Objectives**

#### **BASIC SAFETY (MODULE 00101-00)**

- Identify the responsibilities and personal characteristics of a professional craftsman.
- Explain the role that safety plays in the construction crafts.
- Describe what job-site safety means.
- Explain the appropriate safety precautions around common job-site hazards.
- Demonstrate the use and care of appropriate personal protective equipment.
- Follow safe procedures for lifting heavy objects.
- Describe safe behavior on and around ladders and scaffolds.
- Explain the importance of the HazCom (Hazard Communication Standard) requirement and MSDSs (Material Safety Data Sheets).
- Describe fire prevention and fire fighting techniques.
- Define safe work procedures around electrical hazards.

#### **INTRODUCTION TO BLUEPRINTS (MODULE 00105-00)**

- Recognize and identify basic blueprint terms, components, and symbols.
- Relate information on blueprints to actual locations on the print.
- Recognize different classifications of drawings.
- Interpret and use drawing dimensions.

#### **BASIC RIGGING (MODULE 00106-00)**

- Identify and describe the use of slings and common rigging hardware.
- Describe the basic inspection techniques and rejection criteria used for slings and hardware.

- Describe the basic hitch configurations and their proper connections.
- Describe basic load-handling safety practices.
- Demonstrate proper use of American National Standards Institute (ANSI) hand signals.

#### **COMMUNICATION SKILLS (MODULE 00107-04)**

- Demonstrate the ability to understand information and instructions that are presented in both written and verbal form.
- Demonstrate the ability to communicate effectively in on-the-job situations using written and verbal skills.

#### **EMPLOYABILITY SKILLS (MODULE 00108-04)**

- Explain the construction industry, the role of the companies that make up the industry, and the role of individual professionals in the industry.
- Demonstrate critical thinking skills and the ability to solve problems using those skills.
- Demonstrate knowledge of computer systems and explain common uses for computers in the construction industry.
- Demonstrate effective relationship skills with teammates and supervisors, exhibit the ability to work on a team, and demonstrate appropriate leadership skills.
- Be aware of workplace issues such as sexual harassment, stress, and substance abuse.



#### **INTRODUCTION TO HVAC (MODULE 03101-01)**

- Explain the basic principles of heating, ventilation, and air conditioning.

- Identify career opportunities available to people in the HVAC trade.
- Explain the purpose and objectives of an apprentice training program.
- Describe how certified apprentice training can start in high school.
- Describe what the Clean Air Act means to the HVAC trade.

### **TRADE MATHEMATICS (MODULE 03102-01)**

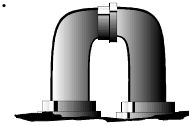
- Identify similar units of measurement in both the inch-pound (English) and metric systems and know which units are larger.
- Convert measured values in the inch-pound system to equivalent metric values and vice versa.
- Express numbers as powers of ten.
- Determine the powers and roots of numbers.
- Solve basic algebraic equations.
- Recognize various geometric figures.
- Use the Pythagorean theorem to make calculations involving right triangles.
- Convert decimal feet to feet and inches and vice versa.

### **TOOLS OF THE TRADE (MODULE 03103-01)**

- Identify and state the use of the following tools:
  - Pipe wrenches
  - Torque wrenches
  - Tinner's and soft-faced hammers
  - Hand cutting snips
  - Hand and power hacksaws
  - Drill press
  - Measuring tools
- Describe the general procedures for maintenance of most hand and power tools.
- Describe or demonstrate the general safety precautions that must be followed when using most hand and power tools.

### **COPPER AND PLASTIC PIPING (MODULE 03104-01)**

- State the precautions that must be taken when installing refrigerant piping.
- Select the right tubing for a job.
- Cut and bend tubing.
- Safely join tubing by using flare and compression fittings.
- Determine the kinds of hangers and supports needed for refrigerant piping.
- State the basic requirements for pressure-testing a system once it has been installed.



### **SOLDERING AND BRAZING (MODULE 03105-01)**

- Assemble and operate the tools used for soldering.
- Prepare tubing and fittings for soldering.
- Identify the purposes and uses of solder and solder fluxes.
- Solder copper tubing and fittings.
- Assemble and operate the tools used for brazing.
- Prepare tubing and fittings for brazing.
- Identify the purposes and uses of filler metals and fluxes used for brazing.
- Braze copper tubing and fittings.
- Identify the inert gases that can safely be used to purge tubing when brazing.

