**Certification Information**

**Scope** - Tests a candidate's knowledge of the installation, service, maintenance, and repair of HVAC systems. System sizes are limited to 12,000 CFM or less airflow.

**Qualifications**

- This is a test and certification for TECHNICIANS in the HVAC industry. The test is designed for top level installation technicians. This test for certification is not intended for the HVAC system designer, sales force, or the engineering community. To become NATE-certified, you must pass this specialty and a CORE INSTALL exam. Once certification is obtained it lasts for five years.
- This test will measure what 80% of the Air Distribution candidates have an 80% likelihood of encountering at least once during the year on a NATIONAL basis.
- Suggested requirement is one year of field experience working on Air Distribution systems as an installation technician and technical training for theoretical knowledge.

**Test Specifications**

<table>
<thead>
<tr>
<th>Closed Book</th>
<th>2.5 Hour Time Limit</th>
<th>100 Questions</th>
<th>Passing Score: PASS/FAIL</th>
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Listed are the percentages of questions that will be in each section of the Air Distribution exam.

<table>
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<tr>
<th>SECTION AREA DESCRIPTION</th>
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<tr>
<td>Installation</td>
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<td>Service</td>
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<tr>
<td>Applied Knowledge</td>
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**Air Distribution Industry References**

The reference materials listed below will be helpful in preparing for this exam. These materials may NOT contain all of the information necessary to be competent in this specialty or to pass the exam.

- American National Standards Institute (ANSI) / Air Conditioning Contractors of America (ACCA) Manuals - Latest Edition
  - “D”, “J”, “QI” - Quality Installation, and “S”
- ACCA Manuals “T” and “RS” - Latest Editions
- ACCA Residential Duct Diagnostics and Repair - Latest Edition
- AHRI-Hydrronics Section-IBO/RAH Latest Edition
- International Mechanical Code - Latest Edition with Addendum
- International Plumbing Code - Latest Edition with Addendum
- Uniform Mechanical Code - Latest Edition with Addendum
- ENERGY 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
- 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

**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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DUCT FABRICATION

DUCT FABRICATION EQUIPMENT
- Ductboard tools - 90 V-groove, end cutoff, female shiplap, hole cutter, stapler, etc.
- Flex tools - tensioning strap tools, knives, etc.
- Metal tools - metal snips, sheers, benders, breaks, hand formers, calipers, rulers, stapler, etc.

FABRICATION TECHNIQUES FOR METAL DUCT
- Making seams - pittsburgh and snap lock
- Making transverse joints - drive slips, reinforced drive slips, "s" slip, and standing "s" slip
- Making cross breaks in rectangular duct
- Crimping round pipe

FABRICATION TECHNIQUES FOR DUCTBOARD
- Layout of duct fitting
- Groove cutting - hand / machine
- Use of joint tape

DUCT INSTALLATION

FIELD CONSTRUCTION / INSTALLATION
- Ductboard installation technique
- Techniques for joining dissimilar duct
- Duct of alternate materials - wood, aluminum, etc.

INSTALLING METAL DUCT
- Assembly methods for rectangular duct
- Installation technique - rectangular metal
- Assembly methods for round duct
- Installation technique - round metal
- Hanging ductwork
- Sealing metal duct
- Insulation - internal and external, vapor barriers
- Assembling for low noise and low pressure drop

INSTALLING FLEXIBLE DUCT
- Assembly methods - appropriate length
- Flexible duct joints
- Hanging flexible duct
- Installation technique - flex duct
- Sealing flexible duct

INSTALLING DUCTBOARD
- Assembly methods for ductboard - supports
- Installation technique - ductboard
- Hanging methods for ductboard
- Sealing ductboard

INSTALLING GRILLES, REGISTERS, DIFFUSERS, & DAMPER
- Mounting to ductwork
- Securing methods

