AIR DISTRIBUTION SERVICE 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 service 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 SERVICE 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 two years of field experience working on Air Distribution systems as a service technician and technical training for theoretical knowledge.

Test Specifications

Closed Book 2.5 Hour Time Limit 100 Questions Passing Score: PASS/FAIL

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

SECTION AREA DESCRIPTION	SECTION PERCENTAGE
Installation	20%
Service	40%
System Components	25%
Applied Knowledge	15%

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-Hydronics Section-IBO/RAH Latest Edition
- International Energy Conservation Code - Latest Edition with Addendum
- International Mechanical Code - Latest Edition with Addendum
- International Plumbing Code - Latest Edition with Addendum
- 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
- 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
  - 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

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

Air Distribution - Low Pressure

Service

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

- Seam types - pittsburgh and snap lock
- Joint types - drive slips, reinforced drive slips, "s" slip, and standing "s" slip
- Use of strength breaks in rectangular duct

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

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

INSTALLATION OF PLENUMS AND DUCT

- Sizing plenums for physical fit
- Types and styles of plenums selected
- Insulation of plenums and ducts

AIRFLOW MEASUREMENTS

AIRFLOW VELOCITY MEASUREMENTS

- Pitot tube and manometer in measuring static pressure

Discharge velocity equipment
Velometer - electronic and mechanical

Anemometer
Velocity measurement procedures
Gauge calibration
Introduction to airflow in Residential HVAC
Velocity

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
Static pressure
Air pressure measurement terminology
Velocity pressure
Total pressure

AIR VOLUME MEASUREMENTS

Airflow hood
Formulae for determining CFM of air
Formulae for weight of air
Locations for air volume measurements
Airflow volume - CFM / SCFM (Static CFM)

SERVICE

AIR BALANCING

GATHERING DESIGN INFORMATION

Interpreting system design
Interpreting specifications
Interpreting equipment information
Interpreting control data
Modifying system design

PREPARATION OF SYSTEM FOR AIR TESTS

Locating registers, grilles, equipment, controls, and dampers in building walkthrough
Setting dampers for tests
Setting thermostat for tests
Checking for proper fan operation and rotation
Checking for proper static pressure and temperature

PROCEDURES FOR CONDUCTING AIR TESTS

Measurements of each supply outlet - total readings
Measurements of each return inlet - total readings

MAKING ADJUSTMENTS

Adjust airflow to achieve required total airflow Re-measure total supply and return grille airflow Adjust dampers to obtain design airflow
Re-measure total airflow to verify that it is within +/- 10%

FINAL TEST

Comparing manufacturer's equipment information with test results
Record sheave, pulley, and belt sizes data
Test and record full load motor amperes
Test and record voltage
Test and record motor and fan RPM
Test and record supply and return static pressures
Test and record supply and return air temperatures - heat and cool

COMPLETION OF APPROPRIATE FORMS

HVAC system report
System diagrams
Duct traverse or data pulley forms
Instrument list - including calibration dates

BASIC HVAC SYSTEM ANALYSIS

NOISE PROBLEMS

Interpreting supply / return air volume
Interpreting supply / return air velocity
Noise problems
Blower cavitation
Oil canning
Motor / belt noise
Vibration

HIGH UTILITY BILLS

Interpreting supply / return air temperature
Interpreting supply / return air volume
Evaluating duct leakage
Evaluating duct insulation
Envelope infiltration
Thermostat air sensing

WIDE TEMPERATURE SWINGS

Interpreting supply / return air temperature
Interpreting supply / return air volume
Evaluating duct leakage
Evaluating duct insulation
Envelope infiltration
Thermostat air sensing

SINGLE AREA IS HOT OR COLD

Interpreting supply / return air temperature
Interpreting supply / return air volume
Evaluating duct leakage
Evaluating duct insulation
Envelope infiltration
Thermostat air sensing