### **FERROUS METAL PIPING PRACTICES (MODULE 03106-01)**

- Identify the types of ferrous metal pipes.
- Measure the sizes of ferrous metal pipes.
- Identify the common malleable iron fittings.
- Cut, ream, and thread ferrous metal pipe.
- Join lengths of threaded pipe together and install fittings.

- Describe the main points to consider when installing pipe runs.
- Describe the method used to join grooved piping.

### **BASIC ELECTRICITY (MODULE 03107-01)**

- State how electrical power is generated and distributed.
- Describe how voltage, current, resistance, and power are related.
- Use Ohm's law to calculate the current, voltage, and resistance in a circuit.
- Use the power formula to calculate how much power is consumed by a circuit.
- Describe the differences between series and parallel circuits.
- Recognize and describe the purpose and operation of the various electrical components used in HVAC equipment.
- State and demonstrate the safety precautions that must be followed when working on electrical equipment.
- Make voltage, current, and resistance measurements using electrical test equipment.

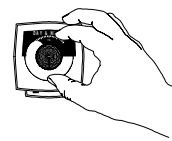
### **INTRODUCTION TO COOLING (MODULE 03108-01)**

- Explain how heat transfer occurs in a cooling system, demonstrating an understanding of the terms and concepts used in the refrigeration cycle.
- Calculate the temperature and pressure relationships at key points in the refrigeration cycle.
- Under supervision, use temperature- and pressure-measuring instruments to make readings at key points in the refrigeration cycle.
- Identify commonly used refrigerants and demonstrate the procedures for handling these refrigerants.
- Identify the major components of a cooling system and explain how each type works.
- Identify the major accessories available for cooling systems and explain how each type works.

- Identify the control devices used in cooling systems and explain how each type works.
- State the correct methods to be used when piping a refrigeration system.

### **INTRODUCTION TO HEATING (MODULE 03109-01)**

- Explain the three methods by which heat is transferred and give an example of each.
- Describe how combustion occurs and identify the by-products of combustion.
- Identify the various types of fuels used in heating.
- Identify the major components and accessories of a forced-air furnace and explain the function of each component.
- State the factors that must be considered when installing a furnace.
- Identify the major components of a gas furnace and describe how each works.
- With supervision, use a manometer to measure and adjust manifold pressure on a gas furnace.
- Identify the major components of an oil furnace and describe how each works.
- Describe how an electric furnace works.
- With supervision, perform basic furnace preventive maintenance procedures such as cleaning and filter replacement.



### **AIR DISTRIBUTION SYSTEMS (MODULE 03201-01)**

- Describe the airflow and pressures in a basic forced-air distribution system.
- Explain the differences between propeller and centrifugal fans and blowers.
- Identify the various types of duct systems and explain why and where each type is used.
- Demonstrate or explain the installation of metal, fiberboard, and flexible duct.

- Demonstrate or explain the installation of fittings and transitions used in duct systems.
- Demonstrate or explain the use and installation of diffusers, registers, and grilles used in duct systems.
- Demonstrate or explain the use and installation of dampers used in duct systems.
- Demonstrate or explain the use and installation of insulation and vapor barriers used in duct systems.
- Identify the instruments used to make measurements in air systems and explain the use of each instrument.
- Make basic temperature, air pressure, and velocity measurements in an air distribution system.

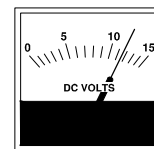
### **CHIMNEYS, VENTS, AND FLUES (MODULE 03202-01)**

- Describe the principles of combustion and explain complete and incomplete combustion.
- Describe the content of flue gas and explain how it is vented.
- Identify the components of a furnace vent system.
- Describe how to select and install a vent system.
- Perform the adjustments necessary to achieve proper combustion in a gas furnace.
- Describe the techniques for venting different types of furnaces.
- Explain the various draft control devices used with natural-draft furnaces.

### **MAINTENANCE SKILLS FOR THE SERVICE TECHNICIAN (MODULE 03203-01)**

- Identify the types of threaded and non-threaded fasteners and explain their use.
- Install threaded and non-threaded fasteners.
- Identify the types of gaskets, packings, and seals and explain their use.
- Remove and install gaskets, packings, and seals.