CHASES USED AS DUCTS
- Floor joists as air ducts
- Vertical chases

RECONNECTING DUCT WHEN REPLACING EQUIPMENT
- Reconnecting metal duct
- Reconnecting flexible duct
- Reconnecting ductboard duct

SYSTEM SETUP

PREPARING SYSTEM FOR OPERATION
- Removing shipping restraints
- Inspecting for concealed damage
- Inspect wiring

SETTING DAMPER POSITIONS
- Determining estimated damper positions
Setting and securing position

SETTING REGISTERS AND DIFFUSERS
- Determining estimated damper positions
- Setting/securing position

SETTING BLOWER SPEEDS
- Determining appropriate setting
- Setting blower for setup checks
- Setting blower for system operation

AIRFLOW MEASUREMENTS

INTRODUCTION TO AIRFLOW MEASUREMENTS
- Introduction to airflow
- Static pressure

AIRFLOW VELOCITY MEASUREMENTS
- Introduction to airflow velocity
- Velometer - electronic and mechanical
- Anemometer
- Velocity measurement procedures
- Gauge calibration

AIRFLOW PRESSURE MEASUREMENTS
- Overview of static pressure measurements
- Inclined manometer
- Diaphragm type differential pressure gauge
- U-tube manometer
- Electronic manometer / pressure measurement
- Gauge / meter calibration
- Absolute vs. Gauge Pressure

AIRFLOW VOLUME MEASUREMENTS
- Introduction to volume
- Airflow hood
- Formulae for determining CFM of air
- Formulae for weight of air
- Locations for air volume measurements

AIRFLOW CHECKS & DESIGN TOOLS
- Using manufacturer's airflow charts and tables
- Using a duct calculator and design charts

SERVICE

BASIC AIR DISTRIBUTION SYSTEM INSPECTION

STRUCTURAL INTEGRITY
- Duct support
- Joint integrity

NOISE PROBLEMS
- Oil canning
- Vibration

AIR LEAKS
- Smoke test - positive and negative envelope pressure

INSPECTION AND REPAIR OF METAL DUCT SYSTEMS

INSPECTING FOR STRUCTURAL INTEGRITY
- Inspecting joints
- Inspecting seams
- Locating improper openings
- Inspecting for proper support

INSPECTING FOR LEAKS
- Visual inspection
- Inspection by sound

INSPECTING FOR NOISE
- Identifying air velocity noise
- Identifying mechanical noise

REPAIRING METAL DUCT SYSTEMS
- Repairing leaks
- Repairing noise problems
Repairing structural integrity problems
Repairing/replacing internal and external insulation

INSPECTION AND REPAIR OF DUCTBOARD SYSTEMS

INSPECTING FOR STRUCTURAL INTEGRITY
- Inspecting joints
- Inspecting seams
- Locating improper openings
- Inspecting for proper support

INSPECTING FOR LEAKS
- Visual inspection
- Inspection by sound

INSPECTING FOR NOISE
- Identifying air velocity noise
- Identifying mechanical noise

REPAIRING DUCTBOARD DUCT SYSTEMS
- Repairing leaks
- Repairing noise problems
- Repairing structural integrity problems

INSPECTION AND REPAIR OF FLEXIBLE DUCT SYSTEMS

INSPECTING FOR STRUCTURAL INTEGRITY
- Inspecting joints
- Locating improper openings
- Inspecting for proper support
- Inspecting for improper routing

INSPECTING FOR LEAKS
- Visual inspection
- Inspection by sound

INSPECTING FOR NOISE
- Identifying air velocity noise
- Identifying mechanical noise

REPAIRING FLEXIBLE DUCT SYSTEMS
- Repairing leaks
- Repairing noise problems
- Repairing structural integrity problems

INSPECTION AND REPAIR OF GRILLES AND REGISTERS

INSPECTING FOR STRUCTURAL INTEGRITY
- Inspecting joints
- Inspecting for proper mounting
- Inspecting for proper settings and adjustments