INDOOR AIR QUALITY

Number of air changes per hour
Odor control
Contaminants

ANALYZING REPORTED SYMPTOMS IN COOLING

POOR COOLING

Interpreting supply / return air temperature
Interpreting supply / return air volume
Interpreting supply / return air velocity
Determining and interpreting the sensible heat ratio
Evaluating duct leakage
Using temperature drop across evaporator coil

HUMIDITY PROBLEMS

Interpreting wet bulb and dry bulb temperatures
Interpreting supply / return air volume
Determining and interpreting the sensible heat ratio
Evaluating duct leakage

DRAFTY

Interpreting supply / return air temperature
Interpreting supply / return air volume
Interpreting supply / return air velocity

ANALYZING REPORTED SYMPTOMS IN HEATING

POOR HEATING

Interpreting supply / return air temperature
Interpreting supply / return air volume
Interpreting supply / return air velocity
Evaluating duct leakage
Using temperature drop across evaporator coil

HUMIDITY PROBLEMS

Interpreting wet bulb and dry bulb temperatures
Interpreting supply / return air volume

Determining the need for additional humidity

Evaluating duct leakage

DRAFTY

Interpreting supply / return air temperature
Interpreting supply / return air volume
Interpreting supply / return air velocity

PLANNED MAINTENANCE

MECHANICAL PLANNED MAINTENANCE

Performance checks - heat exchanger temperature rise
Fan blades / blower scroll
Diffusers, grilles, and registers
Lubrication of blowers

AIRFLOW MEASUREMENTS

AIRFLOW CHECKS & DESIGN TOOLS

Using temperatures to determine airflow
Using manufacturer's airflow charts and/or tables
Measuring total supply and return airflow

SYSTEM COMPONENTS

INTRODUCTION TO BASIC SYSTEMS & COMPONENTS

HEAT TRANSFER AND THE BASIC COOLING CYCLE

Heat transfer and cooling
Basic refrigeration circuit - 10 components
Dynamic analysis of temperatures and pressure in the refrigerant circuit.
Psychrometrics
Subcooling
Superheat

NON-SENSING CONTROLS

RELAYS AND CONTACTORS

Introduction to relays and contactors
Basics of relay and contactor operation - inrush and holding
Selecting relays and contactors
Application considerations for relays and contactors

ELECTRIC HEAT CONTROLS

Sequencers - warp switch
Sequencers - electronically sequenced relays

DUCT SYSTEMS

BASIC DUCT SYSTEMS

Overview of duct systems for split and package 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.

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 use of fan specifications
Selecting registers by air spread and throw capacity

DIFFUSERS

Types and uses
Selecting diffusers
Selecting diffusers by use of fan specifications
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 limit controls
Define vent system
Define burners
Define fan controls
Define gas valve
Combustion air proving (pressure) switch

GAS HEAT - OPERATION

Define combustion air system
Air side requirements

Define sequence of operation

BASIC OIL FURNACES

OIL HEAT - COMPONENTS

- Define heat exchanger
- Define limit controls
- Define vent system
- Define oil burners

OIL HEAT - OPERATION

- Define combustion air system
- Air side requirements
- Define sequence of operation

BASIC AIR CONDITIONING / HEAT PUMPS

BASIC COMPONENTS

- Define evaporator
- Define condenser
- Define compressor
- Define metering device
- Reversing valves
- Defrost controls

BASIC OPERATION

- Define sequence of operation
- Air side requirements

BASIC AIRFLOW PRINCIPLES

INTRODUCTION TO AIRFLOW

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

BLOWERS AND FANS

- Define sequence of operation
- Air side requirements
- Motor selection

ELECTRONIC CONTROLS

OVERVIEW OF ELECTRONIC CONTROLLERS

- Input / output operations
- Logic
- Electronic interface
- Tap boards

ELECTRONIC THERMOSTATS

- Fundamentals of electronic thermostats
- Selecting electronic thermostats
- Overview of electronic thermostat operation
- Electronic fossil fuel kits