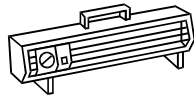
- Identify the types of lubricants and explain their use.
- Use lubrication equipment to lubricate motor bearings.
- Identify the types of belt drives and explain their use.
- Demonstrate and/or explain procedures used to install or adjust a belt drive.
- Identify the types of couplings and explain their use.
- Demonstrate and/or explain procedures used to remove, install, and align couplings.
- Identify the types of bearings and explain their use.
- Explain causes of bearing failures.
- Demonstrate and/or explain procedures used to remove and install bearings.
- Perform basic preventive maintenance inspection and cleaning procedures.
- List work and personal habits that contribute to good customer relations.
- Identify steps in the handling of a typical service call that will contribute to good customer relations.
- Legibly fill out forms used for installation and service calls.



### **ALTERNATING CURRENT (MODULE 03204-01)**

- Describe the operation of various types of transformers.
- Explain how alternating current is developed and draw a sine wave.
- Identify single-phase and three-phase wiring arrangements.
- Explain how phase shift occurs in inductors and capacitors.
- Describe the types of capacitors and their applications.
- Explain the operation of single-phase and three-phase induction motors.

- Identify the various types of single-phase motors and their applications.
- Use a wattmeter, megger, capacitor analyzer, and chart recorder.
- Test inductors and capacitors using an ohmmeter.
- State and demonstrate the safety precautions that must be followed when working with electrical equipment.



## **ELECTRIC HEATING (MODULE 03206-01)**

- Describe and explain the basic operation of a fan coil equipped with electric heating elements.
- Identify and describe the functions of major components of a fan coil equipped with electric heating elements.
- Identify and describe the functions of electric heating controls.
- Measure resistances and check components and controls for operation and safety.
- Determine the cubic feet per minute (cfm) using the temperature rise method.
- Describe and explain the basic operation of other electric heating systems.

## **INTRODUCTION TO CONTROL CIRCUIT TROUBLESHOOTING (MODULE 03207-01)**

- Explain the function of a thermostat in an HVAC system.
- Describe different types of thermostats and explain how they are used.
- Demonstrate the correct installation and adjustment of a thermostat using proper siting and wiring techniques.
- Explain the basic principles applicable to all control systems.
- Identify the various types of electromechanical, electronic, and pneumatic HVAC controls, and explain their function and operation.

- Describe a systematic approach for electrical troubleshooting of HVAC equipment and components.
- Recognize and use equipment manufacturer's troubleshooting aids to troubleshoot HVAC equipment.
- Exhibit competence in isolating electrical problems to faulty power distribution, load, or control circuits.
- Identify the service instruments needed to troubleshoot HVAC electrical equipment.
- Make electrical troubleshooting checks and measurements on circuits and components common to all HVAC equipment.

## **METERING DEVICES (MODULE 03209-01)**

- Explain the function of metering devices.
- Describe the operation of selected metering devices and expansion valves.
- Identify types of thermal expansion valves (TXVs).
- Describe problems associated with replacement of TXVs.
- Describe the procedure for installing and adjusting selected TXVs.

## **HEAT PUMPS (MODULE 03211-01)**

- Describe the principles of reverse-cycle heating.
- Identify heat pumps by type and general classification.
- List the components of heat pump systems.
- Demonstrate heat pump installation and service procedures.
- Identify and install refrigerant circuit accessories commonly associated with heat pumps.
- Analyze a heat pump control circuit.

**LEAK DETECTION, EVACUATION,  
RECOVERY, AND CHARGING  
(MODULE 03212-01)**

- Identify the common types of leak detectors and explain how each is used.
- Demonstrate skill in performing leak detection tests.
- Identify the service equipment used for evacuating a system and explain why each item of equipment is used.
- Demonstrate skill in performing system evacuation and dehydration.
- Identify the service equipment used for recovering refrigerant from a system and for recycling the recovered refrigerant, and explain why each item of equipment is used.
- Demonstrate skill in performing refrigerant recovery.
- Demonstrate or explain how to use a recycle unit.
- Identify the service equipment used for charging refrigerant into a system, and explain why each item of equipment is used.
- Demonstrate skill in charging refrigerant into a system.

