

AIR CONDITIONING

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 30 tons or less cooling capacity.

Qualifications

- Y 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.
- Y This test will measure what 80% of the **Air Conditioning** candidates have an 80% likelihood of encountering at least once during the year on a **NATIONAL** basis.
- Y Suggested requirement is one year of field experience working on Air Conditioning systems as an installation 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 Conditioning** exam.

SECTION AREA DESCRIPTION	SECTION PERCENTAGE
Installation	43%
Service	10%
System Components	27%
Applied Knowledge	20%

Air Conditioning 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.

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Air Conditioning - Air to Air

Installer

INSTALLATION

FABRICATING COPPER TUBING

REFRIGERANT LINE INSTALLATION

- Locating, mounting, and routing
- Understanding limitations of length and diameter

BENDING COPPER TUBING

- Making a proper bend with spring benders
- Making a proper bend with cam type benders

COPPER TUBING PREPARATION

- Cutting copper tubing
- Reaming copper tubing
- Cleaning copper tubing
- Swaging copper tubing

BRAZING

- Overview of brazing copper to copper
- Oxyacetylene brazing
- Using air / fuel to solder
- Use of purging gas when brazing
- Overview of brazing copper to brass
- Overview of brazing copper to steel
- Selection of brazing materials

FLARE FITTINGS

- Making a flare fitting - single and double
- Installing with flare fittings

BRAZING & SOLDERING EQUIPMENT

- Brazing products - rods, flux, etc.
- Oxyacetylene brazing equipment
- Gas purging equipment in field brazing
- Air / Fuel systems - acetylene, propane, MAP, etc.
- Soldering products - solder, flux, and torches
- Tool maintenance and care

INSTALLING CONDENSING UNIT

INSTALLING AND CONNECTING CONDENSING UNIT

- Locating unit
- Preparing site
- Placing unit
- Wiring outdoor units
- Installing refrigerant lines

INSTALLING PACKAGED UNITS

INSTALLING AND CONNECTING

- Locating equipment
- Preparing site
- Lifting unit
- Sealing unit
- Wiring

INSTALLING INDOOR EQUIPMENT

INSTALLATION OF INDOOR AIR HANDLERS / FURNACES

- Installing coil and air handler / furnace
- Connecting ductwork
- Connecting refrigerant lines
- Connecting condensate lines
- Wiring air handler / furnace
- Wiring thermostats
- Wiring electronic air cleaners
- TEV's - installation
- Installing fixed metering devices

- Auxiliary heat
- Handling - lifting, hanging
- Trapping for condensate lines
- Service access and clearance considerations

EVACUATION & CHARGING

SAFE HANDLING OF REFRIGERANT CONTAINERS

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

EVACUATION

- Overview - use of a vacuum pump
- Overview - use of a micron gauge
- Use of a manifold gauge set in evacuation
- Deep single evacuation process
- Removing core of access valves

LEAK CHECKING & DETECTION

- Overview of leak checking and detection
- Leak checking with electronic leak detectors
- Leak checking with soap solutions
- Gas pressurization for leak checking
- Leak checking with ultrasonic leak detectors

CHARGING METHOD

- Weigh in method
- Superheat method and where used
- Subcooling method and where used
- Charging blended refrigerants

DUCT INSTALLATION

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.

INSTALLING METAL DUCT

- Assembly methods for rectangular duct
- Assembly methods for round duct
- Hanging ductwork
- Sealing metal duct
- Insulation - internal and external

INSTALLING FLEXIBLE DUCT

- Assembly methods - appropriate length
- Hanging flexible duct
- Sealing flexible duct
- Installation technique

INSTALLING DUCTBOARD

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

INSTALLING GRILLES, REGISTERS, DIFFUSERS, & DAMPER

- Mounting to ductwork
- Securing methods
- Sealing methods

FIELD CONSTRUCTION / INSTALLATION

- Techniques for joining dissimilar duct
- Duct of alternate materials - wood, aluminum, etc.

CHASES USED AS DUCTS

- Floor joists as air ducts
- Vertical chases

INSTALLING THERMOSTATS

- Locating and mounting
- Wiring electromechanical thermostats
- Wiring electronic thermostats
- Setting anticipators when used
- Installing air side low ambient control
- Installing outdoor thermostat
- Setting balance point on outdoor thermostat

INSTALLING ELECTRONIC AIR CLEANERS

- Installing to a unit - sealing
- Wiring
- Controlling electronic air cleaners

INSTALLING ECONOMIZERS

- Installing
- Wiring
- Controlling economizers

FIELD WIRING

WIRING UNITS & CONTROL WIRING

- Connecting electrical power
- Connecting control circuits
- Meeting manufacturer sizing requirements - wire sizing (size and number)