ZONE CONTROLS

- Fundamentals of zone controls
- Selecting zone controls
- Typical zone control logic
- Bypass dampers
- Types of zone controls

ELECTRONIC COMPRESSOR CONTROLS

- Compressor staging controls
- Compressor time delays

ELECTRONIC TIMERS

- Introduction to blower delay timers

ECONOMIZER CONTROLLERS

- Dry bulb controllers
- Enthalpy controllers
- Potentiometers
- Sensors

ELECTROMECHANICAL SENSING CONTROLS

ELECTROMECHANICAL WALL THERMOSTATS

Basic thermostat types and operation

Thermostat terminals and wiring
Selecting wall thermostats and sub-bases
Using electromechanical thermostats

ELECTROMECHANICAL TEMPERATURE CONTROLS

Introduction to bimetal controls
Disc type temperature limit controls
Overview of electric heat high limits
Fuses and fuse links
Motor overloads
Fossil fuel kits

PRESSURE CONTROLS

Introduction to disc type pressure controls and hi/low controls
Selection of disc type pressure controls
Using disc type pressure controls
Low ambient cooling controls

ELECTROMECHANICAL OUTDOOR THERMOSTATS

Overview of outdoor thermostats
Outdoor thermostat wiring

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 standards

HUMIDITY

Role of humidity in comfort
Using standards

INDOOR AIR QUALITY

Ventilation - comfort
Air cleaning for comfort
Standards for air quality
Outside air

SOUND LEVEL

Equipment location considerations

Isolation, mounting pad, duct, and structure

- Duct systems - flex joints

ZONING
- Single zone
- Multizone

DESIGN CONSIDERATIONS - RESIDENTIAL

SPLIT SYSTEMS
- Ventilation - fresh air
- Ventilation - equipment

AIR BALANCING
- Duct sizing
- Blower speed adjustments
- Damper position adjustments
- Measurement of air flow rate

DESIGN CONSIDERATIONS - COMPONENTS

DIFFUSERS
- Selecting diffusers for capacity
- Selecting diffusers for reduced sound
- Selecting diffusers for spread, throw, and pressure drop
- Locations

GRILLES
- Selecting grilles for capacity
- Selecting grilles for reduced sound
- Selecting location

REGISTERS
- Selecting registers for capacity
- Selecting registers for reduced sound
- Selecting registers for spread, throw, and pressure drop
- Locations

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

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

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

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

MECHANICAL CODE

EQUIPMENT ACCESS
- Minimum clearance
- Electrical disconnects
- Fire dampers

REFRIGERANT LINE ROUTING
- Support requirements
- Inspection requirements

CONDESATE 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

BIDS AND PROPOSALS

SYSTEM SIZING

- Survey of requirements
- Selecting equipment
- Selecting accessories

PREPARATION FOR AIR DISTRIBUTION PROPOSAL

- Understanding forms for proposals and bids
- Understanding legal implications of a bid

$\frac{CFM_n}{CFM_o} = \frac{RPM_n}{RPM_o}$ o = old, n = new CFM and RPM are interchangeable.

$CFMn = CFMo \times \frac{RPM}{o}$ $RPMn = RPMo \times \frac{CFM}{o}$

$\left(\frac{CFM_n}{CFM_o}\right)^2 = \frac{Sp_n}{Sp_o}$ OR $CFMo = JSPP;$ $CFM_n = CFM_o \times \sqrt{\frac{Sp_n}{Sp_o}}$ $Sp_n = Sp_o \times \left(\frac{CFM_n}{CFM_o}\right)^2$

$(\frac{CF}{CFM_o})^3 = \frac{BHPn}{BHP_o}$ OR $CFM_o = \frac{BHPn}{BHP_o}$ $CFM_n = CFM_o \times \sqrt[3]{\frac{BHP_n}{BHP_o}}$ $BHPn = BHPo \times (\frac{CFMn}{CFM_o})^3$

