

# CORE EXAM

## Exam Information

**Scope** – Tests a candidate’s general knowledge, construction knowledge, and HVACR specific knowledge in the areas of safety, tools, basic construction, basic science, achieving desired conditions, taking measurements, and basic electricity.

## Qualifications

- This exam is designed for **technicians** in the HVAC/R industry. This exam is a requirement for most installation or service specialty certifications.

## Test Specifications

**Closed Book**

**1.5 Hour Time limit**

**50 Questions**

**Passing Score: Pass/Fail**

Listed are the percentages of questions that will be in each section of the **Core** exam.

| <b>Section Area Description</b> | <b>Section Percentage</b> | <b>Section Area Description</b>        | <b>Section Percentage</b> |
|---------------------------------|---------------------------|--|---------------------------|
| Safety                          | 18%                       | Achieving Desired Conditions           | 14%                       |
| Tools                           | 10%                       | Taking Temp. and Humidity Measurements | 14%                       |
| Basic Construction              | 8%                        | Basic Electricity                      | 26%                       |
| Using Basic Science             | 10%                       |  |                           |

## Industry References

The reference materials list below will be helpful in preparing for this exam. These materials may **not** contain all of the information necessary to be competent to pass the exam.

- American National Standards Institute (ANSI) / Air Conditioning Contractors of America (ACCA) Manuals – Latest Edition.
  - Manuals “D” “J” “QI” – Quality Installation, and “S”
- ACCA Manuals “T” and “RS” – Latest Editions
- ACCA Residential Duct Diagnostics and Repair – Latest Edition
- AHRI-Hydronics Section – IBO/RAH – Latest Edition
- International Code Council – Latest Editions
  - Mechanical, Plumbing, Energy Conservation, and Residential
- Uniform Mechanical Code – Latest Edition with Addendum
- Specification of Energy-Efficient Installation and Maintenance Practices for Residential HVAC Systems developed by Consortium for Energy Efficiency (CEE) – Latest Edition with Addendum
- ASHRAE Standard-62.2 – Latest Edition with Addendum
- ANSI//ASHRAE Standard- 152-2004 – Latest Edition with Addendum
- ENGERY STAR™ Home Sealing Standards – Latest Edition with Addendum
- Duct Calculators – Sheet Metal, Ductboard, and Flexible Duct
- American National Standards Institute (ANSI)/Sheet Metal and Air Conditioning Contractors’ National Association, Inc. (SMACNA) Manuals
  - HVAC Duct Construction Standards –Metal and Flexible
- Sheet Metal and Air Conditioning Contractors’ National Association, Inc. (SMACNA) Manuals
  - Fibrous Glass Duct Construction Standards, Residential Comfort System Installation Standards Manual, and HVAC Air Duct Leakage Test Manual
- Air Diffusion Council Flexible Duct Performance & Installation Standards
- North American Insulation Manufacturers Association (NAIMA) Manuals
  - Fibrous Glass Duct Construction Standards and A Guide to Insulated Air Duct Systems
- International Fuel Gas Code – Latest Edition with Addendum
- National Fuel Gas Code – Latest Edition with Addendum
- Generally accepted HVACR textbooks
- Generally accepted construction textbooks
- OSHA safety standards
- National Fire Protection Association – Latest Editions
  - Gas, Oil, and Electric

## Passing Score Development Process

The passing scores for the NATE tests were established using a systematic procedure (a Passing Score Study). This procedure employed the judgment of experienced HVAC professionals and educators representing various HVAC specialties and geographical areas. The passing scores were set using criteria defining competent performance. The passing score for different test forms may vary slightly due to the comparative difficulty of the test questions.

## Exam Copyrights

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# NATE

## Core

### Safety

#### Complying with Government Regulations

- Transportation regulations for hazardous materials
- Health and safety regs for hazardous materials
- Environmental regs for hazardous materials

#### Personal Safety and Work Practices

- Regs concerning confined spaces, hard hats, etc.
- Safety with hand tools
- Using ladders and scaffolds
- Refrigerant in confined spaces
- Safe driving practices
- Clothing, safety equipment, and hard hats
- Safety glasses
- Hearing protection
- Safe practices in repair
- Using warning symbols
- Safe handling of hazardous materials
- Safety within confined spaces
- Safe practices in troubleshooting and repair

#### Personal Safety Around Moving Machinery

- Blowers
- Pulleys
- Clothing requirements
- Condenser fans

#### Electrical Safety

- Overview of electrical safety
- Grounding-GFI requirements outdoor extension cords
- Personal protection

#### Safe Brazing and Soldering Practices

- Overview of safety
- Oxygen and acetylene safety
- Using purging gases-Nitrogen, Carbon Dioxide, etc
- Fire extinguishers
- Documentation for hazardous materials - MSDS

#### Safe Handling of Containers

- Disposal
- Securing containers for transport
- Signage and documentation for containers
- Proper storage
- Proper container filling

#### Understanding Hazmat

- Signage for hazardous materials
- Securing hazardous materials for transport
- Documentation for hazardous materials - MSDS
- Worker requirements for HAZMAT training

### Tools

#### Tools

- Tools & Scales - Basic Math Measurement
  - Rulers, compass, square, protractor, etc.
  - Improvised measuring techniques
  - Basic scale drawings
  - Measurements - inches, feet, centimeters, millimeters, etc.
  - Understanding tolerances

#### Fabrication Tools

- Screwdrivers and nut drivers
- Wrenches, pliers, and allen wrenches
- Socket sets
- Levels and squares
- Tool maintenance and care

- Saws and files
- Drills, countersink, reamers, and bits
- Punches, taps, and dies
- Hammers
- Metal tools - metal snips, sheers, benders, breaks, hand formers, calipers, rulers, stapler, etc.