START-UP AND CHECKOUT

PRE-START PROCEDURES

- Surveying installation - checking equipment match
- Inspect connections for tightness
- Set dip switches / jumpers on ECM motors
- Set speed taps on multi-speed motors
- Set adjustable pulleys on belt driven blowers
- Ensure clean filter is in place and accessible
- Ensure condensate line is flowing

START-UP PROCEDURES AND CHECKS

- Surveying installation
- Supply voltage checks
- Motor checks
- Checking sequences
- Check fan rotation
- Check scroll compressor rotation - high noise level, etc. Start-up checklist and preparation
- Metering device - refrigerant circuit checks
- Airflow checks
- Pressure checks
- Temperature checks - dry bulb, wet bulb, etc.

LEAK DETECTION TOOLS

- Soap solution
- Electronic leak detectors
- Ultrasonic leak detector
- Halide leak detector
- Use of dye leak detectors
- Pressurization for leak detection
- Meter calibration and maintenance

REFRIGERANT CIRCUIT TOOLS

MANIFOLD GAUGE SET

- Manifold gauge set
- How to read the gauge set
- How to connect the gauge set for different purposes
- Types and styles of gauge sets
- Using the gauge set for diagnostics
- Low loss fitting connections
- Gauge calibration and maintenance

EVACUATION TOOLS

- Vacuum pump
- Micron gauge
- Valve opening tools - core removers, etc.
- Gauge calibration and maintenance

CHARGING TOOLS

- Charging scales
- Gauge calibration and maintenance

RETROFITTING

EQUIPMENT COMPONENT RETROFITTING

- Changing out an outdoor unit
- Changing out an indoor unit
- Modifying ductwork for replacement equipment

BASIC DUCT FABRICATION

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

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

DIAGNOSTICS

PRELIMINARY SYSTEM DIAGNOSTICS

- Outdoor unit checks
- Indoor unit checks
- Wiring checks
- Refrigerant line checks
- Thermostat checks
- Condensate drain checks
- Accessories

ELECTRICAL CHECKS

- Compressor circuits
- Condenser fan circuits
- Indoor blower circuits
- Wall thermostat circuits
- Transformer circuits
- Electronic controllers - input / output

COMPONENT CHECKS - ELECTRICAL

- Thermostat
- Transformers
- Overcurrent protection
- Relays and contactors
- Condenser fan motors
- Indoor blower motors
- Solenoid valves coils

REPAIR

- Refrigerant circuit on coils
- Ductwork
- Electrical wiring

INTRODUCTION TO ELECTRICAL TROUBLESHOOTING

LOW VOLTAGE CIRCUITS

- Voltage tests
- Equipment continuity tests
- Ground tests

LINE VOLTAGE CIRCUITS

- Voltage tests
- Equipment continuity tests
- Ground tests

SYSTEM COMPONENTS

INTRODUCTION TO SYSTEMS

HEAT TRANSFER PRINCIPLES

- Heat transfer - evaporations and condensation
- Basic refrigeration circuit - 7 components
- Temperature and pressure in the refrigerant circuit.

SPLIT SYSTEMS

- Introduction to split system AC configurations and applications
- Equipment locations and mounting
- Duct designs for split systems air conditioners
- Electrical layouts for split systems air conditioners
- Refrigerant circuits for split systems air conditioners
- Specifications for split system air conditioners
- Attic / Crawlspace layouts for split systems air conditioners
- Closet layouts for split systems air conditioners
- Basement layouts for split systems air conditioners
- Heat options with split system air conditioners
- Ventilation options split systems air conditioners
- Regional considerations in split system air conditioner designs
- Special consideration of indoor coils above living space

PACKAGED SYSTEMS

- Introduction to package AC configurations
- Equipment locations for package air conditioners
- Basic duct designs for packaged equipment
- Electrical layouts with packaged air conditioners
- Packaged equipment in single story applications
- Packaged equipment in multi story applications
- Packaged equipment applied with crawlspace duct designs
- Heat options with packaged air conditioners
- Ventilation options for packaged air conditioners
- Economizer options
- Regional considerations in packaged equipment

MULTI-CAPACITY SYSTEMS

- Overview of multi-capacity systems
- Sequencing of multi-capacity air conditioners
- Refrigerant circuits of multi-capacity air conditioners

DUCT SYSTEMS

DUCT SYSTEMS

- Duct system design
- Duct configurations - extended plenum, reducing extended plenum, perimeter radial, perimeter loop, overhead radial
- Return configurations - ducted, central, etc.
- Return grille locations - low sidewall, high sidewall, etc.
- Supply locations - floor, sidewall, ceiling, etc.