Hydronics: AP =Sp, CFM = GPM, RPM= GPM

$MAT = (OAT \times \%0A) + (RATx\ \%RA)$

0 =Outside
T = Temperature
R =Return
M=Mixed
A=Air

Btuh hydronic (H_20 only) = 500 x GPM x AT
Btuh sensible (at sea level) = 1.08 x CFM x AT
Btuh latent (at sea level) = 0.68 x CFM x AGrains
Btuh total (at sea level)= 4.5 x CFM x AEnthalpy

$CFM = \frac{AC/Hr \times Volume}{60min}$ $V = 4005 \times .Jvp$ $Vp = <4:05)2$

Pressure (PSI)= 0.433 x Head (feet of water)

1 IWC = 0.0360 PSI
1 PSI= 27.72 IWC

Pressure 1 x Volume 1 = Pressure 2 x Volume 2

Rectangular Duct Area (ft2) = $\frac{Length \times Width}{144}$

$Area = 1t \times radius^2$

$A^2 + B^2 = C$

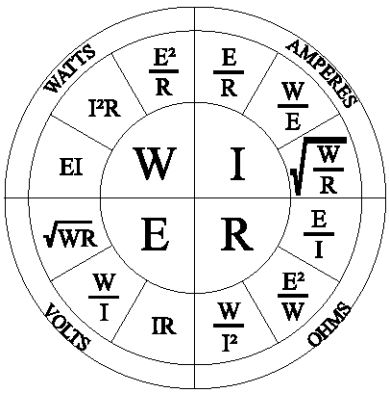
Round Duct Area (ft2) = $\frac{1t \times diameter}{576}$

$Diameter = \frac{Circumference}{1t}$

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

$FR = \frac{ASP \times 100}{TEL}$ (IWqIOO)

CFM = Velocity (fpm) x Duct Area (ft^2)



$CFM = \frac{(Watts \times 3.413)}{\{ATx\ 1.08)}$

$Cr\ (Series) = \frac{1}{\frac{1}{C1} + \frac{1}{C2} + \ldots + \frac{1}{}}$

$C_T\ (Parallel) = C_1 + C_2 + \ldots + C_N$

TEMPERATURE PRESSURE CHART-atsealevel

Pressure (PSIG), Vacuum (in. Of 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)