INSPECTING FOR NOISE
- Inspecting for noise with operating blower
- Inspecting for proper seal
- Inspecting for proper settings

REPAIRING GRILLES AND REGISTERS
- Repairing leaks
- Repairing noise problems
- Repairing structural integrity problems

INSPECTING FOR LEAKS
- Visual inspection
- Inspection by sound

INTRODUCTION TO ELECTRICAL TROUBLESHOOTING

LOW VOLTAGE FIELD WIRING
- Voltage tests
- Troubleshooting equipment with electronic devices
- Equipment continuity tests

LINE VOLTAGE FIELD WIRING
- Voltage tests
- Troubleshooting equipment with electronic devices
- Equipment continuity tests
INTRODUCTION TO SYSTEMS

HEAT TRANSFER AND THE BASIC COOLING CYCLE
- Heat transfer and cooling
- Basic refrigeration circuit - 7 components

DUCT SYSTEMS

BASIC DUCT SYSTEMS
- Overview of duct systems
- Duct configuration - extended plenum
- Duct configuration - reducing extended plenum
- Duct configuration - perimeter radial
- Duct configuration - perimeter loop
- Duct configuration - overhead radial
- Duct configuration - branching flexible
- Duct configuration - concentric

DUCT LOCATION
- Attic
- Basement
- Crawlspace
- Slab
- Roof
- Furr down
- Exposed
- Chases

BASIC ZONE SYSTEMS
- Equipment zoned
- Air side zoned

DUCT MATERIALS
- Define / recognize ductboard
- Define / recognize metal duct
- Define / recognize flexible duct
- Define / recognize PVC pipe
- Insulating material

FITTING NOMENCLATURE
- Define / recognize plenum
- Define / recognize transition
- Define / recognize elbow - 90 degrees and 45 degrees
- Define / recognize round duct
- Define / recognize rectangular duct
- Define / recognize turning vanes
- Return configurations - ducted, central, etc.
- Define / recognize wye - rectangular and round
- Define / recognize damper - rectangular and round
- Sheet metal duct joints - "s" and drive, snaplock, button lock, etc.
- Define/recognize flexible/canvas connector

DAMPERS
- Balancing
- Splitters
- Economizers
- Fresh air
- Fire

GRILLES
- Types and uses
- Selecting grilles by volume and velocity

REGISTERS
- Types and uses
- Selecting registers
- Selecting registers by air spread and throw capacity

DIFFUSERS
- Types and uses
Selecting diffusers
Selecting diffusers by air spread and throw capacity

Filtration Systems
- Media type filters
- Electronic air cleaners (EAC’s)
- Electrostatic filters - non-electric

Ventilation Systems
- Attic exhaust
- Residential exhaust(s)
- Lt. Commercial exhaust(s)
- Heat / energy recovery ventilators
- Infiltration

Humidifiers
- Fundamentals of operation
- Types
- Duct material requirements
- Installation support and location

Basic Gas Furnaces

Gas Heat - Components
- Define heat exchanger
- Define fan controls
- Define limit controls
- Define vent system

Gas Heat - Operation
- Define combustion air system
- Air side requirements

Basic Oil Furnaces

Oil Heat - Components
- Define limit controls
- Define heat exchanger
- Define vent system

Oil Heat - Operation
- Define combustion air system
- Air side requirements

Basic Air Conditioning / Heat Pumps

Basic Components
- Define evaporator
- Define condenser
- Define compressor

Basic Operation
- Air side requirements

Basic Airflow Principles

Introduction to Airflow
- Velocity
- Static pressure
- Airflow volume - CFM / SCFM (Static CFM)

Blowers and Fans
- Introduction to indoor blowers
- Indoor blowers - types and selection
- Fan operation
- Adjustable pulley