WIRING LAYOUTS

POWER WIRING

- Overview of power wiring

LOW VOLTAGE

- Overview of low voltage wiring

COMPONENTS

OUTDOOR COILS

- Types - basic designs
- Airflow characteristics

COMPRESSORS

- Fundamentals of compressor operations
- Compressor types

REFRIGERANTS

- Refrigerants used in Res./Lt. Com air conditioners
- Properties of refrigerants used in Res./Lt. Com air conditioners
- Using temperature-pressure chart
- Refrigerant conservation

SERVICE VALVES

- Front seating service valves
- Back seating service valves
- Gauge port

REFRIGERANT CIRCUIT ACCESSORIES

- Operation fundamentals - accumulators
- Operation fundamentals - filter-driers
- Operation fundamentals - sight glasses, moisture indicators, liquid indicators, etc.
- Operation fundamentals - mufflers

INDOOR COILS

- Types - basic designs and operating characteristics of A-coil, slab, and slant indoor coils
- Basics of selection
- Condensate drains

METERING DEVICES

- Types
- Selection

BLOWERS AND FANS

- Role of indoor blowers
- Role of outdoor fans
- Blower and fan performance

LINE SETS

- Introduction to line sets
- Application considerations when using line sets

AIR SIDE COMPONENTS

- Dampers
- Ventilation fittings
- Electronic air cleaners (EAC's)
- Electrostatic filters - non-electric
- Media type filters
- Fixed outdoor air damper

Insulating material
Flexible connectors

GRILLES, REGISTERS, & DIFFUSERS

Types and uses

FASTENERS

Screws
Bolts
Nuts and washers
Lockpins
Rivets

ELECTRICAL COMPONENTS

Overcurrent protection
Capacitors
Solenoids
Crankcase heaters
Auxiliary strip heat
Transformers

CONSTANT AIRFLOW MOTORS

Intro to variable speed motors - ECM, BPM, and VSIM
Motor mounting and installation requirements
Electronic interface and setting for airflow requirements

ELECTROMECHANICAL SENSING CONTROLS

ELECTROMECHANICAL WALL THERMOSTATS

Basic thermostat types and operation
Thermostat terminals and wiring
Using electromechanical thermostats

ELECTROMECHANICAL TEMPERATURE CONTROLS

Introduction to bimetal controls
Disc type temperature limit controls
Introduction to vapor charged controls
Overview of electric heat high limits
Motor overloads

PRESSURE CONTROLS

Introduction to disc type pressure controls and hi/low controls
Operation of disc type pressure controls

ELECTROMECHANICAL OUTDOOR THERMOSTATS

Overview of outdoor thermostats
Outdoor thermostat wiring
Low ambient cooling controls

REFRIGERANT CIRCUIT CONTROLS

PRESSURE CONTROLS

High pressure limit controls
Low pressure limit controls

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

ELECTRONIC CONTROLS

ELECTRONIC THERMOSTATS

Fundamentals of electronic thermostats
Overview of electronic thermostat operation

ZONE CONTROLS

Fundamentals of zone controls
Typical zone control logic

ELECTRONIC COMPRESSOR CONTROLS

Fundamentals of compressor controls

Operation of compressor controls

ELECTRONIC TIMERS

Introduction to blower delay timers

Introduction to compressor delay timers

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

HUMIDITY

Role of humidity in comfort

INDOOR AIR QUALITY

Ventilation - comfort

Air cleaning for comfort

Outside air

SOUND LEVEL

Equipment location considerations

Isolation, mounting pad, duct, and structure

Duct systems

DESIGN CONSIDERATIONS - EQUIPMENT

SPLIT SYSTEMS

System designs - closets, basements, etc.

Refrigerant piping

Equipment location

Electrical layouts

Duct design / balancing

Condensate drains

Ventilation - fresh air

Regional design considerations

Ventilation - equipment

Secondary condensate drains / pans

Mounting of equipment

PACKAGED SYSTEMS

Package system configurations and design

Equipment locations design

- Applications for packaged systems
- Basic duct designs for packaged equipment
- Condensate drain piping design
- Electrical layouts with packaged air conditioners
- Packaged equipment in single story applications
- Packaged equipment in multi story applications
- Packaged equipment in crawlspace applications
- Heat options with packaged systems
- Ventilation options
- Regional considerations in packaged equipment

DESIGN CONSIDERATIONS - COMPONENTS

DIFFUSERS, REGISTERS, AND GRILLES

- Selecting diffusers, grilles, and registers
- Modifying locations

ACCESSORIES

- Start components
- Filter-driers - When to use? and How to select?
- Filtering - EAC, media, HEPA, electrostatic