TEMP.		REFRIGERANT						
Of	OC	22	134a	404A	407C	410A	4220	507
-40	-40.0	0.6	*14.8*	4.3	*4.6*	10.7	2.3	5.4
-38	-38.9	1.4	*13.9*	5.3	3.2	12.0	*0.8*	6.4
-36	-37.8	2.2	*13.0*	6.3	*1.6*	13.4	0.4	7.5
-34	-36.7	3.1	*12.0*	7.4	0.0	14.8	1.2	8.6
-32	-35.6	4.0	*10.9*	8.5	0.8	16.2	2.1	9.8
-30	-34.4	4.9	*9.8*	9.6	1.6	17.8	3.0	11.0
-28	-33.3	5.9	*8.7*	10.8	2.5	19.3	3.9	12.2
-26	-32.2	6.9	7.5	12.0	3.5	21.0	4.9	13.5
-24	-31.1	8.0	6.3	13.3	4.4	22.7	5.9	14.8
-22	-30.0	9.1	*5.0*	14.6	5.4	24.4	7.0	16.2
-20	-28.9	10.2	*3.7*	16.0	6.5	26.3	8.1	17.6
-18	-27.8	11.4	2.3	17.4	7.6	28.1	9.2	19.1
-16	-26.7	12.6	*0.8*	18.9	8.7	30.1	10.4	20.6
-14	-25.6	13.9	0.4	20.4	9.9	32.1	11.7	22.2
-12	-24.4	15.2	1.1	22.0	11.1	34.2	12.9	23.8
-10	-23.3	16.5	1.9	23.6	12.3	36.4	14.3	25.5
-8	-22.2	17.9	2.8	25.3	13.7	38.6	15.6	27.3
-6	-21.1	19.4	3.6	27.0	15.0	40.9	17.1	29.1
-4	-20.0	20.9	4.6	28.8	16.4	43.3	18.5	30.9
-2	-18.9	22.4	5.5	30.7	17.9	45.8	20.1	32.8
0	-17.8	24.0	6.5	32.6	19.4	48.3	21.6	34.8
1	-17.2	24.9	7.0	33.6	20.2	49.6	22.5	35.8
2	-16.7	25.7	7.5	34.6	21.0	51.0	23.3	36.9
3	-16.1	26.5	8.0	35.6	21.8	52.3	24.1	37.9
4	-15.6	27.4	8.5	36.6	22.6	53.7	25.0	39.0
5	-15.0	28.3	9.1	37.7	23.5	55.0	25.8	40.0
6	-14.4	29.2	9.6	38.7	24.3	56.5	26.7	41.1
7	-13.9	30.1	10.2	39.8	25.2	57.9	27.6	42.2
8	-13.3	31.0	10.8	40.9	26.1	59.3	28.5	43.4
9	-12.8	31.9	11.3	42.0	27.0	60.8	29.5	44.5
10	-12.2	32.8	11.9	43.1	27.9	62.3	30.4	45.7
11	-11.7	33.8	12.5	44.3	28.8	63.8	31.3	46.8
12	-11.1	34.8	13.1	45.4	29.8	65.4	32.3	48.0
13	-10.6	35.8	13.8	46.6	30.7	66.9	33.3	49.3
14	-10.0	36.8	14.4	47.8	31.7	68.5	34.3	50.5
15	-9.4	37.8	15.0	49.0	32.7	70.1	35.3	51.7
16	-8.9	38.8	15.7	50.2	33.7	71.7	36.4	53.0
17	-8.3	39.9	16.4	51.5	34.7	73.4	37.4	54.3
18	-7.8	40.9	17.0	52.7	35.7	75.1	38.5	55.6
19	-7.2	42.0	17.7	54.0	36.8	76.8	39.6	56.9
20	-6.7	43.1	18.4	55.3	37.9	78.5	40.7	58.2
21	-6.1	44.2	19.1	56.6	39.0	80.3	41.8	59.6
22	-5.6	45.3	19.9	58.0	40.1	82.0	42.9	61.0
23	-5.0	46.5	20.6	59.3	41.2	83.8	44.1	62.4
24	-4.4	47.6	21.3	60.7	42.3	85.7	45.2	63.8
25	-3.9	48.8	22.1	62.1	43.5	87.5	46.4	65.2
26	-3.3	50.0	22.9	63.5	44.7	89.4	47.6	66.7
27	-2.8	51.2	23.7	64.9	45.9	91.3	48.8	68.2
28	-2.2	52.4	24.5	66.4	47.1	93.2	50.1	69.7
29	-1.7	53.7	25.3	67.8	48.3	95.2	51.3	71.2
30	-1.1	55.0	26.1	69.3	49.6	97.2	52.6	72.7
31	-0.6	56.2	26.9	70.8	50.8	99.2	53.9	74.3

CONTINUED

TEMPERATURE PRESSURE CHART-atsealevel

Pressure (PSIG), Vacuum (in. Of 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)