Applied Knowledge: Regs, Codes, & Design

Air Quality Regulations

Indoor Air Quality
- Fresh air supplies

Electrical Code

Requirements
- Overview of electrical code
- Circuit breaker and fuse requirements
General wiring practices
Class I wire sizing
Class II wire sizing
Conduit sizing
Definitions

STATE AND LOCAL REGULATIONS AND CODES
STATE AND LOCAL REGULATIONS
State requirements for technicians

CODES
Plumbing
Municipalities
HVAC for Lt. Commercial

FIRE PROTECTION REGULATIONS AND CODES
REQUIRED COMPONENTS
Return air sensors
Fire dampers

FIRE PREVENTION
Overview

DESIGN CONSIDERATIONS - COMFORT
TEMPERATURE
Designing for capacity
Using industry standards

HUMIDITY
Role of humidity in comfort
Using industry standards

INDOOR AIR QUALITY
Ventilation - comfort
Air cleaning for comfort
Industry standards for air quality
Outside air

SOUND LEVEL
Equipment location considerations
Isolation, mounting pad, duct, and structure
Duct systems

DESIGN CONSIDERATIONS - RESIDENTIAL
SPLIT SYSTEMS
Ventilation - fresh air
Ventilation - equipment

AIR BALANCING
Blower speed adjustments
Damper position adjustments

RETROFIT INSTALLATIONS
Insulation
Vapor barrier

DESIGN CONSIDERATIONS - COMPONENTS
BLUEPRINT READING
Determination of dimension from scale blueprint / plans
Introduction to blueprints/plans reading
Visualizing duct layout from blueprints/plans

SPECIAL DUCTS & FITTINGS
Working drawings vs. Isometric drawings
Markings and abbreviations for duct fitting and manufacturing
Measurement for replacement of special duct or fitting

DUCTS & FITTINGS
Specifying physical dimensions
Sketching duct layout
Duct fitting equivalency - EQ to duct size

STATIC PRESSURE LOSSES IN FILTRATION SYSTEMS
Filter grilles
Electronic air cleaners (EAC's)
Electrostatic
Media type filters

DIFFUSERS
Selecting diffusers
Proper locations

GRILLES
Selecting grilles
Proper locations

REGISTERS
Selecting registers
Proper locations

MECHANICAL CODE
EQUIPMENT ACCESS
Minimum clearance
Electrical disconnects
Fire dampers

REFRIGERANT LINE ROUTING
Support requirements
Inspection requirements

CONDENSATE DRAINS
Materials
Sizing

INDUSTRY STANDARDS
EQUIPMENT STANDARDS
Introduction to industry standards
ARI standards for ratings

SYSTEM STANDARDS
Introduction to industry standards

DESIGN CONSIDERATIONS - LIGHT COMMERCIAL
SPLIT SYSTEMS
System designs - closets, basements, etc.
Air distribution systems
Ventilation - fresh air
Ventilation - equipment

PACKAGED SYSTEMS
System designs
Economizers
Ventilation - equipment

AIR BALANCING
Duct sizing
Blower speed adjustments
Damper position adjustments
Measurement of air flow rate
Fan laws
\[
\frac{CFM_n}{CFM_o} = \frac{RPM_n}{RPM_o}
\]

\(o = \text{old}, n = \text{new}\)

CFM and RPM are interchangeable.

\[
\left(\frac{CFM_n}{CFM_o}\right)^2 = \frac{Sp_n}{Sp_o}
\] OR

\[
\frac{CFM_n}{CFM_o} = \sqrt{\frac{Sp_n}{Sp_o}}
\]

\[
CFM_n = CFM_o \times \sqrt{\frac{Sp_n}{Sp_o}}
\]

\[
Sp_n = Sp_o \times \left(\frac{CFM_n}{CFM_o}\right)^2
\]

\[
\left(\frac{CFM_n}{CFM_o}\right)^3 = \frac{BHP_n}{BHP_o}
\] OR

\[
\frac{CFM_n}{CFM_o} = \sqrt[3]{\frac{BHP_n}{BHP_o}}
\]