RECOVERY / RECYCLING MACHINES

RECOVERY MACHINES

- Introduction to recovery machines
- Types and styles of recovery machines
- Typical recovery procedures
- Recovery machine maintenance and cylinder maintenance

RECYCLING MACHINES

- Introduction to recycling machines
- Types and styles of recycling machines
- Typical recycling procedures
- Recovery machine maintenance and cylinder maintenance

MECHANICAL CODE

EQUIPMENT ACCESS

- Minimum clearance
- Electrical disconnects
- Fire dampers

REFRIGERANT LINE ROUTING

- Support requirements
- Inspection requirements

CONDENSATE DRAINS

- Materials
- Sizing

$$\frac{CFM_n}{CFM_o} = \frac{RPM_n}{RPM_o}$$

o = old, *n* = new
CFM and RPM are interchangeable.

$$CFM_n = CFM_o \times \frac{RPM_n}{RPM_o}$$

$$RPM_n = RPM_o \times \frac{CFM_n}{CFM_o}$$

$$\left(\frac{CFM_n}{CFM_o}\right)^2 = \frac{SP_n}{SP_o} \quad \text{OR} \quad \frac{CFM_n}{CFM_o} = \sqrt{\frac{SP_n}{SP_o}}$$

$$CFM_n = CFM_o \times \sqrt{\frac{SP_n}{SP_o}}$$

$$SP_n = SP_o \times \left(\frac{CFM_n}{CFM_o}\right)^2$$

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

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

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

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

$$MAT = (OAT \times \%OA) + (RAT \times \%RA)$$

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

$$Btuh \text{ hydronic (H}_2\text{O only)} = 500 \times GPM \times AT$$

$$Btuh \text{ sensible (at sea level)} = 1.08 \times CFM \times AT$$

$$Btuh \text{ latent (at sea level)} = 0.68 \times CFM \times AGrains$$

$$Btuh \text{ total (at sea level)} = 4.5 \times CFM \times AEnthalpy$$

$$CFM = \frac{AC/Hr \times Volume}{60min}$$

$$V = 4005 \times .Jvp$$

$$Vp = <4.05 \rangle 2$$

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

$$1 IWC = 0.0360 PSI$$

$$1 PSI = 27.72 IWC$$

$$Pressure 1 \times Volume 1 = Pressure 2 \times Volume 2$$

$$Area = 1t \times radius^2$$

$$A^2 + B^2 = C$$

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

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

$$Round \text{ Duct Area (ft}^2) = \frac{1t \times diameter}{576}$$

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

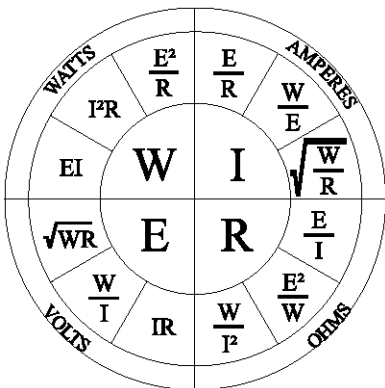
$$FR = \frac{ASP \times 100}{TEL} \quad (IWq100)$$

$$CFM = Velocity (fpm) \times Duct Area (ft^2)$$

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

$$Cr \text{ (Series)} = \frac{1}{\frac{1}{C1} + \frac{1}{C2} + \dots + \frac{1}{CN}}$$

$$Cr \text{ (Parallel)} = C1 + C2 + \dots + CN$$



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	<i>14.8</i>	4.3	4.6	10.7	2.3	5.4
-38	-38.9	1.4	<i>13.9</i>	5.3	3.2	12.0	0.8	6.4
-36	-37.8	2.2	<i>13.0</i>	6.3	1.6	13.4	0.4	7.5
-34	-36.7	3.1	<i>12.0</i>	7.4	0.0	14.8	1.2	8.6
-32	-35.6	4.0	<i>10.9</i>	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	OC	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	109.2	101.7	148.1	96.1	112.0
54	12.2	90.8	50.0	113.3	105.6	153.5	99.8	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	130.5	122.3	176.3	115.4	133.7
64	17.8	109.3	62.7	135.0	126.7	182.4	119.5	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	159.4	150.3	214.8	141.7	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	165.8	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	186.7	176.8	251.2	166.5	191.0
86	30.0	158.2	97.0	192.5	182.4	258.9	171.8	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	217.0	206.3	291.6	194.1	222.0
96	35.6	184.6	115.9	223.4	212.5	300.3	200.0	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	257.8	245.9	346.2	231.3	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	267.6	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	295.8	282.8	397.0	265.8	302.4
118	47.8	253.0	166.0	303.8	290.6	407.8	273.2	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