AIR DISTRIBUTION  INSTALLATION CERTIFICATION

**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.
- 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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<table>
<thead>
<tr>
<th>SECTION AREA DESCRIPTION</th>
<th>SECTION PERCENTAGE</th>
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<tbody>
<tr>
<td>Installation</td>
<td>40%</td>
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<tr>
<td>Service</td>
<td>10%</td>
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<tr>
<td>System Components</td>
<td>28%</td>
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<tr>
<td>Applied Knowledge</td>
<td>22%</td>
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</table>

**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”, “Q” - Quality Installation, and “S”
- ACCA Manuals “T” and “RS” - Latest Editions
- ACCA Residential Duct Diagnostics and Repair - Latest Edition
- AHRI-Hydonics 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.

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INSTALLATION

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/secure 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
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**
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
  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
\[
\frac{CFM_n}{CFM_o} = \frac{RPM_n}{RPM_o} \quad \text{for old, new}
\]

CFM and RPM are interchangeable.

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

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

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

\[
MAT = (OAT \times 0\%) + (RAT \times RA)
\]

\[
0 = \text{Outside}
\]

\[
T = \text{Temperature}
\]

\[
R = \text{Return}
\]

\[
M = \text{Mixed}
\]

\[
A = \text{Air}
\]

\[
\frac{AC/Hr \times Volume}{60\text{min}} = CFM
\]

\[
v = 4005 \times Jvp
\]

\[
Vp = <4:05 > 2
\]

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

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

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

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

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

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

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

\[
\frac{ASP \times 100}{FR} = TEL \quad (\text{IWq100})
\]

\[
\text{Friction} = \text{Series}
\]

\[
\text{CFM} = \frac{\text{CFM} - (\text{Watts} \times 3.413)}{\left(\frac{\text{AT} \times 1.08}{1/CL + 1/C2 + \ldots + 1/Cn}\right)}
\]

\[
\text{CFM} = \frac{\text{Watts} \times 3.413}{\left(\frac{\text{AT} \times 1.08}{1/CL + 1/C2 + \ldots + 1/Cn}\right)}
\]
Pressure (PSIG), Vacuum (in. Hg) - Bold Italic Figures
To determine subcooling for 404A, 407C, and 4220, use BUBBLE POINT values (temperatures above 50° F - gray background)
To determine superheat for 404A, 407C, and 4220, use DEW POINT values (temperatures 50° F and below)

<table>
<thead>
<tr>
<th>TEMP.</th>
<th>PRESSURE (PSIG)</th>
<th>TEMPERATURE (°F)</th>
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<tr>
<td>407C</td>
<td>22</td>
<td>404A</td>
</tr>
<tr>
<td>410A</td>
<td>507</td>
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CONTINUED
To determine subcooling for 404A, 407C, and 4220, use BUBBLE POINT values (temperatures above 50°F -gray background)
To determine superheat for 404A, 407C, and 4220, use DEW POINT values (temperatures 50°F and below)