

AIR-TO-AIR HEAT PUMPS

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 **Heat Pumps** 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 Heat Pumps 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 **Heat Pumps** exam.

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

Heat Pumps 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

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Heating - Reverse Cycle 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 OUTDOOR UNITS

INSTALLING AND CONNECTING OUTDOOR UNITS

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

INSTALLING PACKAGED UNITS

INSTALLING AND CONNECTING PACKAGED UNITS

- 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
- Bulb location selection for TEV's

- Auxiliary heat
- Handling - lifting, hanging
- Trapping for condensate lines

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 ACCESSORIES

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 HUMIDIFIERS

- Installing
- Wiring
- Controlling humidifiers

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 CEM 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.
- Reversing valve checks

LEAK DETECTION TOOLS

- Soap solution
- Electronic leak detectors
- Ultrasonic leak detector
- Halide leak detector
- Use of dye leak detectors

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

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

RETROFITTING

EQUIPMENT COMPONENT RETROFITTING

Changing out an outdoor unit

Changing out an indoor unit

Modifying ductwork for replacement equipment

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

- Supply checks
- Compressor circuits
- Condenser fan circuits
- Indoor blower circuits
- Thermostat circuits
- Transformer circuits
- Defrost control circuits
- Indoor auxiliary heat circuits
- Reversing valve solenoid circuits
- Electronic controllers - input / output

ELECTRICAL COMPONENT CHECKS

- Thermostat
- Transformers
- Overcurrent protection
- Relays and contactors
- Condenser fans
- Indoor blowers
- Solenoid valves coils
- Defrost termination control
- Outdoor thermostats

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 - evaporation and condensation
- Basic refrigeration circuit - 10 components
- Temperature and pressure in the refrigerant circuit

SPLIT SYSTEMS

- Introduction to split system heat pump configurations and applications
- Equipment locations and mounting
- Duct designs for split systems heat pumps
- Electrical layouts for split systems heat pumps
- Refrigerant circuits for split systems heat pumps
- Specifications for split system heat pumps
- Attic / crawlspace layouts for split systems heat pumps
- Closet layouts for split systems heat pumps
- Basement layouts for split systems heat pumps
- Auxiliary heat options with split system heat pumps
- Ventilation options heat pumps
- Regional considerations in split system heat pump designs
- Special consideration of indoor coils above living space

PACKAGED SYSTEMS

- Introduction to package heat pump configurations
- Equipment locations for package heat pumps
- Basic duct designs for packaged equipment
- Electrical layouts with packaged heat pumps
- Packaged equipment in single story applications
- Packaged equipment in multi story applications

- Packaged equipment in crawlspace applications
- Heat options with packaged heat pumps
- Ventilation options for packaged heat pumps
- Economizer options
- Regional considerations in packaged equipment
- Specifications for packaged equipment

MULTI-CAPACITY SYSTEMS

- Overview of multi-capacity systems
- Sequencing of multi-capacity heat pumps
- Refrigerant circuits
- Indoor Airflow
 - 01 MDU of need to adjust airflow per capacity requirements
- MDU of need to adjust airflow per capacity requirements

THE BASIC HEAT PUMP REFRIGERANT CIRCUIT

- Basic circuit layout for a heat pump
- Role of compressor
- Role of evaporator
- Role of condenser
- Role of metering device
- Role of high pressure vapor line
- Role of low pressure suction line
- Role of reversing valves

THE HEAT PUMP REFRIGERATION CYCLE OPERATING MODES

- Heat pump circuit operation in the cooling mode
- Heat pump circuit operation in the heating mode
- The defrost cycle

DUCT SYSTEMS

DUCT SYSTEMS

- Duct system materials - metal, ductboard, flexible duct, PVC, etc.
- 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.
- Duct locations - attic, basement, crawlspace, slab, roof, furr down, and exposed
- Fitting nomenclature - plenum, transition, elbow, round duct, rectangular duct, turning vanes, wyes, and sheet metal duct joints

WIRING LAYOUTS

POWER WIRING

- Overview of power wiring
- Single phase wiring
- Three-phase wiring

LOW VOLTAGE

- Overview of low voltage wiring

COMPONENTS

OUTDOOR COILS

- Types - basic designs
- Airflow characteristics

COMPRESSORS

- Fundamentals of compressor operations
- Compressor types
- Introduction to start components
- Selecting start components
- Considerations in using start components
- Hard start kits - potential relay and start capacitor
- Soft start PTCR assists

REFRIGERANTS

- Refrigerants used in Res./Lt. Com heat pumps
- Properties of refrigerants used in Res/Lt. Com heat pumps
- 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, bi-directional
 - Operation fundamentals - sight glasses, moisture indicators, liquid indicators, etc.
 - 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
- 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 heat
 - Transformers
- REVERSING VALVES**
 - Basics of operation
 - Components
- 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
- ELECTRONIC DEFROST CONTROLLERS**
 - Fundamentals of electronic defrost controllers
- 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

Auxiliary heat options

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 heat pumps

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

Outdoor thermostats - lockout auxiliary heat

Wall thermostat options - electric heat stat vs gas heat stat

MECHANICAL CODE

EQUIPMENT ACCESS

Minimum clearance

Electrical disconnects

Fire dampers

REFRIGERANT LINE ROUTING

Support requirements

Inspection requirements

CONDENSATE DRAINS

Materials

Sizing

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

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