\[
CFM_n = CFM_o \times \sqrt[3]{\frac{BHP_n}{BHP_o}}
\]

\[
BHP_n = BHP_o \times \left(\frac{CFM_n}{CFM_o}\right)^3
\]

\[\text{Hydronics:}\quad \Delta P = Sp, \quad CFM = \text{GPM}, \quad \text{RPM} = \text{GPM}\]

\[\text{MAT} = (\text{OAT} \times \%OA) + (\text{RAT} \times \%RA)\]

\[\text{Btuhr hydronic (H,O only)} = 500 \times \text{GPM} \times \Delta T\]

\[\text{Btuhr sensible (at sea level)} = 1.08 \times \text{CFM} \times \Delta T\]

\[\text{Btuhr latent (at sea level)} = 0.68 \times \text{CFM} \times \Delta \text{Grains}\]

\[\text{Btuhr total (at sea level)} = 4.5 \times \text{CFM} \times \Delta \text{Enthalpy}\]

\[
\text{CFM (AC/Hr)} = \frac{\Delta C}{\text{Hr} \times \text{Volume}}
\]

\[
V = 4005 \times \sqrt{V_p}
\]

\[
V_p = \left(\frac{V}{4005}\right)^2
\]

\[\text{Pressure (PSI)} = 0.433 \times \text{Head (feet of water)}\]

\[1 \text{ IWC} = 0.0360 \text{ PSI}\]

\[1 \text{ PSI} = 27.72 \text{ IWC}\]

\[\text{Pressure 1} \times \text{Volume 1} = \text{Pressure 2} \times \text{Volume 2}\]

\[\text{Area} = \pi \times \text{radius}^2\]

\[A^2 + B^2 = C^2\]

\[\text{Diameter} = \frac{\text{Circumference}}{\pi}\]

\[\text{FR} = \frac{\text{ASP} \times 100}{\text{TEL}} \quad (\text{IWC/100})\]

\[\text{Rectangular Duct Area (ft}^2) = \frac{\text{Length} \times \text{Width}}{144}\]

\[\text{Round Duct Area (ft}^2) = \frac{\pi \times \text{diameter}^2}{576}\]

\[mfd = \frac{(2650 \times I)}{E}\]

\[\text{CFM} = \text{Velocity (fpm)} \times \text{Duct Area (ft}^2)\]

\[\text{CFM} = \frac{(\text{Watts} \times 3.413)}{\left(\Delta T \times 1.08\right)}\]

\[C_T (\text{Series}) = \frac{1}{C_1} + \frac{1}{C_2} + \ldots + \frac{1}{C_n}\]

\[C_T (\text{Parallel}) = C_1 + C_2 + \ldots + C_n\]
TEMPERATURE PRESSURE CHART – at sea level

Pressure (PSIG), Vacuum (in. Of Hg) – Bold Italic Figures
To determine subcooling for 404A, 407C, and 422D, use BUBBLE POINT values (temperatures above 50°F – gray background)
To determine superheat for 404A, 407C, and 422D, use DEW POINT values (temperatures 50°F and below)

<table>
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CONTINUED
## TEMPERATURE PRESSURE CHART

**Pressure (PSIG), Vacuum (in. Of Hg) – Bold Italic Figures**

To determine subcooling for 404A, 407C, and 422D, use BUBBLE POINT values (temperatures above 50°F – gray background)

To determine superheat for 404A, 407C, and 422D, use DEW POINT values (temperatures 50°F and below)

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<tr>
<th>TEMP. °F</th>
<th>TEMP. °C</th>
<th>TEMPERATURE</th>
<th>PRESSURE</th>
<th>DEW POINT</th>
<th>BUBBLE POINT</th>
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<th>407C</th>
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**Note:**
- Temperatures above 50°F are highlighted in gray for subcooling.
- Temperatures below 50°F are highlighted in black for superheat.