Tubing Tools

- Benders - spring, lever, etc.
- Flaring tools
- Tube cutters
- Swaging tools
- Reamers

*Basic Construction*

Plans and Specifications

- Construction
- Materials
- Layout

Plumbing (Piping) Layouts

- Construction
- Materials
- Layout

Room Specs - Clear Span & Ceiling Heights

- Construction
- Materials
- Layout

Roofing

- Construction
- Materials
- Layout

Ceilings

- Construction
- Materials
- Layout

Walls

- Construction
- Materials
- Layout

Floors

- Construction
- Materials
- Layout

Fenestration

- Construction
- Materials
- Layout

Girders & Trusses

- Construction
- Materials
- Layout

Chimneys

- Construction
- Materials
- Layout

*Using Basic Science*

Chemistry Basics

- Properties of matter
- How chemicals react with each other
- Role of chemistry at the jobsite
- Oxidation and combustion
- Weight and density of materials

Electrons in Electricity

- Fundamental electrical concepts
- Electrical charge

Conductors

Insulators

Dielectrics

### Electrical Basic Terms

Voltage

Amps - milliamps, microamps, etc.

Resistance - Ohm's, megohms, etc.

Power - watts

### Magnetism

Magnetic principles in electricity

Magnetic components - coils

Magnetic components - transformer

### AC and DC Circuits

Simple DC circuit

Basic control and loads

Polarity

Ohm's Law in DC circuits

Introduction to AC circuits

Effects of AC on controls and loads

### Basic Circuit Analysis

Difference between AC & DC power

Series circuits

Parallel circuits

Ohm's Law

Current distribution in multiple load circuits

Complex circuits

### Electricity - Generation and Distribution

Intro to electrical distribution

Transformer distribution

Impact of available electrical power on equipment

### Solid State Electronics

Introduction to basic solid state components

Overview of solid state devices in HVAC

Solid state sensing devices

Introduction to basic solid state components

Fundamental solid state circuits

### Pressure Measurements

Overview of pressure systems

Pressure laws and pressure measurement terminology

Temperature vs. Pressure

Gas laws

### Mathematics

Arithmetic

Whole numbers - add, subtract, multiply and divide

Fractions - add, subtract, multiply and divide

Decimals - add, subtract, multiply and divide

Percentages, ratios, and proportions

Rounding off of values

Interpolation

Calculators

Combined calculations

Mixed numbers

Conversion of number forms

Using sequences and series to predict results

Algebra

Basic linear single variable equations

Using basic algebra in problem solving

Transposing formulas

Geometry

Geometric figures used in HVAC - points, lines, rectangles, parallelograms, rhombuses, squares, trapezoids, etc.

Units of measurement. Typical computations using geometry. The right triangle. 30-60-90, 45-45-90.

Parallels and perpendiculars

Concepts of three-dimensional figures. Drawing three-dimensional objects. Computations with three dim shapes.

Estimating areas, perimeters, and volumes of irregular figures

#### Graphs, Charts & Tables

Introduction to basic graphs, plots, and tabular data

Graphs and tables used in instruction sheets

Blueprint reading

#### Mechanics

Simple machines - levers, gears, etc.

Conservation of energy

Complex machines - how mechanisms work

Basics of fluid mechanics

#### Gas Laws

Gas laws

#### Electrical Load Types

Capacitive - momentary and continuous

Inductive - momentary and continuous

Resistive - momentary and continuous

#### Power

Electrical power formulae - conversion of power

Introduction to power factor

#### *Achieving Desired Conditions*

##### Temperature

Role of temperature in comfort

Regional temperature considerations and comfort

##### Humidity

Role of humidity in comfort

Adjusting system performance for humidity control

##### Air Quality

Ventilation - comfort

Air cleaning for comfort

Ventilation - comfort

Odor control

##### Sound

Equipment source

Airflow source

Equipment

Airflow

#### *Taking Temp & Humidity Measurements*

##### Physical Measurements - Temperature & Heat

Latent heat

Sensible heat

Temperature

Fundamentals of humidity

Convection

Conduction

Radiation

BTU - Definition and use

##### Thermometers

Liquid column thermometers

Mechanical thermometers

Electronic thermometers

Infrared thermometers

Gauge / meter calibration

Recording thermometers - digital and analog

Dry bulb and wet bulb Delta T

##### Humidity Measurement and Calculations

Sling psychrometer

Wet and dry bulb thermometers

Electronic humidity measurement

Gauge / meter calibration

Using psychrometric chart

Humidity probes attachments for use with meters

Enthalpy

*Basic Electricity*

Symbols

Introduction to basic symbols

Use of symbols in diagrams

Symbol standards

Field Wiring Diagrams

Basics of field diagram layout

Use of field diagrams

Pictorial Diagrams

Basics of pictorial diagram layouts

Use of pictorial diagrams

Schematic (Ladder) Diagrams

Basics of schematic (ladder) diagram layouts

Reading schematics for determining sequences

Reading schematics for wiring connections

Single Phase Motors

Types

Components

Operating principles

Torque characteristics

Tapped multi-speed

Selecting single phase motors

Three Phase Motors

Types

Rotation

Components

Operating principles

Selecting multi-phase motors

Torque characteristics

Variable Speed Motors

Variable speed motors - ECM, BPM, and VSIM

Actuator Motors

Overview of damper motors

Dual position

Proportional

Digital Electrical Meters

Identify meters and instruments

Digital electrical meters - use and setups

Voltage measurements

Resistance measurements

Amperage measurements

Use with temperature probes

Meter calibration and maintenance

RMS - correction and meter types

Millivolt measurements

Milliampere measurements