TEMP.		REFRIGERANT						
•f	0C	22	134a	404A	407C	410A	4220	507
32	0.0	57.5	27.8	72.4	52.1	101.2	55.2	75.8
33	0.6	58.8	28.6	73.9	53.4	103.3	56.5	77.4
34	1.1	60.2	29.5	75.5	54.8	105.4	57.9	79.0
35	1.7	61.5	30.4	77.1	56.1	107.5	59.3	80.7
36	2.2	62.9	31.3	78.7	57.5	109.7	60.6	82.3
37	2.8	64.3	32.2	80.3	58.9	111.9	62.0	84.0
38	3.3	65.7	33.1	82.0	60.3	114.1	63.5	85.7
39	3.9	67.1	34.1	83.7	61.7	116.3	64.9	87.5
40	4.4	68.6	35.0	85.4	63.2	118.6	66.4	89.2
42	5.6	71.5	37.0	88.8	66.1	123.2	69.4	92.8
44	6.7	74.5	39.0	92.4	69.2	127.9	72.5	96.4
46	7.8	77.6	41.1	96.0	72.3	132.8	75.6	100.2
48	8.9	80.8	43.2	99.8	75.5	137.8	78.9	104.0
50	10.0	84.1	45.4	103.6	78.8	142.9	82.2	108.0
52	11.1	87.4	47.7	1092	101.7	148.1	96.1	112.0
54	12.2	90.8	50.0	1133	105.6	153.5	998	116.1
56	13.3	94.4	52.4	117.4	109.6	159.0	103.6	120.4
58	14.4	98.0	54.9	121.7	113.7	164.7	107.4	124.7
60	15.6	101.6	57.4	126.0	117.9	170.4	111.4	129.1
62	16.7	105.4	60.0	1305	122.3	176.3	1154	133.7
64	17.8	109.3	62.7	1350	126.7	182.4	1195	138.3
66	18.9	113.2	65.4	139.7	131.2	188.6	123.8	143.1
68	20.0	117.3	68.2	144.4	135.8	194.9	128.1	147.9
70	21.1	121.4	71.1	149.3	140.5	201.4	132.5	152.9
72	22.2	125.7	74.1	154.3	145.4	208.0	137.1	158.0
74	23.3	130.0	77.1	1594	150.3	214.8	1417	163.2
76	24.4	134.5	80.2	164.6	155.4	221.8	146.5	168.5
78	25.6	139.0	83.4	169.9	160.5	228.9	151.3	174.0
80	26.7	143.6	86.7	175.4	185.8	236.1	156.3	179.5
82	27.8	148.4	90.0	181.0	171.2	243.6	161.3	185.2
84	28.9	153.2	93.5	1867	176.8	251.2	1665	191.0
86	30.0	158.2	97.0	1925	182.4	258.9	1718	197.0
88	31.1	163.2	100.6	198.4	188.2	266.8	177.2	203.0
90	32.2	168.4	104.3	204.5	194.1	274.9	182.7	209.2
92	33.3	173.7	108.1	210.7	200.1	283.2	188.4	215.5
94	34.4	179.1	112.0	2170	206.3	291.6	1941	222.0
96	35.6	184.6	115.9	2234	212.5	300.3	2000	228.6
98	36.7	190.2	120.0	230.0	219.0	309.1	206.0	235.3
100	37.8	195.9	124.2	236.8	225.5	318.1	212.1	242.2
102	38.9	201.8	128.4	243.6	232.2	327.2	218.4	249.2
104	40.0	207.7	132.7	250.8	239.0	336.6	224.8	256.3
106	41.1	213.8	137.2	2578	245.9	346.2	2313	263.7
108	42.2	220.0	141.7	265.1	253.0	355.9	237.9	271.1
110	43.3	226.4	146.4	272.5	260.3	365.9	244.7	278.7
112	44.4	232.8	151.1	280.1	287.6	376.1	251.6	286.5
114	45.6	239.4	156.0	287.9	275.1	386.4	258.8	294.4
116	46.7	246.1	160.9	2958	282.8	397.0	2658	302.4
118	47.8	253.0	166.0	3038	290.6	407.8	2732	310.7
120	48.9	260.0	171.2	312.1	298.6	418.8	280.6	319.1
125	51.7	278.0	184.6	333.3	319.2	447.4	299.9	340.8
130	54.4	296.9	198.7	355.6	340.7	477.4	320.2	363.6